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Hybrid Approach for Face Recognition Using DWT and LBP

Pawanpreet Kaur Harra
Computer Science and Engineering
Baba Banda Singh Bahadur Engineering College
Fatehgarh Sahib, Punjab, India.
pawanhara807@gmail.com

Deepak Aggarwal
Computer Science and Engineering
Baba Banda Singh Bahadur Engineering College
Fatehgarh Sahib, Punjab, India.
deepak.aggarwal@bbsbec.ac.in

Abstract— Authentication of individuals plays a vital role to check intrusions in any online digital system. Most commonly and securely used techniques are biometric fingerprint reader and face recognition. Face recognition is the process of identification of individuals by their facial images, as faces are rarely matched. Face recognition technique merely considering test images and compare this with number of trained images stored in database and then conclude whether the test images matches with any trained images. In this paper we have discussed two hybrid techniques local binary pattern (LBP) and Discrete Wavelet Transform (DWT) for face images to extract feature stored in database by applying principal component analysis for fusion and same process is done for test images. Then K-nearest neighbor (KNN) classifier is used to classify images and measure the accuracy. Our proposed model achieved 95% accuracy. The aim of this paper is to develop a robust method for face recognition and classification of individuals to improve the recognition rate, efficiency of the system and for lesser complexity.

Keywords- *Face recognition, Local Binary Pattern(LBP), Discrete Wavelet Transform (DWT), Principal component analysis (PCA), K-NN classifier.*

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I. INTRODUCTION

Biometric structures have increasingly turning into vital tool in the information and public security domains. Biometric offer the identification based on the analysis of physical or behavioural modalities of the human body. Numerous features have been used to understand the human identity which consists of fingerprint, voice, iris, palm-print, retina, or signature. [1].

Face recognition is a form of biometric application that will automatically verify or identify an individual in a digital image or a video source by comparing and analyzing the styles in the database and it is also a non-intrusive technique [2]. Face recognition has two important features: identity and verification. Verification is a manner of comparing the face image with the given face image template and gives true or false selection. Identification is the procedure which compares the face image with the entire face image template inside the database and produces a ranked list of matches. We use the face recognition because there is no physical interaction needed. It provides excessive accuracy. In face recognition professionals are not required to interpret the recognition effects. [3] It works on current hardware configurations and presents passive identification. Face recognition has various programs over numerous industrial, security, surveillance, law enforcement system consisting of authenticated access control, automobile driver alertness recognition, human computer interaction, robot-version etc. some of the difficult situations [4] might also faced in face recognition due to a few adjustments in pose , tilt, background-complexity, lighting and expression variance.

In this paper we use two hybrid techniques for face recognition to extract features which are DWT and LBP. Discrete wavelet transformation (DWT) which disintegrate an image into four sub-bands and local binary pattern which is an essential texture descriptors afterword's fusion is done by using principal component analysis which uses an eigen value to fuse an image then accuracy is calculated using k-NN classifier.

This paper is organized as follows feature extraction methods are discussed in Section II. Section III deals with literature review, the purposed methodology is included in section IV. Computational results are performed which is explained in Section V. The conclusion is drawn from the experimental results and presented in Section VI.

II. FEATURE EXTRACTION METHODS

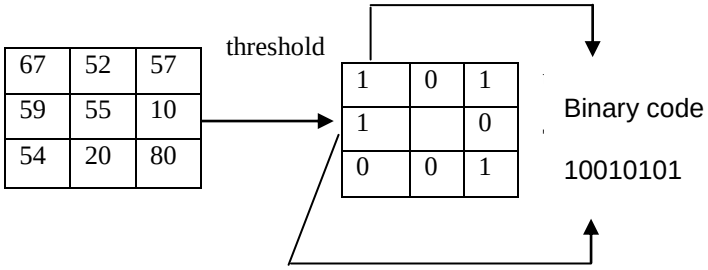
In this paper following feature extraction methods are used namely, Local binary pattern, Discrete Wavelet transformation, Principal component analysis and K-Nearest Neighbor.

A. Local Binary Pattern (LBP)

Local Binary pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image through thresholding the neighborhood of each pixel and considers the result as a binary range. As of its discriminative power and computational simplicity, LBP texture operator has become a famous technique in various applications. [5] It could be visible as a unifying method to the traditionally divergent statistical and structural model of texture analysis. Perhaps the

most critical assets of the LBP operator in real-world programs is its robustness to monotonic gray-scale modifications caused, as an instance, through illumination variations. Another important property is its computational simplicity, which makes it possible to analyze images in challenging real-time settings.

