A Review on Different Techniques of Facial Expression Recognition System

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Abstract: Identification and classification of emotions by computers has been a research area since Charles Darwin's age. The automatic Facial Expression Recognition which is a major approach of emotion detection, has been one of the latest research topic within various fields such as computer vision, medicine and psychology since 1990's. Various techniques of facial expression recognition from static images as well as real time videos have been developed. Despite important advances it also has some challenges including accuracy, limited to posed expressions, lack of rotational movement freedom etc. In this paper, we present an overview of facial expression recognition techniques and related issues. Finally few work done on emotion detection, those are published and reviewed are summarized here briefly**.**

Keywords: *Affective computing, Facial Expression Recognition.*

I. INTRODUCTION

Affective computing is the study and development of systems and devices that can recognize, interpret, process, and simulate human affects. Research in affective computing is of interdisciplinary nature, which combines computer science with many other fields, e.g., psychology, cognitive science, neuroscience, sociology, medicine, psychophysiology, ethics, and philosophy, in order to enable advances in basic understanding of affect and its role in biological agents, and across a broad range of human experience. From a human-machine interaction perspective, the most important topic in affective computing is automatic emotion detection, analysis and recognition. Recognizing emotional information requires the extraction of meaningful patterns from the gathered data. This is done using machine learning techniques that process different modalities, such as speech recognition, natural language processing, or facial expression detection, and produce either labels (i.e. 'confused') or coordinates in a valence-arousal space.

II. APPROACHES OF EMOTION DETECTION

Speech recognition (SR) is the inter-disciplinary sub-field of computational linguistics which incorporates knowledge and research in the linguistics, computer science, and electrical engineering fields to develop methodologies and technologies that enables the recognition and translation of spoken language into text by computers and computerized devices. It is a great method of identifying affective state, having an average success rate reported in research of 63%[1].This result appears fairly satisfying when compared with humans' success rate at identifying emotions, but a little insufficient compared to other forms of emotion recognition (such as those which employ physiological states or facial processing)[1].Natural language processing is a field of computer science, artificial intelligence, and computational linguistics concerned with the interactions between computers and human (natural) languages**.**

A facial recognition system is a computer application capable of identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. The detection and processing of facial expression is achieved through various methods such as optical flow, hidden Markov model, neural network processing or active appearance model. More than one modalities can be combined or fused (multimodal recognition, e.g. facial expressions and speech prosody,[2] facial expressions and hand gestures,[3] or facial expressions with speech and text for multimodal data and metadata analysis) to provide a more robust estimation of the subject's emotional state. This process is known as multimodal fusion, and it is the object of several research works from nineties to now.

*A. Facial Expression Recognition***:**

In general, facial expression recognition system mainly involves four parts which were face image collection, image preprocessing, features extraction and expression recognition. Facial expression recognition system chart is shown in Fig. 1(a,b).The most important parts of facial expression recognition system are feature extraction and expression classification. Here, we will introduce the four parts of facial expression system.

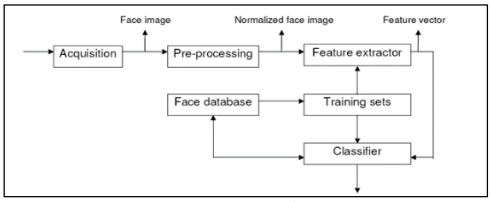

Fig.1(a): Facial expression classification block diagram

Image acquisition can be accomplished by digitally scanning an existing photograph or by using an electro-optical camera to acquire a live picture of a subject. Video can also be used as a source of facial images. Image preprocessing algorithm that compensates for illumination variations in images is used prior to recognition. Face detection is a computer technology that determines the locations and sizes of human faces in arbitrary

images. Feature Extraction is responsible for composing a feature vector that is well enough to represent the face image and its goal is to extract the relevant data from the captured sample.

