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A Review of Human Facial Expressions Recognition Methodologies

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Abstract- **At present, researches on gestures at home and abroad mostly focus on the study of the hand, and there is less research on facial gestures. Based on the premise of multi-channel human-computer interaction and the rapid development of artificial intelligence, facial gestures based on facial features are proposed. Firstly, the definition of facial gestures and the recognition of facial gestures, as well as the introduction of facial gesture processing, are analyzed. Then facial detection technology based on Face and a set of interactive gestures based on facial features are designed according to the detected facial features, to achieve the interaction with the computer. Finally, a facial gesture application is implemented in Java language and the facial gesture technology is tested and analyzed. The results show that facial gestures are more conducive to hands-on disability for people with disabilities to more easily interact with computers and reduce the burden on their hands.**

***Keywords*-Facial gestures, Human-computer interaction, Face detection, Biometrics**

I. INTRODUCTION

Face reveals the emotion states as well as cognitive activities, faster than people verbalize or even realize their emotional state. Psychologists have also found that the cognitive interpretations of emotions from facial expressions were innate and universal to all humans regardless of cultures. Paul Ekman has identified six basic categories of emotions (i.e. fear, anger, sadness, surprise, disgust and happiness). He has created the Facial Action Coding System (FACS) to recognize the emotional states from the measurement of facial movements.

It is a leading method used in behavioral science, but for a human expert to identify the 46 defined Action Units a minimal 100 hours of training is needed. Each of the defined Action Units corresponds into each independent motion of the face. Faster automated approaches, such as measurement of facial motion through optic flow and analysis of surface textures based on principal component analysis (PCA) are benchmarked and best classification accuracy of about 90% for the recognition of twelve facial actions, was obtained using Gabor filter representation. All these techniques depend on the full face features to be available. When some of the face features such as the eyes or nose and mouth are masked, these facial actions could not be determined.

People who are wearing sunglasses have hidden their eyes from view. Women belonging to the Islam faith wear a veil as part of their religious practice. Hence, the challenge would be to correctly identify the emotional states from the other non-covered parts of the face. Most of these systems use a set of feature vectors to represent facial images, without describing the relationship between the feature vectors. Tsoi proposed using tree structures to preserve and make use of these relationships and processing them by specific machine learning models. In this paper, we propose an emotion recognition system for transforming the feature vector data into tree structure representation, which encodes the feature relationship information among the face features. Sixty Localized Gabor Feature (LGF) and one Global Gabor Feature are obtained as a feature vector and transforming them into a Face Emotion Tree Structure (FEETS) representation. The layers in the FEETS form a localized to holistic analysis of the facial images and recognition is based on the collective inputs at various layers.

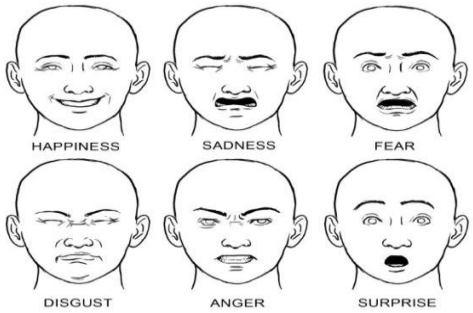

Fig. 1 Six basic Facial Expressions.

II. FACIAL FEATURE EXTRACTION

Contracting the facial muscles produces changes in both the direction and magnitude of skin surface displacement, and in the appearance of permanent and transient facial features. Examples of permanent features are eyes, brow,

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and any furrows that have become permanent with age. Transient features include facial lines and furrows that are not present at rest. In order to analyze a sequence of images, we assume that the first frame is a neutral expression. After initializing the templates of the permanent features in the first frame, both geometric facial features and Gabor wavelets coefficients are To detect and track changes of facial components in near frontal face images, multi-state models are developed to extract the geometric facial features (Fig. 1). A three-state lip model describes lip state: open, closed, and 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. Transient facial features, such as nasolabial furrows, have two states: present and absent. 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. Both permanent (e.g., brows, eyes, lips) and transient (lines and furrows) face feature changes are automatically detected and tracked in the image sequence. We group 15 parameters which describe shape, motion, eye state, motion of brow and cheek, and furrows in the upper face. These parameters are geometrically normalized to compensate for image scale and in-plane head motion based two inner corners of the eyes.

A recursive neural network is proposed for classification of the FEETS in this paper. This method is benchmarked against other classifiers in which the flat vector representations were used in the recognition experiments. We made use of the Cohn-Kanade AU-Coded Facial Expression database by Robotics Institute in Carnegie Mellon University (CMU), USA to illustrate the performance of the recognition system. Fig. 2 illustrates our proposed emotion recognition system, which constitutes the low-level feature extraction and the high-level tree structure representation for emotion recognition. The details of the major components in the proposed system will be described in the following sections.