In this technique the LBP of a pixel is produced by thresholding the 3X3 neighborhood of each pixel value with the center pixel's value so that the centre point is considered as the threshold. All the other neighbour are assigned value 1 or 0 depending whether the point has greater or lesser value than the threshold value.[6] The binary pattern obtained by the technique is used to get a decimal value. That number describes as a local pattern.



$$LBP(P,R) = \sum_{P=0}^{P-1} S(g_p - g_c)\, 2^P$$

where R is the radius and p is the number of neighborhood points on the circle.

$$S(x) = \begin{cases} 1 & \text{if } x \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

By assigning a binomial factor 2^P for each sign S(gp - gc) , we transform the above equation into a unique LBP.

B. Discrete Wavelet Transform (DWT)

Wavelet transform is one of the most popular equipment for image processing .It has been used in various applications for recognition, detection and compression purpose. The key reason for selecting wavelet transform is its complete theoretical skeleton, high flexibility and low computational complexity [7]. The main benefit of wavelet over other transformation strategies is that its temporal resolution, because it computes both frequency and location information.

Discrete Wavelet transform (DWT) is a commonly used feature extraction method. In Two-dimensional wavelet decomposition is executed on an image that uses a specific wavelet. 2D DWT is accomplished by applying 1D DWT on the rows than on the columns. It decomposes an image into 4 sub bands namely LL, LH, HL and HH which corresponds to approximate, horizontal, vertical and diagonal features respectively. Usually, HH is high frequency features which represent noise [8]. The variety of rows and columns in the sub bands is about 1/2 that of the actual image. The desired features are extracted from LL, LH and HL sub bands obtained with 2D DWT on the pre-processed image.

C. Principal Component Analysis (PCA)

PCA is an crucial approach that have been utilized in image recognition and compression. It is a statistical approach. The main purpose of PCA is to reduce the dimensionality of the data space or image space to the same intrinsic dimensionality of the feature space. PCA transforms a number of correlated variables into some of uncorrelated variables called principle components or eigen faces such that the primary eigen face has the maximum quantity of variance amongst images and the ultimate has least quantity of variance.[9] PCA can carry out prediction redundancy elimination ,statistics compression and function extraction etc . PCA is a classical technique which could do something within the linear domain such as signal processing ,system and control theory , image processing ,communication etc. Fusion process is performed within the PCA area through maintaining only those most effective features that include a significant amount of information. [10] PCA has the potential to carry out feature extraction , that capable of capture the most unique data components of samples and select the range of vital individuals from all feature components. It is also known as eigen faces technique, which extract the eigen values.

D. K-Nearest Neighbors (K-NN)

K-NN is a pattern type of method and it is broadly used classifier because of its simplicity and effectiveness. K-NN classifies images through a majority vote of its neighbours. So to form the distance matrix, the Euclidean distance between the testing image features and each training image feature is used. The summation value of the distance matrix is estimated and then increasingly sorted. The primary k elements are chosen in order for classifying the image in which the value of majority class is determined [11].It calculate the accuracy by using the following equation:

Accuracy= Correctly detected face images ⁄ Total no. of face images.

III. LITERATURE REVIEW

1) Eyupoglu et al. [12] discussed k-Nearest Neighbour (k-NN) in order to classify color face images. Firstly, the classification is performed using simplest k-NN classifier. After that Principal Component Analysis (PCA) and k-NN classifier are used together. Further, these two methods are implemented for different color space models and k values. Finally, the experimental outcomes are compared with each other.

2) Thamizharas et al. [13] introduced a Discrete Wavelet Transform technique used for pre-processing. The complexity was turned by reducing the size of the image to 1 by 4. Discrete Wavelet Transform was applied to face images and divided into four blocks and the energy of every block is calculated. Block energy is maximized and enhanced image was produced. K Means clustering algorithm was used to cluster the pixels in face image obtained from pre-processing step. Binary threshold was applied within the clusters. The

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overall performance of the proposed method was tested using Fuzzy K Nearest Neighbour classifier and face recognition accuracy rate was computed.

3) Prabin Jose et al. [14] proposed a new color face recognition (FR) method. The effectiveness of color information played an important role when face images were taken under strong variations in illumination, in addition with low spatial resolutions. The proposed method had 3 steps. In the first step, the input color image was converted into various color space models. In the second step eigen values and eigen vectors were extracted from each color space models. In the final step a nearest neighbour classifier was designed for classifying the face images based on the extracted features. The accuracy of proposed method was impressively better than the results of other FR methods over different FR challenges which include highly uncontrolled illumination, moderate pose variation, and small resolution face images.

