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An Efficient Face Recognition using Discriminative Robust Local Binary Pattern and Gabor Filter with Single Sample per Class

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Abstract: ***Nowadays face recognition plays an important role in today's world. It has achieved greater importance in the field of information security, law enforcement and surveillance. Now this face recognition approach is applied to many areas like Airport security, Driver's License, Passport, Customs and Immigration. In face recognition Local appearance based methods had achieved greater performance. In this paper, single sample per class using Discriminative Local Binary pattern and Gabor filter is proposed .It helps to extract the facial features efficiently. Then the Gabor filter extracts the textual feature and generates a binary face template based on that features. And this binary face template act like a mask to extract local texture information using Discriminative Robust Local binary pattern. This method is efficient to face recognition since it is less sensitive to illumination and scaling. Feature level fusion is used. Finally the Decision is done by applying Euclidian distance matching and Decision Fusion. It reduces the computational time complexity and space complexity. Here FERET database is used for face recognition.***

Index Terms - Discriminative Robust Local binary pattern, Gabor filter, Feature and Decision Fusion, single sample per class.

I. INTRODUCTION

The need of security is increasing day by day, so in order to enhance the security, we are face recognition in today's world .Now face recognition is applied to many areas like entertainment, law, investigation etc. Face recognition is used to identify an individual based on his or her physiological traits. The physiological traits are face, fingerprint, iris etc. The most commonly used face recognition techniques are Eigen faces, Fisher faces, and Laplacian faces, Neural Networks. In practice there is some difficulty in dealing with different illumination, pose, facial expressions, ageing. Another important problem is single sample problem. In order to avoid this single sample problem, we are using single sample for each individual. In the case of passport, adhar card, driving licence, voters id, etc. only one image is available for training. Some face recognition techniques are proposed to solve this single sample problem. The Face recognition method is classified mainly into two. They are holistic matching method and local matching method. The holistic matching method considers the entire face image. And this method uses Principle Component analysis (PCA) , Linear Discriminant analysis (LDA)[6,7] and the Independent Component Analysis (ICA). PCA is applied to training set based on Eigen faces. Where each image is the Represented by Eigen vector [3] for each image Eigen value is calculated and Eigen vector with highest value is used to represent a particular image. Comparison is done by Euclidian distance between Eigen vector coefficients. LDA is based on Fisher Faces [13]. It uses multiple image of a person, it maximises inter-class and minimizes intra class scatter. Likewise ICA is used. Local matching method is suitable for single sample per class than holistic method. In local matching method we will be considering single facial features rather than the whole image. Here, Low dimensional local vector features represent the original features. And the different facial features improve classifiers diversity. Local features can be length, breadth, contrast, brightness etc. Discriminative Robust Local Binary Pattern (LBP) method was first proposed in an image texture descriptor .Now it's applied on face-recognition application. LBP method provides better result in terms of speed and discrimination performance. One advantage of using LBP [15], it is less sensitive to Illumination variation and scaling variation. A Gabor feature-based face recognition [7] is used mainly in image processing, pattern recognition, computer vision etc. Gabor filter exploits spatial localization, orientation selectivity and spatial frequency characteristics. Gabor filter extracts essential features of face and creates binary face template.

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BRIEF DESCRIPTION OF DRLBP AND GABOR FILTER

In this section, a brief description about LBP and Gabor Filter is given.

A .Discriminative Robust Local Binary Pattern

Local Binary Pattern [11] operation is introduced by Ojale et al in1996. It summarizes local grey-level structure. The operator takes local neighborhood values around the pixel. It takes the central pixel and considers all the neighborhood values of central pixels.

