Chapter 13
Comprehensive Study of Face Recognition Using Feature Extraction and Fusion Face Technique

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ABSTRACT

Face recognition is a process by which the identity of a person is determined from the face images stored in a face database. Face recognition is one of the most successful applications of image analysis. In the present scenario, face recognition plays a major role in commercial and law enforcement applications, such as surveillance system, passport, security, personal information accesses, human machine interaction, etc. At present, very reliable methods of biometric personal identification exist. In face recognition, a feature vector usually represents the salient characteristics that best describe a face image. However, these characteristics vary quite substantially while looking into a face image from different directions. This chapter addresses this issue by means of image fusion and presents a comprehensive study of different image fusion techniques for face recognition. Image fusion is done between the original captured image and its true/partial diagonal images.

INTRODUCTION

Face recognition is a process by which the identity of a person is determined from the face images stored in a face database (Dey et al., 2014). Face recognition is one of the most successful applications of image analysis. In present scenario, face recognition plays a major role in commercial and law enforcement applications, such as, surveillance system, passport, security, personal information accesses, human

DOI: 10.4018/978-1-6684-6903-3.ch013

machine interaction, etc. (Yuille et al., 1989; Zitová et al., 2003). At present, very reliable methods of biometric personal identification exist. The fingerprint analysis, retinal or iris scans, etc., are examples of the biometric personal identification method. However, these methods rely on the active cooperation of the participants (Graham et al., 1998). The person identification system, which is based on analysis of frontal or profile images of the face, is very effective without the participant's cooperation or knowledge. Face perception is an important part of the capability of human perception system (Alvarado et al., 2006). It is also a routine task for human. It is a true challenge to build a computer system which parallels human ability to recognize faces. Therefore, face recognition has become an active research area, and it attracts researchers from the field of image processing, pattern recognition, neural networks, computer vision, etc. (Zhou et al., 2014). Although, presently the face recognition system has reached a certain level of maturity, but the success of the face recognition system is limited by the conditions imposed by many real-world applications. For example, face recognition in an outdoor environment with variations in illumination, and/or pose remains a very challenging problem (Fraser et al., 1998; Sing 2015). Therefore, the present systems are still far away from the capability of the human perception system. The face recognition system can be developed as a three-step process (Li, 2014). The first step of the face recognition system is face detection (Keller et al., 1985). Face detection is the process of extracting face region from the input scene (Yang et al., 2004). It has many applications in face tracking (Zhuang & Dai, 2007), pose estimation, compression, human-computer-interaction (HCI) system, etc. The next step of the face recognition system is feature extraction (Tan et al., 2006), which acquires relevant facial features from the face images (Adini et al., 1997; Zou et al., 2007). Features are properties which describe the whole face image (Xu et al., 2013). Feature extraction process must be efficient enough in terms of computing time and memory usage (Kwak et al., 2005). There are many applications of the feature extraction process in facial feature tracking, emotion recognition, gaze estimation, and human-computer-interaction (HCI) system (Nandakumar 2008; Cament et al., 2015; Shen et al., 2004). The face detection and feature extraction are often performed simultaneously (Er et al., 2002; Bartlet et al., 2002). The final step is face recognition. In this phase, the face images are identified or verified by applying the extracted facial features on some classifiers (Zhao et al., 2012).

PROCEDURE TO GENERATE THE DIAGONAL IMAGES

Generation of true diagonal images

Let X be an image matrix of dimension $m \times n$as shown in Figure 1(a). We start to scan the image matrix from the upper left-corner pixel, along the diagonals from left to right upwards, towards the lower right-corner pixel. Pixel(s) of the major and minor diagonals are placed into rows of the diagonal image starting from the top row, ensuring that the pixel(s) of the minor diagonals are placed in the middle of the corresponding row as shown in Figure 1(b). The generated diagonal image may be either square (if m=n) or rectangle (if mGn) in size. Thus, we generate true diagonal images from the original face images by placing the diagonal vectors along the horizontal direction. As a result, its size is greater than the original one. The dimension of resultant truly diagonal image is $(m + n - 1) \times MIN\ (m, n)$. Since, the size of the diagonal image matrix is higher; this diagonal face images are scaled own into the size of the original face images($m \times n$).