4) Saleh et al. [6] presented two most popular face recognition methods that were discussed and compared using average image on Yale database. To lessen calculation complexity, all training and test images were converted into gray scale images. The whole face recognition process was divided into two parts face detection and face identification. For face detection part, Viola Jones face detection method was used out of several face detection methods. After face detection, face was cropped from the actual image to remove the background and the resolution was set as 150x150 pixels. Eigen faces and fisher faces methods were used for face identification part. Average images of subjects were used as training set to improve the accuracy of identification. Both methods are investigated using MATLAB to find the better performance under average image condition.

5) Liu, et al. [5] have evaluate the performance of 6 feature extraction methods, i.e., Local Binary Patterns, Histograms of Oriented Gradients, Scale Invariant Feature Transform, Speed-Up Robust Features, Fully Affine SIFT and Gabor features. Every feature was tested on 3 face databases of Yale, ORL and UMIST. The experimental recognition rate and matching time are given and compared to indicate different preferential features for different application conditions. ASIFT has the best result in recognition rate while SURF outperforms others in matching time.

IV. METHODOLOGY

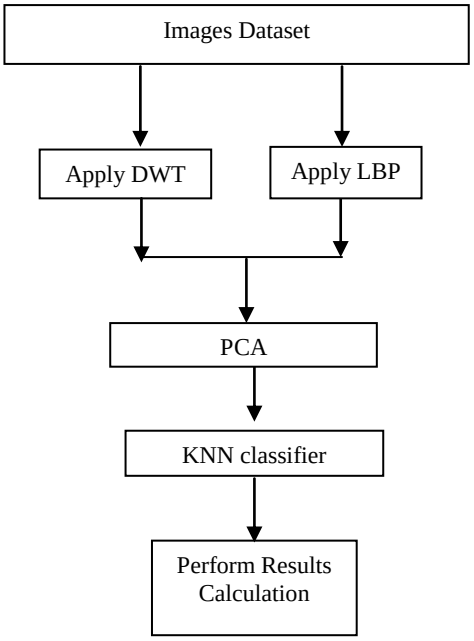

Fig.1. Feature Extraction on Face Images Using DWT and LBP

In this paper, features of face images are extracted using both local binary pattern technique (LBP) and discrete wavelet transformation (DWT). PCA is applied to fuse extracted features using eigen values. In the same way both training and testing is carried out and at last K-NN classifier is used to calculate the accuracy.

V.COMPUTATIONAL RESULTS

In this paper, firstly we train the system and fuse the extracted features and afterwards testing is performed in which extracted features are fused. K-NN is used for calculating the accuracy rate**.**

In this work, 14 face images are taken for training dataset and 21 face images for testing dataset.

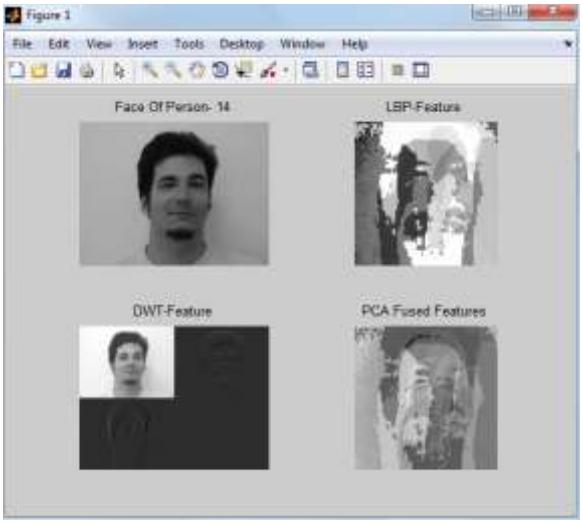

Fig.2. Training: Feature Extraction

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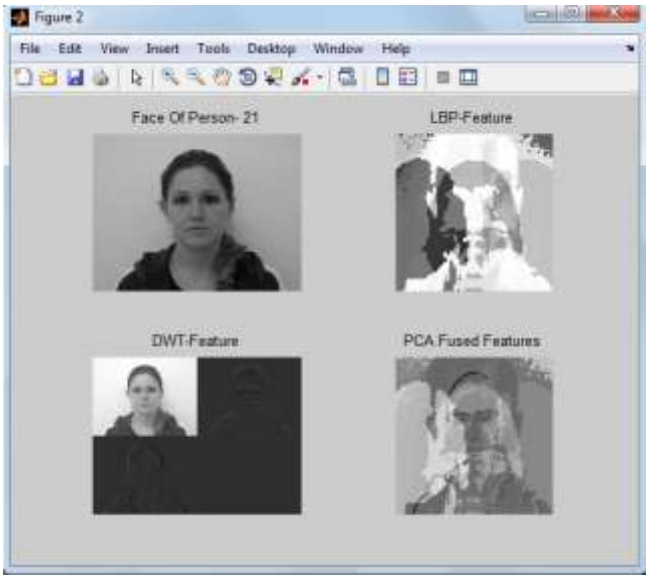

