

FACIAL EXPRESSION RECOGNITION: From Artificial Intelligence and Psychological Perspectives

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ABSTRACT

Human face is the most dynamic part of the human body that conveys information about the instant feelings of the person. Even though there are earlier studies, the studies of Charles Darwin in early 1900s can be accepted as milestones. In these early studies, human and animal facial expressions are categorized into classes. Later, in the early 1970s, Paul Ekman and his colleagues classified the facial expressions in six basic classes that are anger, disgust, fear, happiness, sadness and surprise. Including the neutral face, there were seven basic classes in total. With the rapid advancements in computer science in 1980s, digital systems came into our lives and business. Especially, after the developments in machine learning studies and deep learning studies at the beginning of 2000s, there are significant improvements in computer vision and artificial intelligence applications. Automatic facial expression recognition is the task of a computer to automatically detect and classify the expression classes using single or multi facial images. It is a well-studied problem in computer vision. The main motivation is to support human-computer interaction during communication. Another motivation is to monitor the emotional states of the people automatically to provide instant emotional state information. Different machine learning algorithms including Support Vector Machines (SVM) and different imaging techniques including Gabor filters are applied. Currently, the literature about the automatic recognition of the basic seven classes of facial expressions are able to provide robust recognition systems. Furthermore, there are commercialized algorithms and services given by private companies to integrate automatic facial expression recognition to software products. Furthermore, computers are also capable of analyzing the facial muscle movements as well. There are three milestones proposed in the literature to standardize these facial definitions. One is the Facial Action Coding System (FACS) including Action Units (Aus) proposed by Paul Ekman and his colleagues. The others are MPEG-4 Facial Definition Parameters (FDPs) and Facial Action Parameters (FAPs) and the Active Appearance Models. All the models here are trying to parameterize faces and facial movements with landmark points and vectors representing the muscles. Then, by combining several muscle movements, facial expression categories can be recognized. Currently, with the available computational abilities, the facial expression recognition is going beyond the basic expression analysis. That is the compound facial expression analysis where more than one expression is combined to define the state of the face. Compound facial expression analysis currently is being researched with the availability of varying datasets. Datasets are also varying according to the number of classes provided. These class variations are between 12 and 50 classes of compound expressions. By using facial expression recognition, stress, anxiety and depression can be also detected automatically. There are also significant improvements in automatic stress, anxiety and depression detection. Technically, automatic facial expression recognition is a signal processing and pattern recognition task. Proposed algorithms can be investigated in two main

categories that are geometric feature based and appearance feature based (texture) studies. There are also studies that are fusing both facial texture and geometry. Currently, automatic facial expression recognition systems are going into the next levels where micro expressions on the face will be also captured and recognized by computers in the near future. Overall, these studies will accelerate the assisted artificial intelligence applications in psychology. Fully automatic and real time facial analysis will be providing information about the instant emotional states of humans and serve the psychologists. In the next decade, exciting adaptation of such artificial intelligence systems to the service of psychology will be inspiring for both psychologists and computer scientists.