Face Recognition using Independent Component Analysis Algorithm

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ABSTRACT
Face recognition system compares the tested face with the various training faces reserved in the database with an efficient success rate. The best matching of the tested face with the training faces is an important task. In this article, how to recognize a face is presented; two different analysis algorithms are included in the evaluation system: Eigenface and ICA. The local dataset used in this article is pre-processed using statistical standard methods. Pre-processing software, which is provided by the Colorado State University (CSU) Face Identification Evaluation System Version 5.0 under Unix Shell scripts, was written using ANSII C code. Independent Component Analysis algorithm (ICA) is written using Matlab for face recognition implementation. This article explains how the faces, having some variations such as facial expressions and viewing conditions w.r.t the original faces reserved in the database, are detected with an improved accuracy and success rate. Finally, the result shows several graphs by Matlab.

General Terms
Pattern Recognition, Image processing, ICA Algorithms et. al.

Keywords
Pattern Recognition, Face Recognition System, ICA algorithm, Eigenface.

1. INTRODUCTION
During the past three decades, extensive research has been conducted on automatically recognizing the identity of individuals based on their facial images. In spite of the existence of alternative technologies such as fingerprint and iris recognition, the human face remains one of the most popular cues for identity recognition in biometrics. Face recognition possesses the non-intrusive nature and is often effective without the participant's cooperation or knowledge. It makes a good compromise between performance reliability and social acceptance and well balances security and privacy. Other biometric methods do not possess these advantages. For instance, fingerprint recognition methods require the subjects to cooperate in making explicit physical contact with the sensor surface [1]. Similarly, iris recognition methods require the subjects to cooperate in placing their eyes carefully relative to the camera. Nowadays, automatic face recognition has become one of the most popular areas of research in computer vision, and it is also one of the most successful applications of image analysis and understanding [2]. Face recognition system is a biometric technique that is used in law enforcement agencies, personal identification systems, and for security purposes. This computer application automatically identifies a person from a digital image [3].Face recognition can be done by several algorithms such as PCA, ICA, LDA, EP, EBGM, AMM, SVM, and HMM [2].

Principal component analysis (PCA) is a popular unsupervised statistical method that is used to find useful image representations. Some of the most successful representations for face recognition, such as eigenfaces [4], holons [5], and local feature analysis [6], are based on PCA. In a task such as face recognition, much of the important information may be contained in the high-order relationships among the image pixels, and, thus, it is important to investigate whether generalizations of the PCA, which are sensitive to high-order relationships, not just second-order relationships, are advantageous. Independent component analysis (ICA) [7] is one such generalization. An algorithm for performing ICA has been proposed. In this article, we do the task using ICA algorithm and eigenvectors. The approach transforms face images into a small set of characteristic feature images, called "eigenface," which are the principal component of the initial training set of face images [8]; then, we apply the Independent Component Analysis (ICA), which is a statistical and computational technique used for revealing hidden factors that underlie sets of random variables, measurements, or signals [9]. The first step for a face recognition system is to recognize a human face and extract it from the rest of the scene. Next, the system measures nodal points on the face, such as the eyes and mouth; these nodal points are used to remove the background of the image and keep the statistical feature (distinct face).

The rest of this article is organized as follows. Section 2 provides the necessary related work to face recognition. Section 3 describes enrollment images for the system (3.1), preprocessing the local data set images (3.2), and the image recognition system (3.3). Section 4 shows experimental results and discussion. Section 5 concludes with practical rec-ommendations.

2. RELATED WORK
The development of face recognition over the past years provides an organization with three types of recognition algo-rithms, namely frontal, profile, and view tolerant recognition, depending on the kind of images and the recognition algorithms.

This section gives an overview of the major human face recognition techniques that apply mostly to frontal faces; the advantages and disadvantages of each method are also given. The methods considered are eigenfaces (eigenfea-tures), neural networks, dynamic link architecture, hidden Markov model, geometrical feature matching, and template matching. The approaches are analyzed in terms of the facial representations they use [10].

Bell and Sejnowski [11, 12] developed an algorithm from the point of view of optimal information transfer in neural networks with sigmoidal transfer functions. This algorithm has proved successful for separating randomly mixed auditory