Several Face Images Recognition in Uncontrolled Illumination Variation Images

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***Abstract*—This paper to study and present a face recognition system under uncontrolled illumination images. It consists of pre-processing method, a hybrid Fourier feature extraction and a score fusion. In the pre-processing stage a face image is transformed in to an illumination-insensitive image, called an "integral normalized gradient image". The hybrids Fourier feature are extracted from different Fourier domains in different frequency bandwidth. In this paper the multiple Face Models are generated by plural normalized face images that have different eye distances. Finally to combine the scores from multiple complementary classifiers, a log likelihood ratio-based score fusion scheme is applied. This system using the Face recognition Grand Challenge (FRGC) experimental protocols is evaluated. it shows the average verification rate on 2-D face images under various environmental variations such as illumination changes, expression changes, and time elapses.**

***Keywords*— Face recognition, Face recognition grand challenge, Feature extraction, preprocessing, score fusion**

I. Introduction

Automatic face recognition is an important vision task with many practical applications such as biometrics, video survelliance, image retrieval, and human computer interaction. One of the major issues for face recognition is how to ensure recognition accuracy for a large data set captured in various conditions. In many Face data sets are compared to many different algorithms with the same protocols on the same data sets[2].Most recently, face recognition grand challenge(FRGC) has been designed to improve the accuracy of face recognition in particularly the person's identification and focused on verification.[3] The FRGC data set contains face images collected in different conditions. One is controlled studio setting versus uncontrolled illumination conditions with two different facial expressions neutral versus smiling taken for several months. In FRGC the main situation is to match two face images of the same person under different situations. One is taken in a controlled studio setting while the other is uncontrolled environmental problems; it combines the multiple classifiers with the complementary features instead of improving the accuracy of a single classifier. Illumination insensitive preprocessing and a score fusion are determined to the face recognition system. In the preprocessing the main importance to that of same person changes under different illumination conditions are greater than those of different persons among the same illumination. In face recognition especially when the appearance-based methods are applied. In the illumination –insensitive image integral normalized gradient image (INGI) method is to overcome the unexpected illumination changes in face recognition with the limited side effects such as image noise and the halo effect. Based on intrinsic and extrinsic factor the normalize the gradients with a smoothed image and then integrate the division results with the anisotropic diffusion method. it can compensate for unexpected artifacts and have smoother and more natural output images for face recognition. In the feature extraction to be used for person classification are extracted to identify any invariance in the face images against environmental changes. They include the Principal Component Analysis (PCA) [4] and linear discriminator analysis (LDA)[5] and independent component analysis(ICA). These methods are easy to implement for practical applications. In addition, with these methods it is not necessary to carry out extra high computational burden expect vector projections, while other structural based schemes such as dynamic link architecture and perform intense template matching on relatively high resolution images to localize fuci dial points near eyes, nose , mouth,etc. in the face recognition it can be largely classified in to two different classes of approaches, the local feature-based methods to analyse a plural of local features such as a gabor wavelet features extracted from the high resolution image, but most of the approaches impose a heavy computational burden on the target device, in particular on mobile devices, which have low computational power. In the global feature based methods is simple, they are good devices with low computational power inspite of limited accuracy compared to the local feature based methods. There are three types of Fourier feature domain, concatenated real and imaginary components, Fourier spectrums and phase angle are represented. Three different frequency bandwidth are also designed to extract more complementary frequency features. in multiple face model that have three face models with different eye distances with a regular face image region. In the Score Fusion it builds a unified classifier combining the complementary classifiers. It is based up on log likelihood ratio is a probabilistic approach for face recognition.

II. Related Works

As the related works of number of preprocessing algorithm to minimize the effect of illumination changes for face recognition have been developed and their training stages.