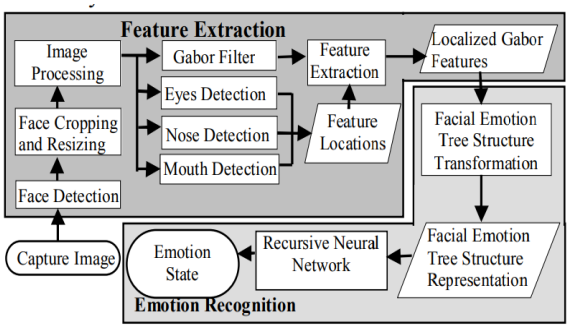

Fig. 2 Emotion Recognition System Diagram.

III. FACIAL EXPRESSION RECOGNITION SYSTEM

The most favored application of emotion recognition system is the facial expression recognition system. Most of the research on facial expression refers to the work of Prof.Paul Ekman. He proposed the Facial Action Coding System (FACS) to code the facial expression extracted from thousands of photographs and tens of thousands of filmed and videotaped facial expressions (Ekman, 2003). The FACS can be extracted from the face and used as the features for facial expression classification. The implementation of a facial expression recognition system can be realized in a similar way using the biometricde sign. The facial expression recognition system applies more specific steps as follows:

- Detection of the face.
- Feature extraction (part of facial landmark such as eyes, mouth or the whole face).
- Expressions classification.

The first step utilizes the sensor to collect physiological signal of facial expression from the person. For that purpose, a camera can be used to produce a still image of the face. Alternatively, for continuous monitoring of facial expression, a video or web camera will be more suitable to be used for various conditions and environments. In the facial expression recognition system, the most important part is the feature extraction process. A proper feature extraction process will produce a better recognition system with a more accurate result.

The algorithms used for facial features extraction can be classified into two main groups, namely: geometric based methods which collect feature points or motion of points by tracing them from the face images and classifying the expressions from the tracked features; and, appearance-based methods which collect the whole or part of the face landmarks and arrange them as one long array feature vector and apply them in the classification process. The appearance-based method has more advantage compared to the geometric based method.

IV. LITERATURE REVIEW

Aleix Martinez,Shichuan Du (2012) In cognitive science and neuroscience, there have been two leading models describing how humans perceive and classify facial expressions of emotion—the continuous and the categorical model. The continuous model defines each facial expression of emotion as a feature vector in a face space. This model explains, for example, how expressions of emotion can beseen at different intensities. In contrast, the categorical model consists of *C* classifiers, each tuned to a specific emotion category .This model explains, among other findings, why the images in a morphing sequence between a happy and a surprise face are perceived as either happy or surprise but not something in

between. While the continuous model has a more difficult time justifying this latter finding, the categorical model is not as good when it comes to explaining how expressions are recognized at differentiatesities or modes.

Mehang B. Patel, Dipak L. Agrawal (2016) Facial expression recognition has many potential applications which have attracted the attention of researchers in the last decade. Feature extraction is one important step in expression analysis which contributes toward fast and accurate expression recognition. Happy, surprise, disgust, sad, anger and fear facial expressions Emotion are of facial recognition. Facial expressions are most commonly used for interpretation of human emotion. There is a range of different emotions in two categories: positive emotion and non-positive emotion.

Ecole Polytechnique Federale de Lausanne (2018), In this work, we study the use of attention mechanisms to enhance the performance of the state-of-the-art deep learning model in Speech Emotion Recognition (SER). We introduce new Long Short-Term Memory (LSTM)-based neural network attention model which is able to take into account the temporal information in speech during the computation of the attention vector. The proposed LSTM-based model is evaluated on the IEMOCAP dataset using a 5-fold cross-validation scheme and achieved 68.8% weighted accuracy on 4 classes, which outperforms the state-of-the-art models.

Moon Hwan Kim¤, Young HoonJoo (2015) An emotion detection algorithm using frontal facial image is presented in this paper. The algorithm is composed of three main stages: image processing stage and facial feature extraction stage, and emotion detection stage. In image processing stage, the face region and facial component is extracted by using fuzzy color, virtual face model, and histogram analysis method.

Ashish B. Ingale, D. S. Chaudhari (2012) Emotion recognition from the speaker speech is very difficult because of the following reasons: In differentiating between various emotions which particular speech features are more useful is not clear. Because of the existence of the different sentences, speakers, speaking styles, speaking rates accosting variability was introduced, because of which speech features get directly affected. The same utterance may show different emotions. Each emotion may correspond to the different portions of the spoken utterance.

V. CONCLUSIONS

This paper describes a new approach for structural pattern recognition, which is referred to as adaptive processing of data structures, to recognize emotion from facial expression revealed by the uncovered part of the face. Sunglasses and veil are used to illustrate the situations where part of the face is covered. The recursive neural network model has been created and used to classify the facial expression represented by the FacE Emotion Tree Structures (FEETS). Our system demonstrated that it has higher classification accuracy against conventional classifiers when features are lost due to undetected key feature locations.

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