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It is defined by 3X3 neighborhood where (2, 2) represents the central pixel. It is 8-bit coded based on central pixel. DRLBP operator takes,

$$DRLBP\ (x_c,\ y_c) = \sum_{n=0}^{7} 2\ s(\ i_n - i_c\ )$$

Here n has eight neighbors over central pixel c, where 'i_n' and 'i_c' are grey scale values of c and n,

$$s(u) = \begin{cases} 1 & x \geq 0 \\ 0 & Otherwise \end{cases}$$

Here in DRLBP method we divide face image into a regular grid of cell. And histogram is applied for equalization. At last cell-level histogram concatenation produces uniform result. Here the threshold value is 70.And we will subtract the threshold values from the neighboring pixels. And if the value is negative we will convert the value to 0.Otherwise if the value is positive we will convert it into 1.To obtain a small set of the most discriminative LBP-based features for better performance and dimensionality reduction, LBP-based representations are associated with some popular techniques of feature-selection schemes to reduce the feature length of DRLBP codes, which contain rule-based strategy, boosting and subspace learning, etc. A large number of variations are designed to expand the scope of application, which offer better performance as well improve the robustness in one or more aspects of the original DRLBP.

This histogram effectively has a description of the face on three different levels of locality: the DRLBP labels for the histogram contain information about the patterns on a pixel-level, the labels are summed over a small region to produce information on a regional level and the regional histograms are concatenated to build a global description of the face .It should be noted that when using the histogram based methods the regions do not need to be rectangular. It can be circular or any other. Neither do they need to be of the same size or shape, nor have to cover the whole image. It is also possible to have partially overlapping regions. Using a circular neighbourhood and bilinear interpolating values at non-integer pixel coordinates allow any radius and number of pixels in the neighbourhood. The gray scale variance of the local neighbourhood can be used as the complementary contrast measure. In the following, the notation (P,R) will be used for pixel neighbourhoods which mean P sampling points on a circle of radius of R. Another extension to the original operator is the definition of so called *uniform patterns*, which can be used to reduce the length of the feature vector and implement a simple rotation-invariant descriptor. This extension was inspired by the fact that some binary patterns occur more commonly in texture images than others. A local binary pattern is called uniform if the binary pattern contains at most two bitwise transitions from 0 to 1 or vice versa when the bit pattern is traversed circularly. It summarizes local grey-level structure.

In this method it is only essential to generate DRLBP for particular pixel of face image. For this purpose we are using Gabor filter first and then we are going for DRLBP. Gabor filter extracts the local image features efficiently. On basis of these features binary face template is produced. This binary face template explains the variation of local texture, which is robust against facial variation. Only for this reason we have used Gabor filter prior to the local binary pattern.

B. Gabor Filter

Using Gabor filter textual features are extracted and convert it into binary face template. And it is used to remove noise from the extracted image. Gabor filter improves the recognition rate. It is a linear filter used for edge detection. Gabor filter is a band pass filter. Frequency and orientation of Gabor filter are similar to those of human visual system. This filter is found efficient for textual representation and discrimination.

Here 2D Gabor filter $\psi f,\theta$ (x,y) is represented as a complex sinusoidal signal. And it is modulated by a Gaussian Kernel function. Where n=1, 2…pp En and p is the orientation.

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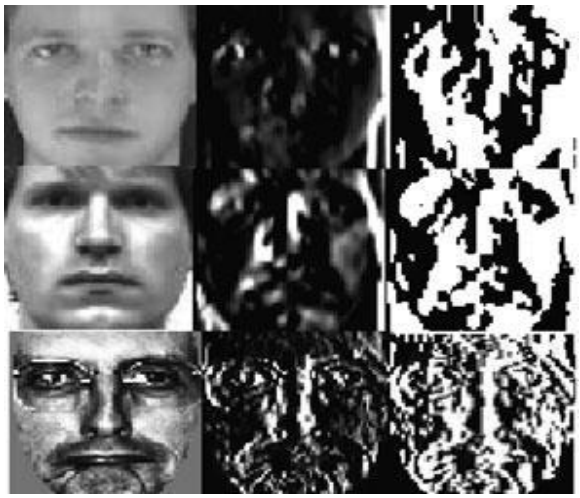
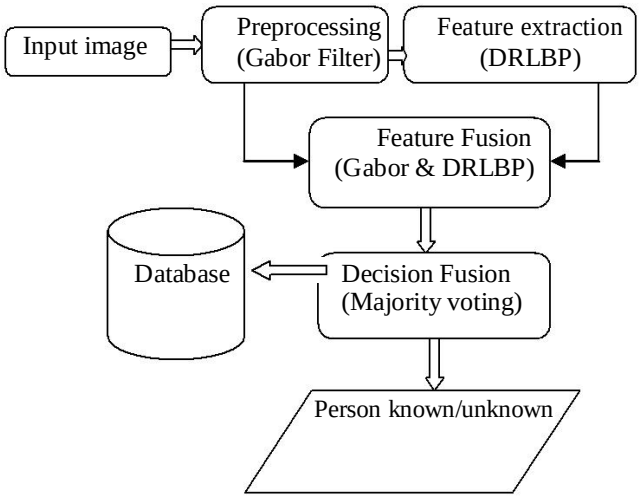