Wang *et.al* [6] proposed a introduced the self quotient image (SQI) method that extracts intrinsic and illumination invariant features from a face image based up on quotient image

techniques. It is assumed to that the intrinsic part of the image is mainly located in a high frequency region, and according to the Lambertian model, the intrinsic part and extrinsic part to be analyzed. The SQI method could remove the shaded parts of a face image

Jobson *et.al* [7] proposed the reflectance estimation method with the ratio of an original image in to its smooth version. The difference between the two retinex-based algorithms is that Job son's filter is isotropic and anisotropic. Since those approaches do not need a 3-D or 2-D model, they are relatively simple to implement and are generic

Kumar *et.al* [8] proposed a frequency domain feature of face images for recognition by proposing a cross-correlating method based up on the fast Fourier transform. And further extended a correlation filter for redundant class –dependent feature analysis in the frequency domain it is a non linear correlation filters for redundant in the frequency feature domain.

Yang and liu [9] it proposed a color image discriminate(CID) model that seeks to unify the color image representation and recognition tasks in to one frame work. The proposed models have two sets of variables: a set of color component combination coefficients for color image representation and multiple projection basis vectors for color image discrimination using face recognition and future work to develop more controlled experiments for use of additional modalities to improve the robustness of the system.

Belhumeur and kriegman *et. al.* [10] proposed a face images with the same pose under different illumination conditions form a convex cone, called an illumination cone. It is applied a spherical harmonic representation to explain the low dimensionality of different illuminated face images. The synthesis and recognition results of the illumination cone and spherical harmonics cast lights on robust face recognition [10] it also introduces the under various illumination conditions of the model.

Tan and Triggers *et.al.* [11] proposed a use of heterogeneous feature sets such as Gabor Wavelets and LBP (local Binary Pattern) features. Each feature is projected in to reduced dimension spaces by PCA.

su *et.al* [12] proposed a hierarchical framework mixing global and local classifiers. The global classifier is based up on Fourier features originating from a low resolution image while the local classifiers are organized by a combination of patch-based gabor features from a high resolution facial image.

Motivated by the results of [6], [7], [8], [9] and [10], are illumination changes for the face recognition.

III. LDA and PCLDA Based on Hybrid Fourier Feature

In LDA it is a supervised learning method that finds the linear projection in subspaces, it maximizes the between the class scatter of the projected data. According to this objective, two scatter matrices- the between-class scatter matrix and with in-class scatter matrices. To overcome this problem, PCA is first used with the sample data to reduce its dimensionality. it is called as PCLDA. In the Hybrid Fourier feature domains, namely the real and imaginary component (RI) domain, Fourier Spectrum and phase angle domain. It presents and applies the three frequency band selections B1, B2, B3 to the three Fourier feature domains. In the other hand the Phase and Fourier spectrum domain don't make use of the highest frequency region because the discriminating power of the highest frequency parts in these Fourier domains. Moreover, the higher frequency information of the phase angle is sensitive to small spatial changes and thus it is adopted. In this respect, this selection to small spatial changes and, thus, to be determined. In this respect, this selection procedure in phase information is a kind of compensation for the susceptible phase coefficients. All Fourier Features are independently projected in to discriminative subspaces by PCLDA theory.

In the multiple face model of the internal facial components have been commonly employed, because external features (eg., hair) are too variable for face recognition. In the multiple face models that consists of three face models with different eye distances in the same image sizes. It is designed to imitate the human visual system and examines a face image from the internal facial components to the external facial shapes. Three face models with the same image sizes, 46x56 are constructed with the three different eye distances and the integral normalized gradient image. We finally have fine, dominant, and coarse face models. The fine face model is formed to analyze the internal components of a face, such as eyes, nose, mouth, while the coarse face model includes the general structure of the face. In the dominant face model is a compromise between the fine model and the coarse model in the face recognition.

