Review Article

FACIAL EMOTION RECOGNITION TECHNIQUES: A REVIEW

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ABSTRACT

Natural facial expressions commonly occur in social interactions among people and are useful in providing an emotional context for interaction and communicating social intentions. Facial expression recognition has been the subject of active research in recent years. Various techniques have been proposed for facial detection, extraction of characteristics, and classification of emotions. This paper presents an overview of the effective methods proposed in recent years, a brief introduction to the system and database that have been used for this purpose. Several authors have used different algorithms for the same problem described in this document. In this review paper various methods of emotion recognition are discussed and compared.

INTRODUCTION

Recognition of emotions can take place in different ways, such as word, facial expression, body gesture etc. Emotion recognition through facial expression has taken a lot of interest in the last decades. The image of facial expression is more than a thousand words. A facial expression is one or more motions or positions of the muscles beneath the skin of the face. According to one set of controversial theories, these movements convey the emotional state of an individual to observers. They are primary means of conveying the social message among humans.

In the year 1872 Darwin was the first to suggest the correlation between the facial expression and emotion. According to Darwin, emotions and their expression were biologically innate and evolutionary adaptive and that similarities in them could be seen phylogenetically [1]. In the year 1972 Ekman, Friesen and Ellsworth [2] worked on the idea of Darwin and found that according to psychology, perspective facial expressions were culture specific, like any culture had its own verbal language; emotion had its own language of facial expression. Mc Carter and Tokmin, in the year 1964 gave the first study, demonstrating that facial expressions were reliably associated with certain emotional state [3]. In the psychological research one can express his feelings and attitude 7 % by speaking, upto 38 % through his vocal expression and 55% through his facial expressions [4-5]. This shows that facial expression plays an important role for an individual to express their intention, attitude, feelings, emotional state and other non-verbal messages in speech communication. Facial expression shows emotional state or mood of a person how one is feeling at a particular moment like sad, happy, anger etc.

Paul Ekman [6] provides six universal emotions: sadness, happiness, anger, fear, disgust, and surprise. The recognition of emotions through the expression of the face has always been a lot of interest due to its vast applications, such as robotics, where communication done between humans and machines and communication should be improved. Other emotion recognition applications are surveillance, security, biometrics, customer center, and Human Computer Interaction. Face detection is the first stage of recognizing the emotions in which the face is identified in the rough image. The rough image has many objects in it. The background object of the image determines the face only by rejecting all the other objects. The second step is to separate the elements that help in extracting features. The feature extracted in the second step is taken as the last step in the classifier group that thus returns a labeled emotion previously characterized. This work is the study of the different procedures used in the three phases of emotion recognition, i.e. different facial detection techniques, extraction of features and classification.

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Table 1 below shows the comparison between different emotion recognition techniques:

[Author,year]	Technique used	Database used	Accuracy	Number of points	Time taken	Advantages	Limitation
Jia-Jun Wong, Siu-Yeung Cho [2006]	Face emotion tree structures (FEETS)	Cohn-Kanade AU-Coded	90%	--		SVM has an astounding high review rate (more than 99%) than these approach revealed some portion of the face.	
[Peng, 2010]	Canny filter, AAM, Least square method	JAFFE	85%	24	--	can reduce the computing complexity	in real-time identification system, for the gathered human face pictures may not be certain pictures. images.
F. ABDAT, C. MAAOUI and A. PRUSKI 2011	Shi & Thomasi method	Cohn-Canade Database and FEEDTUM Databse	90%	--	--	Recognition accuracy of 90% is achieved	--
[F. Abdat, 2011]	Shi & Thomasi method, RBF Support Vector Machine	Cohn-Kanade	95%	38	721 ms With PC Pentiu M processor 3.4GHz	Recognition accuracy of 95% is achieved	--
DevDrume, Anand Singh Jalal, 2012	PCA + SVM	Local dataset	93.58%	--	--	--	--
[Rohit, 2013]	LBP, Support Vector Machine, Ada Boost	JAFFE	86.67%	Texture based	227 ms (Support Vector Machine), 1052 ms (Adaboost) with Intel i3 processor	--	--
Sadeghi, H, Raie, and Mohammadi, M.-R.,2013	Local Binary Patterns, SVM	Extended Cohn-Kanade database (CK+)	Higher success rate was achieved than existing work on CK+	--	--	--	--
[Myungho, 2014]	ASM, SVM classifier	Cohn-Kanade	72%	77	421.6 ms	--	--
[Kamlesh, 2014]	AAM, LBP, Neural Network classifier	Cohn-Kanade	88%	68	--	Recognition accuracy of 88 % is achieved	Poses problem in unconstraint environment.
Ira Cohen, Ashutosh Garg, Thomas S. Huang [2014]	Markov models (HMM)	Cohn-Kanade	82.46% mproved recognition rate	--	500 ms	Improve the recognition rate dramatically.	--
Xiao-Hu Wang, An Liu, Shi-Qing Zhang 2015	Fuzzy SVM(FSVM) KNN	JAFFE	with reduced computational complexity.	--	--	--	--
S SBavkar, J S Rangole and VU deshmukh, 2015	SVM and RBFNN	Cohn Kanade databases	91%	--	--	Recognition accuracy of 91% is achieved	--
Xijian Fan, TardiTjahjadi, 2015	Multi-class SVM	CK+ and MMI datasets	83.7%	--	--	--	--
Happy, S.L.; Routray, A., 2015	LBF, SVM	JAFFE and CK+	94.63%	--	--	Recognition accuracy of 94.63% is achieved	--
Li Zhang; Hossain, A.; Ming Jiang, 2014	NN based and multi-class (SVM) based classifiers	Local Dataset	76%	--	--	--	--
MihaiGavrilescu 2013	Neural Network and Haar-Cascade Classifier	MMI and CK dataset	11.5% better emotion recognition rate for CK database and 14.2% better emotion recognition rate for MMI database	--	--	--	Average recognition rate is lesser for anger class due to confusion with neutral and anger classes.

MouhebLahbiri *et al.* 2013	Hidden Markov Model	Local Dataset	>90%	--	--	--	--
Suchitra, Suja P., Shikha Tripathi	Active Shape Model and Adaboost	CMU Multi PIE Database	94%	26	120ms	Recognition accuracy of 94% is accomplished with normal handling time of 120ms	--

METHODS

Emotion recognition is an extraction process that helps to recognize the mood and perception of the individual. The immense measure of work is done in the field of emotion recognition. The basic emotions are anger, happiness, disgust, fear, surprise and sadness. The recognition of emotions through expression of the face is discussed by Ekman [6]. His work was based on psychology. Ira *et al.* [8] gave the engineering of concealed Markov models for automatically segmenting and recognizing human facial expressions from video sequences automatically. Spiros *et al.* [9] provided the method of extracting features and recognizing emotions based on video sequences. It perceives the emotions of the user's emotional state that can be hearty to facial expression variations among different users. Tim Ahonen *et al.*, 2006 utilized a novel and productive portrayal of a face picture that is based on LBP (Local Binary Pattern) and texture characteristics. LBP descriptor functions are extracted by dividing facial images into various regions.

In 2016 Deepjoy and Alok Das Chakrabarty presented a study on emotion recognition using raw pixels. Profound learning squares, for example, RBM, DBN and the SAE + SM learning portrayals shaped by the pixels and foresee the presence of feelings with an exactness of 99.68%. In 2015, Leo Pauly and Deepa Sankar presented a new system of recommendation based on facial recognition and sensation detection. Chakraborty *et al.* [10] used fuzzy relational approach to recognize human emotions from facial expressions. Three different fuzzy sets are used: HIGH, LOW, MODERATE using only three facial features eye opening, mouth opening and the length of eyebrow constriction and recognized six basic emotions with the accuracy of 89.11% for adult males, 92.4% adult females and 96.28% for 8-12 years children. Maglogiannis *et al.* [11] recognized four basic emotions through the eyes and mouth utilizing edge location and angle estimation of the eyes and mouth region. Accuracy detection and emotion recognition function was 82.14%. Pantic and Rothkrantz utilize administer based thinking and build up a mechanized framework for recognizing facial expressions in the static face of the image, front and / or profile color.

CONCLUSION

Numerous robust methods have been developed for recognition of facial expressions using different face detection techniques, feature extraction analysis and classification methods.

This paper has briefly overviewed these methods. Some of the methods improves the accuracy of classification over the others while some methods take less time for output. Most of the methods used for emotion recognition used the Cohn-Kanade database and few used JAFFE database. In future, the aim is to develop a powerful facial detection technique with high accuracy and less processing time.

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