

# Survey of Soft Biometrics and Their Application for Person Recognition

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## ABSTRACT

The importance of utilising biometrics to establish personal authenticity and to detect impostors is growing in the present scenario of global security concern. Development of a biometric system for personal identification, which fulfils the requirements for access control of secured areas and other applications like identity validation for social welfare, crime detection, ATM access, computer security,.. is felt to be the need of the day Several existing biometric systems gather ancillary information like gender, age, height, and eye color from the users during enrollment. However, only the primary biometric identifier (fingerprint, face, hand-geometry, .) is used for Person Recognition.Hence, the ancillary information is rarely utilized and they are not fully distinctive by themselves in face recognition tasks. However, this information can be explicitly fused with automatic recognition systems to improve the overall face-recognition accuracy.

**Index Terms**—Soft biometrics, labels, primary biometrics, face recognition, at a distance, on the move.

## 1. INTRODUCTION

Biometric systems recognize users based on their physiological and behavioral characteristics[1].Unimodal biometric systems make use of a single biometric trait for user recognition.It is difficult to achieve very high recognition rates using unimodal systems due to problems like noisy sensor data and non-universality and/or lack of distinctiveness of the chosen biometric trait. Multimodal biometric systems address some of these problems by combining evidence obtained from multiple sources [2].A wide variety of biometric systems have been developed for automatic recognition of individuals based on their anatomical (e.g., fingerprint, face, and iris) and behavioral(e.g., signature and gait) characteristics [3]. Soft biometric traits are defined as characteristics that provide some information about the individual, but lack the distinctiveness and permanence to sufficiently differentiate any two individuals [4]. The use of soft biometric traits is expected to improve the face-

recognition performance when appropriately combined with a face matcher.

## 2. FACE RECOGNITION TECHNIQUES

### 2.1. Principal Component Analysis

It is one of the popular methods used for feature extraction and data representation and not only reduces dimensionality of the image, but also retains some of the variations in image data [5]. Facial features are extracted by PCA method, which reduces the dimensionality of the original face images while preserving some discriminating features within training images. After performing the PCA structural information is acquired for each person from lower-dimensional training images. The key idea of the PCA method is to transform the face images into a small set of characteristics feature images, called eigenfaces, which are the principal components of the initial training set of the face images. The PCA method is used for dimension reduction for linear discriminate analysis (LDA), generating a new paradigm,

called fisherface. The fisherface approach is more insensitive to variations of lighting, illumination and facial expressions. However, this approach is more expensive than the PCA approach.

## 2.2. Discrete Cosine Transform

Data compression is essential for both biological and computer signal processing. It involves both face normalization and recognition. The basic idea in [7] here is to compute the DCT of the normalized face and retain a certain subset of the DCT coefficients as a feature vector describing this face. This feature vector contains the low-to-mid frequency DCT coefficients, as these are the ones having the highest variance. To recognize a particular input face, the system compares this face's feature vectors to the feature vectors of the database faces using a Euclidean distance nearest-neighbor classifier. Number of Training Faces and Number of Testing Faces are used as parameter for DCT. DCT based recognition system is simple, but is not suitable for the conditions where there are large pose or illumination variations.

## 2.3 Gabor wavelet

The Gabor wavelet, which captures the properties of orientation selectivity, spatial localization and optimally localized in the space and frequency domains, has been extensively and successfully used in face recognition [8]. Gabor wavelets (filters) characteristics for frequency and orientation representations are quite similar to those of human visual system. These have been found appropriate for texture representation and discrimination. This Gabor-wavelet based extraction of features directly from the gray-level images is successful and widely been applied to texture segmentation, and fingerprint recognition. Wavelet based technique is working better than DCT based technique and PCA based technique even in large pose and illumination variations.

## 2.4. Independent Component Analysis

ICA minimizes both second-order and higher-order dependencies in the input. . ICA can be viewed as a generalization of PCA since it concerns not only second-order

dependencies but also high-order dependencies between variables [11]. It is intimately related to the blind source separation (BSS) problem, where the goal is to decompose an observed signal into a linear combination of unknown independent signals. Provided two architectures of ICA[9] for face recognition task: Architecture I – statistically independent basis images and Architecture II – factorial code representation. ICA is one method perhaps the most widely used, for performing blind source separation [10].

## 2.5. Linear Discriminant Analysis

LDA suffer from the disadvantage that their optimality criteria are not directly related to the classification ability of the obtained feature representation. Linear discriminant analysis (LDA) is powerful tools used for data reduction and feature extraction in the appearance-based approaches. LDA is based upon the concept of searching for a linear combination of variables (predictors) that best separates two classes (targets). LDA [13] is performed in the lower dimensional PCA subspace. However, it has been shown that the discarded null space may contain significant discriminatory information [14] [15].

Method	Category	Characteristics
PCA [16]	Holistic-based	PCA for learning eigenfaces, unsupervised
LDA [17]	Holistic-based	LDA for learning fisherfaces, supervised
ICA [18]	Holistic-based	ICA for catch facial independent components,two architectures are proposed.
Gabor and dynamic link architecture [19]	Feature-based	Gabor features extracted at facial feature locations, while performing one-by-one matching
DCT[20]	Holistic-based	applied to each of these local features individually and also to the global features

Table-1: The summary of face recognition techniques.

## CONCLUSION

In this paper, many face recognition techniques have been proposed to improve the accuracy for Person Recognition. We can conclude that though DCT based recognition system is simple, but is not suitable for the conditions where there are large pose or illumination variations. PCA based face recognition system is appropriate for both types of database, one having less variations and the other having large variations. But the problem is the complexity of the PCA based system. However, Wavelet based technique is working better than DCT based technique and PCA based technique even in large pose and illumination variations. Wavelets with PCA are a good choice, as representation by any of them is very good. So, we are getting good recognition rate. Overall, these techniques can provide better performance and high accuracy in person recognition.

## FUTURE WORKS

- We can use LDA for better representation of feature vectors of faces.
- For dimension reduction purpose IDA can be used.
- For searching the best sub-band in wavelet based face recognition, we can use PSO and Genetic Algorithm.
- For getting better result in pose and illumination variation conditions, Gabor wavelets can be used, also by using different fusion technique the recognition rate can be checked.

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