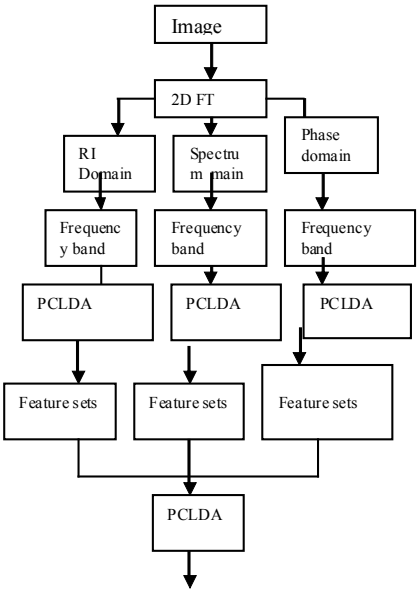

Fig.1 Structure of hybrid fourier based PCLDA

IV. Simulation Results And Discussions

In this section, we use to compute the simulations to evaluate the performance of the proposed scheme with and using Matlab function. The simulation scenario involves a device used by a soldier who can use Face Recognition system such as biometric applications. We consider a three different types of face image model with fine model, coarse model, dominant model.. Here we call it PCLDA hybrid Fourier feature based method. If the face model are collected in Yale data base from the different facial features are to be extracted. In the Hybrid PCLDA based scheme. In these schemes are classified in to the three different types of classifiers such as Fourier transform, Frequency band selection, feature concatenation, Score Fusion techniques are to be evaluated. In the normal face images are simulated to the pre-processing stage such as smoothing, normalizing, gradient, reconstruction and Fusion scheme. So in these pre-processing method is called the Integral Normalized Gradient Image (INGI). It also provides more accurate average verification rate on various conditions. In face recognition system there are many applications such as Toys in intelligent robotic system. In vehicles such as the safety alert system based on eyelid movement.

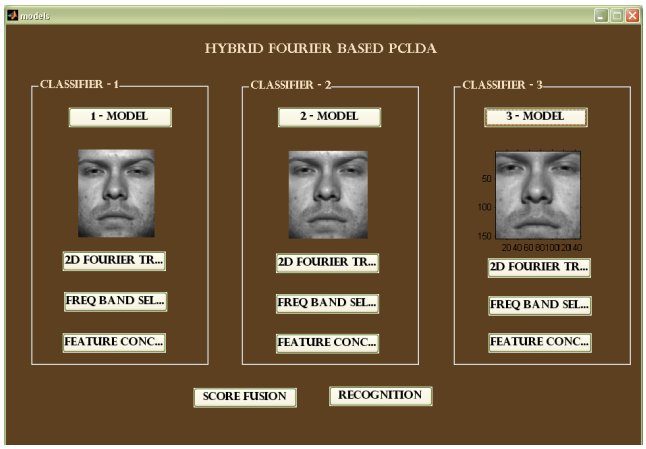

Fig.2 Simulation of Hyrid based PCLDA in I& II nd &IIIrd model

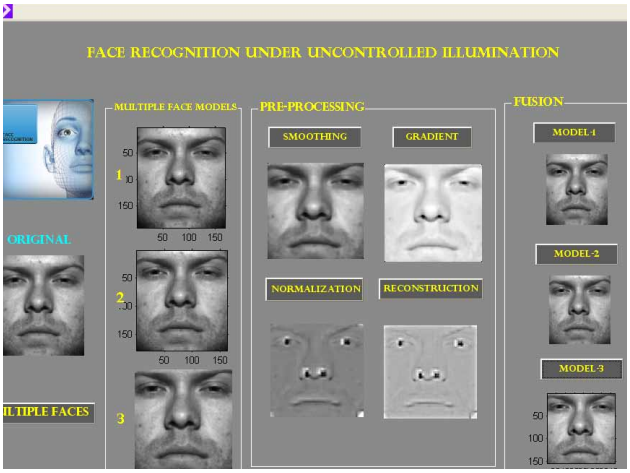

Fig. 3 Simulation of Integral Normalized Gradient Image

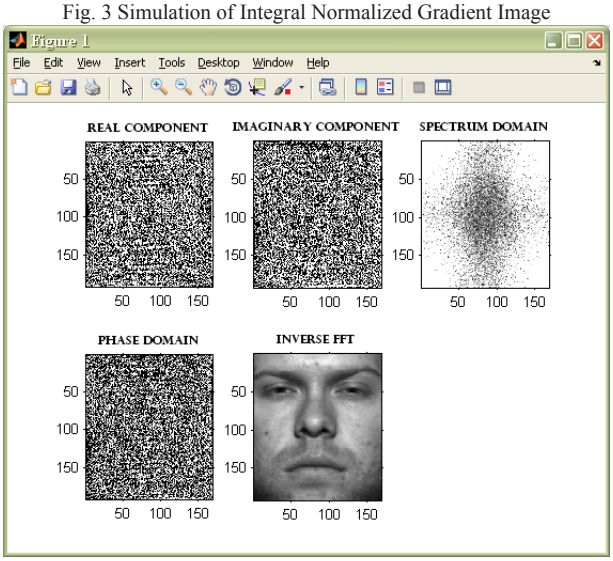

Fig. 4 simulation of model 1 in fourier feature LDA.