Fig. 1.1 The *first column* shows sample faces FERET datasets. The *second column* shows the response of the Gabor filter. The Gabor filter features-based generated binary face templates are shown in the *third column.*

The Gabor filter-based selected region of a face gives more unique information about that face. Hence there is no variation in the performance due to the missing pixels. So we probably get a good matching score with less computation overhead. Similar to LBP the feature extraction with this approach is also a straightforward (real-time) process. So there is no need for training.

II. PROPOSED APPROACH

Here we are using mainly two techniques. They are local texture based face recognition using Gabor filter and Discriminative Robust local binary pattern. First the facial features are extracted by using discrete cosine transformation.
And then we proceed with Gabor filter and Discriminative Robust LBP.



Block diagram for the proposed Gabor filter and DRLBP based face recognition system.

A. Creation of face template using Gabor filter

Here first we perform convolution process of face image with Gabor filter and provides Gabor representation of face image. Let I(x, y) be the intensity coordinate (x, y) in a grey-scale image

Convolution of Gabor filter $\psi_{f,\theta}(x,y)$ is defined by, $g_{f,\theta}(X,Y) = I(X,Y) \otimes \psi_{f,\theta}(x,y)$
Where θ denotes convolution operator.

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Fig 2.1: Gabor Face Sum

The Gabor kernel filter representation is a complex function with real part R $\{g_{f,\theta}(x, y)\}$.
And imaginary part is given by $I\{g_{f,\theta}(x, y)\}$.
And finally we generate Binary Face Template from the real part of complex information,

BFT(X, Y) =1 if complex information>0
BFT(X, Y) =0 if complex information<=0.

B. Discriminative Robust local binary pattern

Normally Discriminative Robust Local Binary Pattern (DRLBP) is used to extract representative features from each facial image. DRLBP approach generates LBP for each pixel, which describes the face image. In this method it is only essential to generate LBP for particular pixel of face image. For this purpose we are using Gabor filter first and then we are going for DRLBP. Gabor filter extracts the local image features efficiently. On basis of these features binary face template is produced.

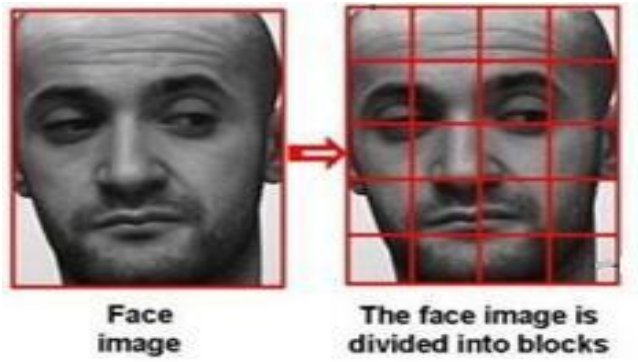

Fig 2.2: Face Description with DRLBP

This binary face template explains the variation of local texture, which is robust against facial variation..