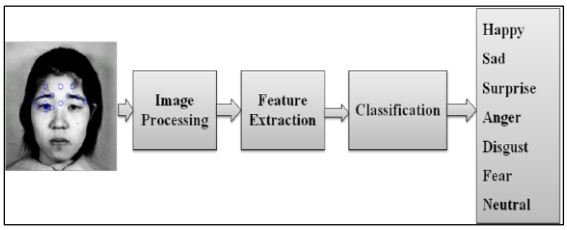

Fig.1(b)

The Last step is to compare the features generated in step four with those in a database of known faces.

B. Challenges in facial expression recognition system:

To attain successful recognition performance, most current expression recognition approaches require some control over the imaging conditions. The controlled imaging conditions typically cover the following aspects.[4]

1. *View or pose of the head*-Although constraints are often imposed on the position and orientation of the head relative to the camera, and the setting of camera zoom, it should be noted that some processing techniques have been developed, which have good insensitivity to translation, scaling, and in plane rotation of the head. The effect of out-of-plane rotation is more difficult to mitigate, as it can result in wide variability of image views. Further research is needed into transformation-invariant expression recognition.
2. *Environment clutter and illumination*-Complex image background pattern, occlusion, and uncontrolled lighting have a possibly negative effect on recognition. These factors would commonly make image segmentation more difficult to perform reliably. Hereafter, they may possibly bring about the spoiling of feature extraction by data not related(data not identified with) to facial expression.
3. *Occlusion*- Occlusion is anything that obstructs vision. Removing occlusion is very important for better perception and object recognition. Occlusion is a big challenge in many of the computer vision algorithms. Faces may be partially occluded by other objects. In an image if face is occluded by some other faces or objects such as mask ,hair, glasses. For that image extraction of expression features are complex

C. Comparative study on some of the related works of emotion detection:

Year	Paper Ref.	INPUT	NO. OF EMOTIONS CAN BE CLASSIFIED	USED ALGORITHM FOR			USED DATABASE	ACCURACY (%)
				Face localization	*Feature extraction*	*Classification*		
2007	MaringantiHimaBindu[5]	Uncertain ,contradicted,occluded image	22(Flexible to increase more)	Discrete Hopfield Networks	Gabor Wavelet(GW) transform	PCA+Back-propagation neural network	Cohn-Kanade Action Unit Coded Facial Expression Database.	85.7
2008	Caifeng Shan[6]	Standard Still image	7		Boosted-LBP	Support Vector Machine (LINEAR)	MMI	86.7
							JAFFE	79.8
							Train:Cohn–KanadeTest:MMI	50.8
							Train:Cohn–KanadeTest:JAFFE	40.4
						SVM (POLYNOMIAL)	MMI	86.7
							JAFFE	79.8
							Train:Cohn–KanadeTest:MMI	50.8
							Train:Cohn–KanadeTest:JAFFE	40.4
						SVM (RBF)	MMI	86.9
							JAFFE	81.0
							Train:Cohn–KanadeTest:MMI	51.1
							Train:Cohn–KanadeTest:JAFFE	41.3
2010	KuanChieh[8]	Standard Still image	7		Modified Active Shape Model (MASM)	Back propagation neural network	JAFFE	65.1

2011	Xiao-Wei Wang[10]	Standard Video image	4		Electroencephalogram(EEG) signals	KNN	Standard video image	59.84
						Multilayer perceptron		63.07
						SVM		66.51
2012	Tran Binh Long[11]	Standard Still image	7	Zernike moments-Artificial neural network	Pseudo Zernike moment invariant (PZMI)	Radial basis function (RBF) network	JAFFE	98.33
2016	Duc Minh Vo[15]	Standard Still image	6		Deep CNN	convolutional neural network (CNN)+SVM	Cohn-Kanade	96.04

III. CONCLUSION

As with every computational practice, in affect detection by facial processing, some obstacles need to be surpassed, in order to fully unlock the hidden potential of the overall algorithm or method employed. It is generally known that the degree of accuracy in facial recognition has not been brought to a level high enough to permit its widespread efficient use across the world. So advance study may open the paths to find efficient algorithms to reduce computational cost and to decrease the time required for detecting the object.

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