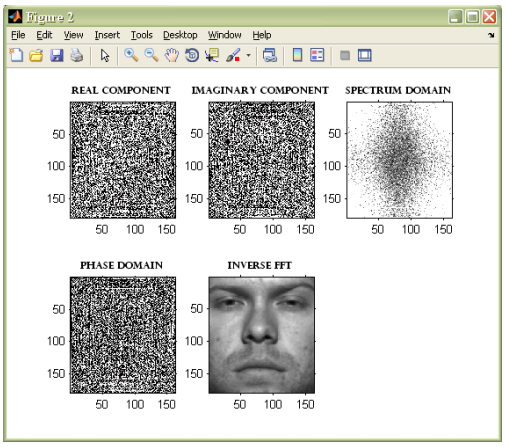

Fig. 5 simulation of model 2 in fourier feature LDA

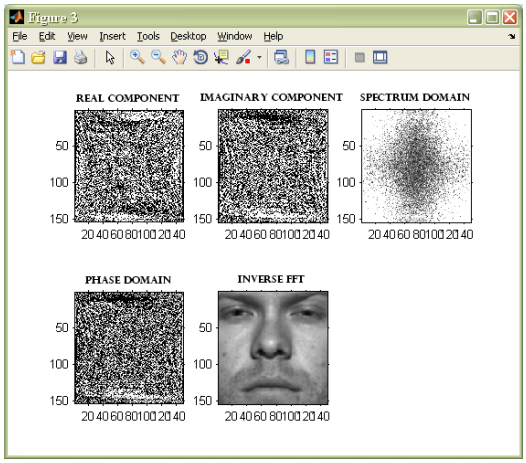

Fig. 6 simulation of model 3 in fourier feature LDA

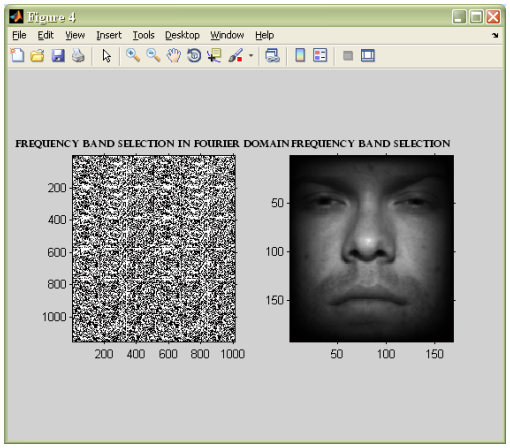

Fig. 7 simulation of model 1 in frequency band selection model.

V. Conclusion

We have presented a Whole face recognition system with Pre-Processing, feature extraction and classifier, and score fusion methods for uncontrolled illumination situations. First , We proceed a preprocessing method based up on the analysis of the face imaging model with the definitions of intrinsic and extrinsic factors of a human face and proposed the INGI method as illumination insensitive representation. for face recognition. We also proposed hybrid Fourier-based classifiers with the multiple face models, consists of real and imaginary components, Fourier spectrums and Phase angle. The Fourier features are extracted from each domain with its own proper frequency bands, and to gain the maximum discriminative linear subspace with the PCLDA scheme. We build the multiple face models namely, fine, dominant, and coarse face models. They have the same image sizes with the different eye distances. Multiple face models always better than the dominant face model. Moreover, to effective utilize the several classifiers, we proposed the score fusion method based up on the log likelihood ratio(LLR) at the final stage of the face recognition system.in this method it achieved a average verification rate and accuracy. Compared with the other global feature-based algorithms, this system demonstrated successful accuracy in face recognition under uncontrolled illumination situations.

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