International Journal of Advanced Research in Engineering Technology & Science
ISSN: 2394-2819
Email: editor@ijarets.org Volume-4, Issue-5 May- 2017 www.ijarets.org

COMPARATIVE ANALYSIS OF HOLISTIC AND LOCAL FEATURES EXTRACTION APPROACH FOR MULTIMODAL BIOMETRIC SYSTEMS

Navdeep[1], Surender[2]
[1]Ph.D Research Scholar.[2]Supervisir
Department of Computer Science & Engineering
Singhania University, Jhunjhunu, Rajasthan, INDIA

ABSTRACT: Feature extraction is important for the success of the recognition and classification process, and should be able to extract more information while reducing noise and avoiding redundant data with fast computation. The features given by the extraction process can be used to gain statistical information using supervised and parametric learning techniques. Holistic approaches directly compute the data from raw images and process the raw image as two dimensional holistic patterns. Linear projection method such as PCA and LDA are two traditional methods which have become default tools in holistic based approaches to reduce dimension of feature vectors and increase. Holistic approaches directly compute the data from raw images and process the raw image as two dimensional holistic patterns. Linear projection method such as PCA and LDA are two traditional methods which have become default tools in holistic based approaches to reduce dimension of feature vectors and increase discrimination power in the feature space..This paper investigates holistic and local feature extraction techniques used for feature fusion level in multimodal biometric systems for fusion of images.

KEYWORDS: Holistic Feature Extraction, Local Feature Extraction, PCA, LDA, DCT, DWT

I. INTRODUCTION

Multimodal biometric is became famous comparative to single biometric system due to its higher rate of success. In case of multimodal biometric systems more than one image are fused and stored in data base based on different fusion approaches [10-19]. Multimodal biometric systems that have been proposed in the literature can be categorized based on three parameters, i.e., (i) type of biometric information fused, (ii) level of fusion, and (iii) fusion methodology. Information fusion at the feature level is believed to give better performance for classification due to the utilization of complementary and the most discriminative features existing in both modalities. Holistic and local feature extraction approaches are widely used in future fusion extraction in multimodal biometric system. Further, in this paper we analysis both the approaches in details.

II. LITERATURE SURVEY

PCA performs linear projection method in the image space producing glow dimensional feature vectors where the projection directions will maximize the total scatter across all images [2].During the projection process which maximizes the total scatter matrices, PCA also retain sun wanted variations which exist in the images, such as those caused by differences in illumination and facial expressions which will not give the best results in terms of discrimination power.

The feature design procedure generate new features from 2D biometric images using signal processing tools to convert raw data into a frequency domain which is believed to enhance the information in the image. The analysis of biometric images in the frequency domain is a commonly used method in image representation and recognition, and some work has used frequency domain techniques to extract information for facial recognition. Hafed [5] proposed the transformation of features of facial images to

the frequency domain using a Discrete Cosine Transform (DCT), and performance was evaluated in terms of the recognition rates [3]. In this method, the whole face image is transformed to the frequency domain and only low frequency coefficients are preserved for classification.

Another approach to the representation of the biometric feature vector is to use a discrete wavelet transform where a multi resolution analysis of the signal is performed with localization in both time and frequency. Wavelet coefficients representing the contribution of wavelets in the function at different scales and orientations are computed by convolving the image with wavelet kernels such as the Haar and Daubechies wavelets. The wavelet decomposition technique is able to extract the intrinsic features and reduce the dimensions of data in the pixel images by dividing the original image into several sub images using low pass and high pass filters. Son [4, 5] proposed a feature fusion method for face and iris multimodal biometrics by concatenating the feature vectors extracted from the three levels of wavelet decompositions.

III. HOLISTICFEATURESEXTRACTION APPROACH

A new representation called the holistic Fourier invariant features is computed from the wavelet sub band which corresponds to the low frequency components of both vertical and horizontal directions of the original image [2]. Another method to represent features based on the Fourier transform is the use of phase information instead of values of magnitude, as suggested in [4]. The phase information given by the 2D-DCT of the palm print image is used to calculate similarity to the templates stored in a database by using phase correlation function, where a sharp peak is achieved for a similar image. In order to increase the performance of the recognition process, the similarity measure from the phase information of the 2D DFT and feature representation using local 2D-DCT are fused at the matching score level. Jing and Zhang [3] uses DCT to extract the holistic features of face and palm print images and then proposed a method called two dimensional separability judgments to select the DCT frequency band.

The DCT coefficients in a selected frequency band of the whole image are learned using linear discrimination technique to reduce dimension of feature vector, and a nearest neighbour classifier is used for classification. Li et al [6] applied the Fourier transform to extract information from the spatial domain to the frequency domain in palmprint images. In order to perform the classification task, the features in the frequency domain are compared with the templates stored in a database. Lai [6] applied the Fourier transform to the wavelet transform of face images in order to generate a feature vector that invariant to translation, scale and rotation on the plane.

Holistic approaches directly compute the data from raw images and process the rawimageastwodimensionalholisticpatterns.Linearprojectionmethodsuchas PCA and LDA are two traditional methods which have become default tools in holistic based approaches to reduce dimension of feature vectors and increase discrimination power in the feature space.

IV. LOCAL FEATURE REPRESENTATION

In contrast to the holistic features where an entire image is used to compute the feature representation, local feature extraction methods extract the information from diverse levels of locality and quantify them precisely. The general idea of local feature extraction technique is to divide the image into several parts and then the information is extracted each part individually. Another method is to locate several components of features such as the eye, nose and mouth in a facial image, and then classify them using several matching methods. Anila [7] proposed using the Gabor transform with local regions of a face image in order to construct an independent feature vector.

The analysis shows that fusing the match scores from each local region gives better results compared to concatenating the local features and classifying them by using a single classifier. However, this method requires frontal face images with less variation in poses and the complexity increases due to the use of a multiple classifier for each local region. Sanderson [8] proposed representing local features by using modified 2D-DCT coefficients computed in 8 x 8 sub block windows. A modified DCT is computed

using the DCT coefficients by introducing new coefficients for the first three original DCT coefficients where the new coefficients are computed from neighboring blocks. By removing the first three DCT coefficients, it is believed that robustness to illumination changes increases, but a significant amount of discrimination information may be lost. Thus, to overcome the performance loss, it was suggested that the first three coefficients should be replaced with their proposed delta coefficients.

Extracting local features can also be accomplished by choosing certain parts of a biometric image instead of dividing the image into several sub blocks as above. Lucey [9] proposed to use several shapes in face to extract local features, where regions of a face image such as the eye, nose, mouth and eyebrow are modelled in a single Gaussian distribution.

V. CONCLUSION

Information fusion at the feature level is believed to give better performance for classification due to the utilization of complementary and the most discriminative features existing in both modalities. However, the success of feature fusion depends on the information contained in both modalities. Thus, it is believed that, by using an effective method to extract the most important features, this could be beneficial to fusion itself. This section proposes patch based feature representation for feature level fusion utilising the frequency domain, which is able to extract multi resolution texture images.

Compared to LBP, where the patterns are predefined and fixed, the new local patterns are learned from the patch set, which is constructed by sampling patches from the Gabor filtered image. In order to construct the representation of the image, each facial image is converted into multiple pattern maps and the histograms of each block image are concatenated together. In general, the choice of these three parameters depends on the application scenario and it has been found that they have a profound influence on the performance of a multi biometric system.

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