Multiresolution Face Recognition

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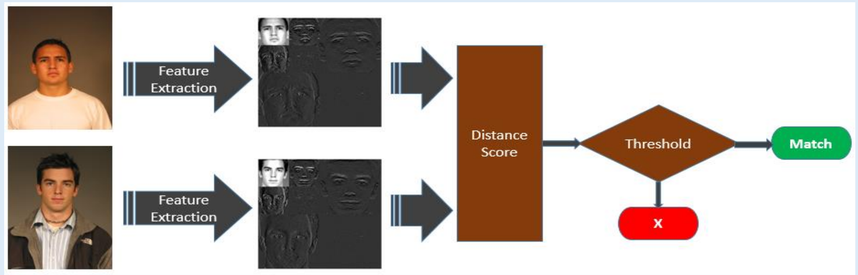
Introduction



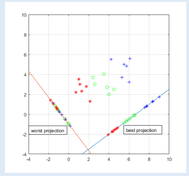
Face recognition is an important technique for people identification and recognition. The algorithms evolved rapidly in this decade. Although good multiresolution face recognition methods exist, it is still not well understood which aspect of the face contribute to recognition, for instance, in terms of location and frequency content. On the other hand, face recognition performance is limited due to the wide variety of illumination, facial expression and pose variations, lightning conditions, ageing, disguises such as slight cut, glasses or makeup.

The aim of this PhD research is to investigate which aspects of the face, in terms of location and frequency content, contribute to face discrimination in relation to image quality factors like pose, illumination and resolution.

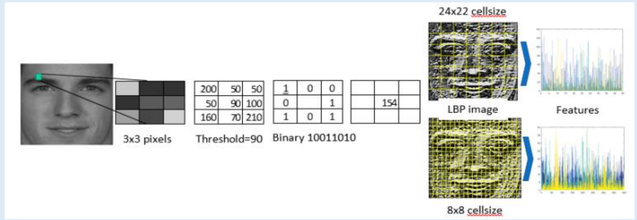
Research Questions

- **Which aspects of face information, in terms of location and frequency content, contribute to face discrimination?**
  - **How can multiscale decomposition be used to identify these aspects?**
  - **What is the discriminative information in higher frequency bands and how to exploit it?**
  - **What is the effect of pose, illumination, expression, and image resolution on these aspects?**
  - **How can this knowledge be used to improve face recognition?**
  - **In term of location, what is the important information in the face that influence to recognition and how to exploit it?**
  - **What is the effect of morphing on facial regions, in term of identity information?**

Research



PCA-LDA [1]
This paper presents the analysis of PCA-LDA behavior for face recognition using Singular Value Decomposition (SVD). The experimental results is shown to analyze face recognition performance, i.e. the impact of number of subjects, images per subject, training set size, and trade-off between the number of subjects and the number of images per subject on recognition performance, in relation with the number of PCA-LDA coefficients. The comparison of three classifiers, i.e. Euclidean Distance, Cosine Similarity, and Likelihood Ratio, are presented to obtain knowledge about their characteristics. All experimental evaluations are in the verification context.



LBP [2]
This paper presents an analysis of the recognition performance of LBP at different frequency bands to exploit their discriminative information. The work presented in this paper is part of an investigation about which aspects of a face contribute to automated face recognition. Multi-resolution analysis, by means of wavelet transform, is commonly used to explore the features of an image. The each step of wavelet transform decomposes an image recursively into four frequency bands: approximation, horizontal, vertical, and diagonal band. The approximation band is a downsampled version of the original image. Whereas, the other bands are detail bands that contain detail information of the image in horizontal, vertical, and diagonal directions. The noise is more dominant in these bands. The information contained in the detail bands is more related to high frequency-components and local structures such as edges. In order to analyze the impact of the various bands, we performed classification experiments on them. For the A-bands, that contain the global information of the facial image, we used PCA/LDA classifiers. For the detail bands, that contain local structures, we used LBP

[1] N.H.Lestriandoko, L.J.Spreeuwers, R.N.J.Veldhuis, "The Behavior of Principal Component Analysis and Linear Discriminant Analysis (PCA-LDA) for Face Recognition", Proceedings of SITB 2018
[2]] N.H.Lestriandoko, L.J.Spreeuwers, R.N.J.Veldhuis, "Multi-Resolution Face Recognition: The Behaviors of Local Binary Pattern at Different Frequency Bands", Proceedings of 2019 Symposium on Information Theory and Signal Processing in the Benelux, pp. 63-70

Research

Morphing (Current research)
The aspect of the face that contributes to recognition is important information to the face recognition algorithm. On the other hand, the development of face recognition improvements still lacks knowledge on what parts of the face are important. The current research presents face exploitation to obtain important recognition information in a certain area of the face from the black box perspective. We propose a more advanced way to select parts without introducing artifacts using the average face and morphing. Furthermore, multiple face recognition systems are used to analyze the face component contribution.

Future Work

The future works will implement the knowledge of face component contribution to improve the recognition system.

Acknowledgement

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