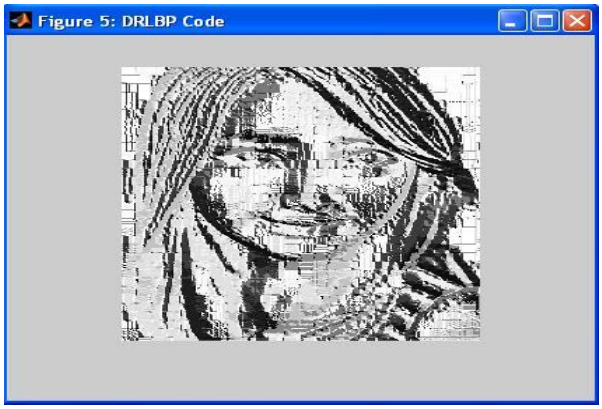

Fig 2.3: DRLBP face Recognition

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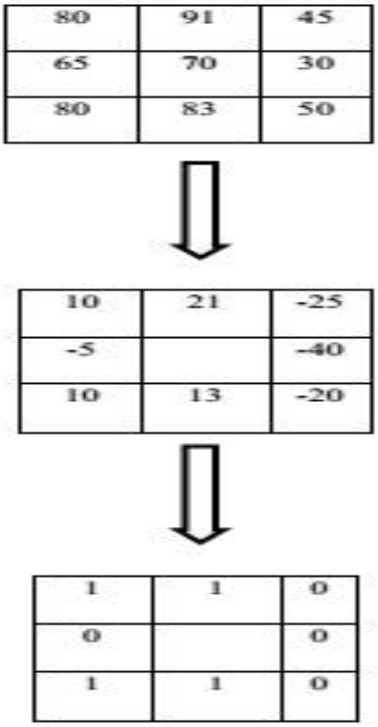
Only for this reason we have used Gabor filter prior to the local binary pattern This approach generates adaptive LBP only for pixel I(X, Y), which has a value corresponded to BFT(X, Y).Due to this we reduce the number of patterns. This Gabor filter-based face recognition gives more unique information about face. Since there is no variation in performance due to missing pixel. We get good matching score. This is a straight forward process and there is no need of training. The main advantage of using LBP is it is less sensitive to illumination variation, scaling and rotation. The LBP operator is generalized by allowing larger neighborhood radii r and different number of sampling points s. These parameters are indicated by the notation LBP (s,r). have considere1sampleper person .Here we will store each person's image in the FERET database and later which can be used for matching.FERET database is a standard database which is used for storing images.



And the resolution of image is128X128The results shows that the selective local texture features reduces the number of Discriminative Robust LBP into half compared to the existing LBP method. Due to this reduction the proposed method reduces the computation time considerably. First the facial features are extracted using discrete cosine transform. Then the textual features are extracted by using Gabor filter and converted into binary face template. And the binary face template acts like a mask to extract the local texture features using Discriminative Robust Local Binary Pattern

III. FEATURE AND DECISION FUSION BASED FACE RECOGNITION SYSTEM

Feature Level Fusion

Feature level fusion is used to extract the feature sets extracted from multiple data sources can be fused to create a new feature set to represent the individual.

Decision level Fusion

In Decision Fusion, When each matcher outputs its own class label (i.e., accept or reject in a verification system, or the identity of a user in an identification system), a single class label can be obtained by employing techniques such as majority voting or AND/OR rules.

IV. EXPERIMENTAL RESULTS

In this section we have evaluated the performance of selective local feature extraction based on Gabor filter and Discriminative Robust LBP on single sample per class. Here we test the proposed approach using FERET dataset for face recognition. The image is cropped and made into 64X64 from middle of location of eyes. Here we have considered the local features such contrast, brightness, length, breadth etc.

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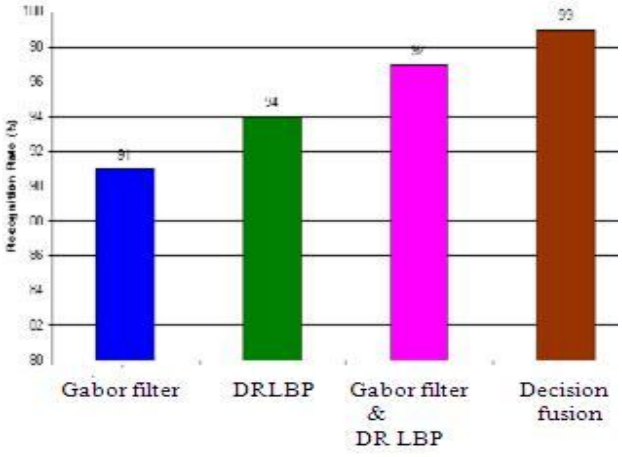
Here we

Fig 4.1: Result of Matching

Here FERET database is used to store the images for training and testing. Here in this method we had used single sample for each individual. Since we are using single sample, the space and time complexity have been reduced. Hence the performance had been improved. In future we can apply pose invariant face-recognition to improve performance with single sample per person.

