

Enhanced facial expression recognition using multi-features and fuzzy linear projection

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Abstract— In this research study, we describe an enhanced automated vision-based system for the classification of facial expressions. The face within an image is firstly localized using a simplified method then it will be characterized in three different ways; by compacting its geometric characteristics using Zernike moments feature vector then by obtaining its spectral source model through AR Burg representation. Finally, a statistical distribution analysis of the luminance information is performed through the LBP method. The three characterization feature vectors are used separately to train three back propagation neural networks to perform facial expression recognition. Combined feature vectors are used to train neural networks. Finally, a fuzzy linear discriminant analysis is applied to these combined feature vectors in order to enhance facial expression recognition process. Experiments performed on the JAFFE database along with comparisons to other methods have affirmed the potency of the proposed approach attaining promising results compared to those reported in the literature.

Keywords—*face detection; expression recognition; AR model; Zernike moments; LBP; fuzzy linear projection;*

I. INTRODUCTION

Facial expression recognition still a challenging area of research with a number of problems exacerbate the accuracy of such systems. Indeed, recognition of facial expression is related to several semantic concepts. Thus, we have to distinguish between the terms 'expression' and 'emotion' ; the last one being only a semantic interpretation of the first one as the term 'happiness' to 'smile'[1]. So a facial expression is simply a physiological activity of one or more parts of the face (eyes, nose, mouth, eyebrows,...) [2] while an emotion is our semantic interpretation to this activity. This problem still difficult to disentangle especially as our mathematical models still does not have the ability to create the semantic dimension in the representation of our environment. In addition, an expression can be simulated and has no relation with the emotional state of the person. Cultural background related to the ethnicity is also pointed as a serious constraint [3], [4]. Technical problems related to acquisition devices and variation of illumination conditions set the problem more harder [5].

However, the significant advances in several related fields such as image processing, pattern recognition, detection and face recognition, have provided researchers with significant effective tools which enabled them to make a huge advances in this field especially in automatic analysis, classification,

synthesis, and even expressive animation [6]. The different research studies that have been carried out to date were all oriented to the study and classification of basic facial expressions (universally recognized); six in all and are summarized on Figure 1.

Figure 1 : Example of Basic facial expressions from the JAFFE database



Classification of developed methods, can be done according to the characterization step, in the recognition process, or according to the classification one [7].

According to characterization step, methods are "motion extraction" [8], [9] or "deformation extraction" [10], [11]. According to the classification step, methods are "spatial methods" [12], [13], or "spatiotemporal methods" [14], [15].

Another way to perform methods classification is how to consider the face; as a single entity which will lead to "global process" or as a set of features which have to be extracted before performing characterization step.

In the present work, we propose to enhance the characterization step in the expression recognition process by performing three types of global face characterization. The first one aims to extract the geometric information made by the face through the compilation of the Zernike geometric moments. The second one exploits the well known LBP technique to enclose the statistical luminance information contained by the face and the last one computes the spectral source model of the face using the simplest known way namely AR Burg Model. The classification step is then performed through three different neural networks implemented in a parallel manner. A combined feature vectors were generated and then used to train a neural network classifier directly then across a fuzzy linear discriminant analysis.

In the following section, we explain the global scheme of the proposed system and detailing the face detection procedure and the implementation procedures for each one of the characterization methods. The third section will be dedicated to the fuzzy linear discriminant analysis. The classification step