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TIFd-FR: Trends, Issues and Future directions of feature extraction in Face Recognition

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Abstract

Today, face recognition is the most prevalent and effective mechanism among various biometric technologies as it is non-invasive method. It helps in identifying or verifying the identity of a person by utilizing its face. But face recognition (FR) can be prone to high error rate. Therefore, efficient feature extraction methods are required for extracting robust facial features to develop efficient FR system. A FR system comprises of mainly three phases, that is, face detection and orientation, extracting facial features and classification of features. The most vital part of an efficient recognition system is extraction of robust features. Hence, extracting facial features is active research area of image processing. Although algorithms have been developed for extracting features, efficient and robust feature extraction still offers great challenge to researchers. Hence, a thorough analysis of feature extraction techniques presented in this work will enable the researchers to select the best suited technique for developing efficient system for recognition of face images. The performance of different feature extraction methods varies under variations in illumination, occlusion and pose etc. It is observed that deep-learning based feature extraction methods outperform wavelet-based methods. After rigorous analysis of various state-of-art techniques it is found that highest accuracy rate of 99.5% is achieved on AR database using wavelet based feature extraction whereas 99.78% is attained using convolutional neural network accuracy and various results achieved till now are stated.

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Keywords:Feature extraction; face recognition; deep learning; pattern recognition

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1. Introduction

Face recognition has attained a huge attention in the domain of computer vision and is in the precedence for researchers nowadays; however, there are certain limitations that need to be resolved. Automatic face recognition (FR) system have wide area of application such as access control; security such as in social networking websites, desktops, laptops; Surveillance based applications involves installations of CCTV cameras in markets and malls for identifying shoplifters etc. The basic stages of FR model are face alignment, pre-processing, robust feature extraction (FE) and classification of features [1]. But the most prevailing step to make any face recognition model efficient and computationally inexpensive is feature extraction. This step develops a feature vector (v) from original facial features (m), such that v < m that results in reduced dimension. Feature selection also plays an important role in feature extraction where most appropriate features (fa) are selected from total extracted features (m) (fa < m) [2].

These two phases leads to an efficient face recognition system with good accuracy. Thus, in this paper, comparative analysis is performed for efficient robust feature extraction techniques under various categories. Recognition of faces becomes challenging under uncontrolled conditions such as variation in lighting situation, changes in pose, expression (such as happy, sad etc.) and images with occlusion. Accuracy decreases under these circumstances, hence more efficient techniques need to be developed. The foremost aim of this paper is to analyze feature extraction techniques in real scenario or uncontrolled circumstances. The main contribution of this work is summarized as follows:

- Recently, many reviewers have reviewed some of the aspects of face recognition and only classical feature extraction techniques are studied. This work precisely summarizes the classical feature extraction techniques but also, gives insight of modern feature extraction approaches such as transform domain methods, 3D models, color models, and feature extraction techniques based on deep learning.
- Robust features can be extracted by utilizing various approaches which are summarized in a novel categorical way as illustrated in Figure 1. Also, past, present and future direction of FE techniques is presented that can help researchers to understand this domain better.
- A comprehensive analysis and comparison of feature extraction techniques is carried out and recognition rate of each approach is summarized (Table 1-4).

The review is further presented as follows the categorization is done broadly as classical feature extraction techniques and modern approaches as discussed in Section 2. In Section 3, various issues in face recognition are discussed. In Section 4, comparison among various feature extraction techniques are compared and summarized. In Section 5, insight is given on the possible future direction to develop more efficient FR system. Finally, Section 6 concludes the literature work done.

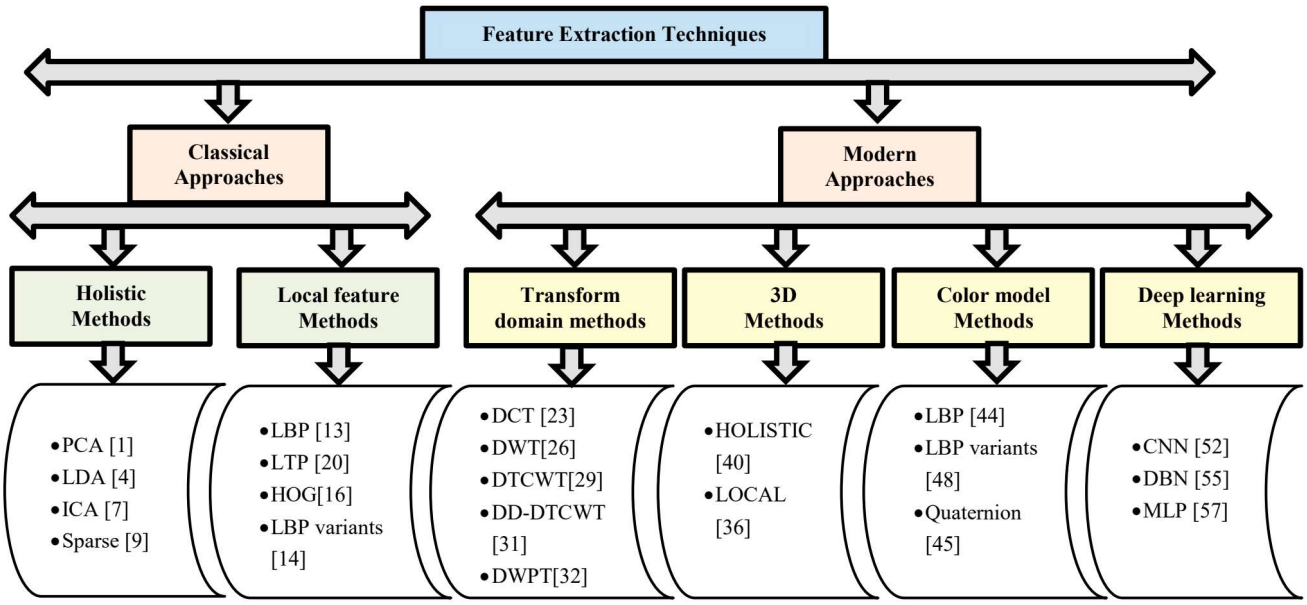

Fig. 1. Taxonomy of feature extraction techniques for face recognition