V.PERFORMANCE MEASUREMENTS OF THE PROPOSED SYSTEM

Valid face database has been used to measure the performance of the proposed system where four different office environment facial images are exists for each person. 150 persons facial images are chosen to evaluate the performance where three faces are used for learning and other face is used for testing purpose. FERET database is a standard database which is used for storing images. And the resolution of image is 128X128The results show that the selective local texture features reduces the number of DRLBP into half compared to the existing LBP method. Due to this reduction the proposed method reduces the computation time considerably.



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CONCLUSION

In this paper, we had used local matching method for face recognition using Gabor filter and Discriminative Robust Local Binary Pattern. Then the textual features are extracted by using Gabor filter and converted into binary face template. And the binary face template acts like a mask to extract the local texture features using Discriminative Robust Local Binary Pattern. This method is efficient to face recognition since it is less sensitive to illumination and scaling. Feature level fusion is used. Finally the Decision is done by applying Euclidian distance matching and Decision Fusion. Here FERET database is used for face recognition. FERET database is used to store the images for training and testing. The reduction of 50% of computation time for the FERET dataset training is very considerable. This approach reduces the space complexity since we are using single sample per class. Here in this method we had used single sample for each individual. Since we are using single sample, the space and time complexity have been reduced. Hence the performance had been improved.

REFERENCES

[1] Turk M, Pentland A, Neurosci J (1991) Eigen faces for recognition. J Cogn Neurosci 3(1):71–86

[2] Ojala T, PietikainenM, Harwood D (1996) A comparative study of texture measures with classification based on feature distributions. Pattern Recognit 29(1):51–59

[3] Belhumeur PN, Hespanha JP, Kriegman DJ (1997) Eigenfaces vs. Fisher faces: recognition using class specific linear projection.IEEE Trans Pattern Anal Mach Intell 19(7):711–720

[4] Etemad K, Chellappa R (1997) Discriminant analysis for recognition of human face images. J Opt Soc Am A 14(8):1724–1733

[5]Lawrence S, Lee Giles C, Tsoi A, Back A (1997) Face recognition: a convolutional neural-network approach. IEEE Trans Neural Netw 8(1):98–113

[6] Mika S, Ratsch G, Weston J, Scholkopf B, Muller KR (1999) Fisher discriminant analysis with kernels. In:Proceedings of Neural Networks for Signal Processing IX,pp 41–48

[7] Liu C, Wechsler H (2002) Gabor feature based classification using the enhanced Fisher linear discriminant model for face recognition. IEEE Trans Image Process11(4):467–476

[8] Chen S, Liu J, Zhou ZH (2004) Making FLDA applicable to face recognition with one sample per person. Pattern Recognition 37(7):1553–1555

[9] He X, Yan X, Hu Y, Niyogi P, Zhang H (2005) Face recognition using Laplacian faces. IEEE Trans Pattern Anal Mach Intell 27(3):328–340

[10] Tan X, Chen S, Zhou ZH, Zhang F (2005) recognizing partially occluded, and expression variant faces from single training image per person with SOM and soft k-NN ensemble. IEEE Trans Neural Netw 16(4):875–886

[11] Ahonen T, Hadid A, Pietikainen M (2006) Face description with Local Binary Patterns: application to face recognition.IEEE Trans Pattern Anal Mach Intell 28(12):2037– 2041

[12] Tan X, Chen S, Zhou ZH, Zhang F (2006) Face recognition from a single image per person: a survey. Pattern Recognition 39(1):1725–1745

[13] Xiang C, Fan AX, Lee HT (2006) Face recognition using recursive fisher linear discriminant. IEEE Trans Image Process 15(8):2097–2105

[14] Ojala T, Pietikainen M, Maenpaa T (2010) Multiresolution grayscale and rotation invariant texture classification with local binary patterns. IEEE Trans Pattern Anal Mach Intell 24(7):971–987

[15] K.Jaya Priya, R.S Rajesh (2011) Selective local texture feature based face recognition with single sample per class. Springler.

[16] Abdallah Mohamed1, 2, and Roman Yampolskiy1, Face Recognition Based on Wavelet Transform and Adaptive Local Binary Pattern.

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