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Effectual Face Recognition System for Uncontrolled Illumination

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Abstract-Facial recognition systems are biometric methods used to pinpoint the identities of faces present in various digital formats by comparing them to facial databases. The variation in illuminating conditions is a huge hindrance for efficient operation of facial verification systems. The effects of change in ambient lighting conditions and formation of shadows can be nullified by an effortless pre-processing system. This paper presents an effectual Facial Recognition System which consists of three stages: the illumination insensitive preprocessing method, Feature Extraction and Score Fusion. In the preprocessing stage, the light-sensitive images are converted to light-insensitive images so that uncontrolled lighting will no more be a liability for any kind of identification. In the feature extraction stage, hybrid Fourier classifiers are used to obtain transforms which are projected into subspaces using PCLDA Theory. And the output is passed onto the Score Fusion stage where the discriminating powers of the classifiers are unified by using LLR and knowing the ground truth optimizations. This proposal has passed the Face Recognition Grand Challenge (FRGC) Version-2 Experiment, Extended Yale B and FERET datasets.

Keywords: biometric, preprocessing, subspaces, extraction, classifiers, fusion, ground truth optimization, datasets

I. INTRODUCTION

Face recognition is one of the latest and fastest growing biometric methods after finger print identification and iris recognition systems, used in law enforcement, fatigue driving detection, e-learning, human-computer interaction and other commercial activities. An added advantage of this biometric method is that since it is a non-contact process, no interaction with the person is required for identification. A computer algorithm matches certain features of a face pulled out from a digital format against an already existing database. The process of facial recognition is far from simple; there are a lot of hindrances involved. Even though there is a wide range of recognition algorithms available for face recognition, none of the algorithms have been able to come anywhere near the pattern recognizing ability of the human brain in recognizing faces. The success rate of these algorithms, tested in controlled environments, is further reduced due to variances in ambient environment, expression or occlusion. This reduces the effectiveness of this method, and hence the complete potential of facial recognition is unexploited. One of the main hindrances in recognizing faces in uncontrolled environments is the variation in illumination. The variation in lighting can mislead the algorithm and lead to greater differences than different individuals under the same lighting conditions, thus distorting the input image and failing as an authenticating system. The limitation of geometric method for illumination invariant face recognition is that it works only on frontal face databases. Many subspace methods like Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) etc. are used to convert high dimensional input data to lower dimension subspace so that it can be further processed to reveal the information which is hidden due to the illumination factor. A multiple face model is utilized to analyze the image from different standpoints for increasing the superiority of performance. A coarse-to-fine detection algorithm is used for detecting the coarse areas of an image, which is then further analyzed by multiple classifiers to detect the finer areas for robust face detection. The information acquired by the classifier is compressed in the score generated by it. The scores of multiple component classifiers are used to produce a single score by a process called as score fusion. The need to fuse individual component classifiers arises because of the increase in the number of region based methods to overcome the problems in face recognition. Some methods of score fusion methods are product rule, sum rule, Bayesian method etc. In this system a probabilistic statistical approach of LLR is used.

II. LIGHT INSENSITIVE PREPROCESSING METHOD

The preprocessing technique improves the results of the algorithm used in feature extraction. Each image consists of two types of factors: intrinsic and extrinsic factors. The intrinsic factors are the distinct features independent of illumination, whereas the extrinsic factors are the features which are strongly reliant on the ambient lighting.

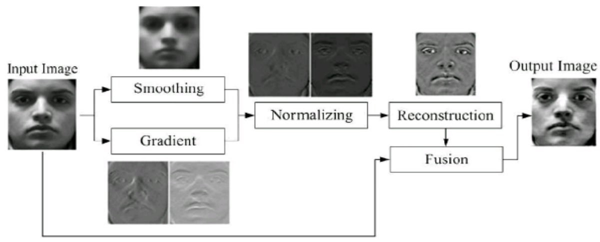

Fig.2. Structure of the integral normalized gradient image

In the proposed system, an Integral Normalized Gradient Image (INGI) is used as the light insensitive image. The input image is first divided into two components: a high frequency component and a low frequency one. The high frequency component is smoothed while the low frequency component is normalized. A new grayscale image is then created by normalizing the gradient and integrating it with the smoothed version of the input image. To reduce image noise while preserving features like edge, lines etc., which are required for constructing the image, anisotropic diffusion is used. Anisotropic diffusion is an iterative diffusion process in which a computation is applied over and over again on consecutive images until a certain degree of smoothing has been reached. Each consecutive image is a convolution of the image and a Gaussian filter, which is based on the content of the initial image. Thus in the preprocessing stage intrinsic factors are enriched while the extrinsic factors are diminished.

III. FEATURE EXTRACTION

Feature extraction techniques are utilized for getting only the features which would be useful for recognition i.e. it is a dimensionality reduction technique which represents only the concerned part of the image as a compact feature. This is required as large input data cannot be processed with ease and a reduced feature representation is required for image matching and retrieval through the removal of redundant data. This is turn reduces computational costs and results in faster processing. This is where subspace methods come into play, and the linear method of PCLDA (Principal Component Linear Discriminate Analysis) is used to project the data into lower dimension sub-space.

