

Classification of Mouth Action Units using Local Binary Patterns

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Abstract

Automated facial expression recognition remains a grand challenge in computer vision. This paper lays the groundwork for building a system that automatically, and in real-time, accurately classifies Action Units (AUs) of the Facial Action Coding System. We use Local Binary Patterns (LBP) for the feature extraction stage, followed by support vector machines for classification. LBPs require no manual initializations, are computationally simple, run in real-time, are illumination tolerant, and do not require high image resolutions. Experiments compare the performance of LBP to that of image quantization in the spatial and frequency domains. Results show that using LBPs for feature vector extraction of mouth AUs yielded the highest average classification rate of 80%, suggesting that such LBP feature vectors may be used for classifying more AUs and AU combinations. Results obtained are consistent for template matching and support vector machines.

1. Introduction

Automated facial expression classification has many applications including Human-Computer Interaction, psychological and computer vision research, and medicine. Examples include interactive computer games, smarter interfaces, automatic database labeling, automatic monitoring of patients' moods, and driver state detection. Most of these applications require real-time implementations.

Ekman and Friesen's Facial Action Coding System (FACS) [5] is a comprehensive coding system for describing facial expressions. Muscle movements are coded as action units (AUs) and facial expressions are coded using one or more AUs. Humans produce thousands

of expressions, all of which can be objectively described using FACS. Thus, FACS has been used extensively for the automated analysis of facial expressions, e.g., [3,6,15,19], and is more descriptive than systems that only recognize a limited set of basic emotions.

Automated facial expression recognition consists of three main stages after image pre-processing: extracting the feature vector which describes the facial image, reducing the dimensionality of that vector if possible, and finally, classifying test images into certain classes after training using the reduced dimensionality vector. Feature extraction is key, because finding a descriptive, representative, efficient, and easy to compute feature vector of the facial image will largely impact the classification results.

This paper describes feature extraction and classification of mouth AUs from static images. Seyedarabi *et al.* [21] emphasize that the mouth has the most flexible deformability, while Liu and Wang [16] assert that the mouth contributes the most to facial expressions. The principal contribution of the paper is the feature extraction of mouth AUs using Local Binary Patterns (LBPs), a feature extraction technique that is efficient, is automated and runs in real-time, while maintaining classification accuracy. LBPs are also illumination tolerant, and do not require high image resolutions and are therefore suited to real-world contexts and environments.

The paper is organized as follows: section 2 surveys feature extraction methods for face analysis, as well as related work that use LBPs; section 3 gives an overview of Local Binary Patterns for representing mouth AUs. Section 4 describes classification using template matching and support vector machines; section 5 present experimental evaluation and result, while section 6 concludes the paper.

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