A Scheme for Face Recognition in Complex Environments

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ABSTRACT

In this paper, the authors propose a scheme for human face recognition in complex environments. The proposed scheme consists of three phases: moving object removal, face detection and face recognition. It could be applied to certain specific environments such as computer users in office, shopping mall, and reception or pokie machine gamblers in casinos. In these environments, the target human face for recognizing will be considered as the foreground and the moving objects (such as cars, walking persons etc) as the background. The objective of this paper is to implement a scheme for human face recognition so as to improve recognition precision and reduce false alarms. The scheme can be applied to prevent computer users or gamblers from sitting too long in front of the screens in offices or pokie machines in casinos. To the best of the authors’ knowledge, this is the first time face recognition in complex environments has been taken into consideration.

KEYWORDS
Face Detection, Face Recognition, LDA, Moving Object Removal (MOR), PCA

1. INTRODUCTION

Face detection and recognition are one of the most important biometrics in multimedia applications and computer vision (Azad et al. 2015; Chen et al. 2015; Kshirsagar et al. 2011; Turk and Pentland 1991; Tsapatsoulis et al. 2000). It has been broadly used in fields such as surveillance, information security, identification systems, and law enforcement systems (Vinaya and Ashwini 2009). In face recognition, the system
needs to first detect a human face using OpenCV (Viola and Jones 2001), and then recognize the face using a classifier assisted by a training set. The classical classifiers include Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) etc (Slavković and Jevtić 2012; Sirovich and Kirby 1987; Turk and Pentland 1991; Martinez and Kak 2001). The automatic face analytics such as face detection, recognition and facial expression recognition are useful in recent security and forensic research. The technology has been well developed in decades, and some relevant systems have already been employed in real applications.

However, as one of object recognition problems in the digital image processing, face recognition still suffers from problems such as luminance changes, pose changes, making-up, complex environments, head rotation, aging issues (Georghiades et al. 2001; Wei 2014). Most of these problems are still under investigation.

In this paper, we take human face recognition in complex environments into consideration. In order to correctly count elapsed time and reduce false alarms, we remove the background of pictures having moving objects so as to increase the recognition precision. We then calculate the precision and recall, and compare them using the results before/after using Moving Object Removal (MOR).

This paper is structured as follows: we review related work in Section 2, our contributions are presented in Section 3, our results are demonstrated in Section 4, and conclusion is depicted in Section 5.

2. RELATED WORK

Face detection in complex environments has achieved very remarkable results, such as the typical algorithms with long standing impact e.g. Adaboost, etc (Viola and Jones 2001) and Skin Color fusion model (Azad et al. 2015). However, most of the recent researches are focusing on Skin Color instead of background processing. Usually face recognition is able to be completed in four steps: 1) Locate a face based on image feature and template (such as eyes, nose and mouth); 2) Segment the face in the image (face shape based); 3) Normalize the frontal face; 4) Recognize the face with the eigenface method. However, the precision of face recognition has not been deeply taken into consideration yet due to various reasons.

Yuan et al. proposed a method to detect frontal faces in a complex environment by using image segmentation and face detection and verification. The face detection and verification are regarded as consisting of Valley-like detector and face verification with positive-negative attractor (Yuan et al. 2002). The Valley-like detector distinguished the differences between surrounding pixels and core ones in a mosaic image. The positive-negative is used to identify the positive attractor such as eyes and mouth, the negative attractor such as the surround pixel (Yuan et al. 2002). However, all of
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