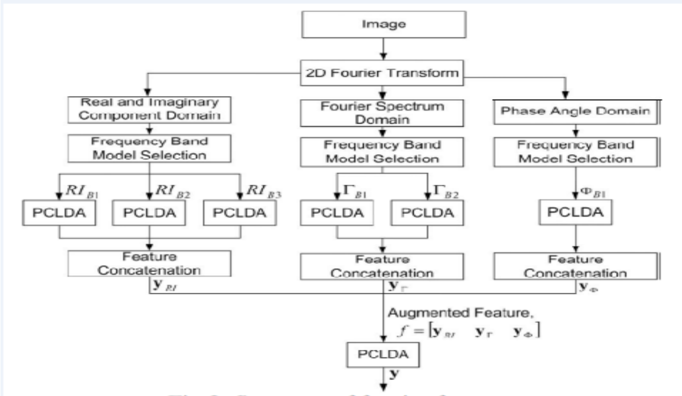

Fig.3. Structure of fourier feature

A 2D discrete Fourier transform is used to enhance the features before PCLDA is applied. This is done by dividing the image into several blocks and applying 2D Fourier filters on them. The hybrid Fourier features extracted are present in the following three domains: Real and Imaginary Domain, Fourier Spectrum Domain and Phase angle domain. For complementary features to be obtained three different frequency bandwidths are used when deriving the features from the three domains. LDA (Linear Discriminate Analysis) performs the projection of the feature space onto a smaller subspace while simultaneously preserving the class-discriminatory information.

Multiple Face Models
These models are used with different eye positions and same image size. The algorithm used here is a coarse-to-fine detection using multiple classifiers. Using dual ellipse templates, face-like areas are found in coarse detection. From the coarse locations, the fine classification is done to categorize the local image as a face by using multiple face classifiers. The most extricate facial feature- the eyes are used for finding the most resembled face image area from multiple face models for fine classification.These multiple classifiers take into account the pixel distribution, gradient and texture. A dominant face model is formed as a compromise between the coarse and fine model.

IV. SCORE FUSION

In score level fusion, the classifier based scheme of fusion is utilized. The outputs of several classifiers are concatenated to obtain a single scalar score.

Score fusion calculates the weighted sum of scores, where weight represents the discriminating power of the individual classifier. In the proposed system, a statistical approach, LogarithmicLikelihood Ratio (LLR) procedure is used for score fusion. The ground truth distribution scores are required to compute the accuracy of a training set’s categorization for supervised computing techniques. The LLR based score fusion is ideal if the ground truth distribution scores are known. Otherwise a simple approximation of the ideal score fusion is computed based on the score distribution from the training set.

Recognition Rate
The recognition rate is used to calculate the superiority of different recognition algorithms.

$$\text{Recognition Rate} = \frac{No.of\ Correctly\ identified\ races}{\text{Total no. of Faces present}}$$

The proposed system, when used on a widely used standard data collection of images, showed an improved recognition rate compared to previously used algorithms.

V. CONCLUSION

This paper proposes a technique for effectual face recognition under different lighting conditions. The following three steps are followed in the proposal: Preprocessing method, Feature Extraction and Score Fusion. The preprocessing method is used to convert the light sensitive image into a light insensitive one by creating INGI images. Then hybrid Fourier transform is applied to obtain Fourier features in three domains: merged Real and Imaginary domain, Frequency Spectrum domain and Phase angle domain. Three different frequency bandwidths are used and then LDA is used to project the data into lower dimension sub-space by removing redundant data. The multiple face model method uses the coarse-to-fine detection using multiple classifiers. Finally score fusion is done where the outputs of several classifiers are merged into that of a single one using the statistical approach of LLR. In order to increase the recognition rate other factors like expression variation and age factors can be taken into account for uncontrolled conditions. Age variation can be corrected using Age Mapping and pose variation by using Affine Transform which produces correction with frontal pose images.

References

[1] Kannan Subramanian “An Efficient Face Recognition under varying Image Conditions” in IJIRCCE, Vol-2, Issue 8, August 2014, pp 5291- 5296
[2] Belhumeur P.N and D.J. Kriegman, “What is the set of images of an object under all possible lighting conditions?” in Proc, IEEE Conf. Comput. Vis. Pattern Recognit. June 1996, pp. 270-277
[3] Samsung,S. “Integral Normalized gradient Image A Novel Illumination Insensitive Representation” in Proc. IEEE Conf. Compt. Vis. Pattern Recogn. June 2005 pp. 166-172

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[4] Wang. H. S. Li and Y.Wang "Generalized Quotient Image" in Proc. IEEE Conf. Compt. Vis. Pattern Recogn. July 2004, vol-2, pp. 498-505
[5] HanjinRyu, Ja-Cheon Yoon, SeungSoo Chu, SanghoonSul, "Coarse-to-Fine Classification for Image-Based Face Detection", Springer, Img. And Video Retrieval Volume 4071, pp 291-299
[6] Ralph Gross and Vladimir Brajovie, "An Image Preprocessing Algorithm for Illumination Invariant Face Recognition", 4th International Conference on Audio and Video Based Biometric Person Authentication, pp. 10-18
[7] Wonjun Hwang, Gyutae Par, Jongha Lee and Seok-CheolKee, "Multiple Face Model of Hybrid Fourier Feature for Large Face Image Set", in Proc. IEEE Conf. Compt. Vis. Pattern Recogn. , vol-2, 2006, pp. 1574-1581
[8] Jamal Hussein Shah, Muhammad Sharif, MudassarRaza, "Robust Face Detection Technique under Varying Illumination", in Journal of Applied Research and Technology (JART), February 2015, Vol-13, pp. 97-105.