

DOCTORAL THESIS

Face recognition from video

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Face Recognition From Video

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Abstract

With the increasing installation of camera devices in many areas, there is an increasing demand on the applications of Face Recognition from Video (FRfV) and more and more attention has been paid to FRfV. Comparing to the existing still image based recognition technique, FRfV encounters new challenges when the videos are used as input. The face region from the video is often small, in view of the fact that the face is not close to the camera when the video is captured. This makes the existing face recognition algorithms may not work well on the videos. Moreover, some of the research issues, such as illumination / pose variations, become more challenging when the face region is small. In this thesis, three key research issues, namely face tracking on low resolution videos with illumination variations, very low resolution face recognition problem and boosting multi-image based face recognition system, will be discussed and addressed.

Generally, a typical face recognition system includes three modules, namely the segmentation module, the feature extraction module and the classification module. Segmentation module extracts face region from the videos, which is often implemented by face tracker. However, existing face tracking algorithms may not work well on the low resolution videos with illumination changes. A straightforward method to solve this problem is performing illumination normalization before tracking. However, most of the existing illumination normalization algorithms require good face alignment, which is not feasible in the tracking case. In this thesis, we addressed the problem by using a new feature, namely Gradient-Logarithmic Field, in the particle filter framework. This new feature is insensitive to significant lighting changes,

so that the GLF-based tracking algorithm can handle the illumination variances. GLF-based tracker does not assume any model for the face and is effective in low-resolution video. Experimental results show that the proposed GLF-based tracker works well under significant illumination changes and outperform the stat-of-the-art algorithms.

The second research issue induced from the low resolution face is the very low resolution (VLR) face recognition problem. In this thesis, VLR face recognition problem is defined that the face image to be recognized is not greater than 16×16 . Existing feature extraction algorithms do not work well directly on the original low resolution face image, as the low resolution face image only contains little recognizable information. We addressed this problem by the proposed relationship learning based super-resolution algorithm. It learns the relationship between high-resolution (HR) and VLR images and reconstructs the HR images by the learnt relationship. To reduce the complexity of the relationship learning problem, linearity clustering is proposed, so that a piece-wise linear regression model can learn the relationship between high resolution (HR) and low resolution (LR) image pairs effectively. After linear clustering, a regression relationship learning framework has been developed for super resolution. Based on the relationship learning framework, the new data constraint and the discriminative constraint are designed for good visual application and face recognition application, respectively. It is noted that the proposed method is the first super-resolution algorithm which utilizes the class label information to improve the recognition performance. The experimental results show that proposed method works well on VLR face images.

Comparing to single still image based face recognition, extra information from the videos is available and how to utilize the multiple images is a key research issue. We propose to perform quality measurement before recognizing the face images. By assessing these images, the good "quality" image(s), will be selected for recognition, so that the performance can be improved. In this thesis two new measurements, namely the discriminability index (DI) and reliability index (RI), are proposed to

measure the effectiveness of the images for recognition purpose. DI considers the data distribution of the reference images, while RI considers the distribution of the distances between the query image and the reference images. DI and RI are developed by using not only the information from one single image, but also the whole distribution of the data. This helps to better utilize multiple images for recognition. The results on public face databases show that the proposed method can improve the existing face recognition algorithms effectively.

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