Fig.3. Testing: Feature Extraction

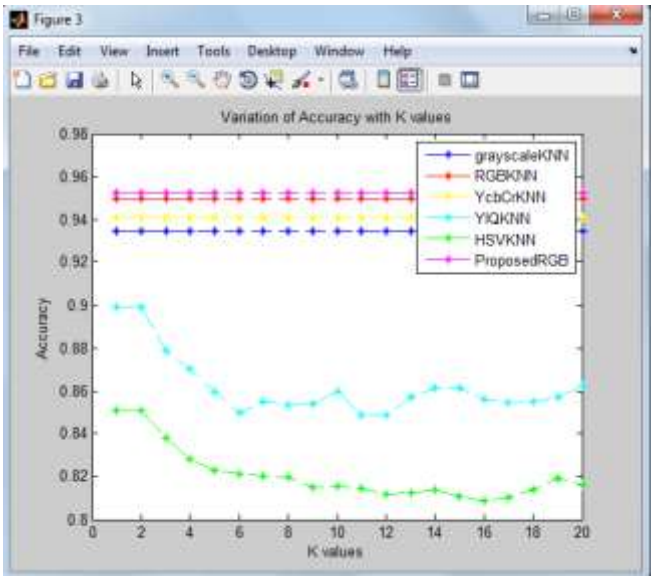

Fig.4. Accuracies of models in K-NN.

TABLE I. ACCURACIES OF K-NN FOR RGB MODEL AND K VALUES.

K VALUES	**PREVIOUS RGB VALUES**	**PROPOSED*RGB VALUES***
1.00	0.9495	0.9524
2.00	0.9495	0.9524
3.00	0.9495	0.9524
4.00	0.9495	0.9524
5.00	0.9495	0.9524
6.00	0.9495	0.9524
7.00	0.9495	0.9524
8.00	0.9495	0.9524
9.00	0.9495	0.9524
10.00	0.9495	0.9524
11.00	0.9495	0.9524
12.00	0.9495	0.9524
13.00	0.9495	0.9524
14.00	0.9495	0.9524
15.00	0.9495	0.9524
16.00	0.9495	0.9524
17.00	0.9495	0.9524
18.00	0.9495	0.9524
19.00	0.9495	0.9524
20.00	0.9495	0.9524

In Table I, the accuracy rate is increased by using hybrid technique than the previous value and change of k value does not affect the accuracy rate. As a result accuracy rate is 0.9524 which is greater than the traditional system. The proposed approach is implemented using the MATLAB platform.

VI. CONCLUSION

In this paper the hybrid system is designed for the face recognition. From the results obtained using hybrid technique it is concluded that the accuracy of the system is more as compared to the traditional approaches. The accuracy rate of the hybrid approach is higher as compared to the traditional systems. So this system is considered to be better and efficient. In future the enhancement can be done by using the hybrid classifiers for the classification so, that the accuracy of the system can be increased. 3D-DWT technique may also be applied for more enhanced feature extraction. The future options in the field of the recognition are on the analysis of the recent classification approaches available so that can provide much enhanced results for the field of security, authentication etc.

REFERENCES

[1] Benzaoui, A., Boukrouche, A., Doghmane, H., & Bourouba, H. "Face recognition using 1DLBP, DWT and SVM". *Control, Engineering & Information Technology, 3rd International Conference.* pp. 1-6. IEEE. 2015.

[2] Hegade, P. P., Nishanth, R., Manikantan, K., & Ramachandran, S. "DWT-based Face Recognition using Morphological Edge Detection as a pre-processing technique". *Nirma University International Conference.* pp. 1-6. IEEE. 2013

[3] Agrawal, A. K., & Singh, Y. N. "Evaluation of Face Recognition Methods in Unconstrained Environments". *Procedia Computer Science*. Volume 48. pp. 644-651. Elsevier. 2014.

[4] Akhil, M. B. S. S., Aashish, P., & Manikantan, K. "Feature selection using Binary-ABC algorithm for DWT-based face recognition". *Computational Intelligence and Computing Research, IEEE International Conference.* pp. 1-7. IEEE. 2015.

[5] Liu, Y., Li, C., Su, B., & Wang, H. "Evaluation of feature extraction methods for face recognition". *Computational Intelligence and Design, Sixth International Symposium.*Volume 2. pp. 313-316. IEEE. 2013.

[6] Saleh, S. A., Azam, S., Yeo, K. C., Shanmugam, B., &Kannoorpatti, K."An improved face recognition method using Local Binary Pattern method".*Intelligent Systems and Control, 11th International Conference.* pp. 112-118. IEEE. 2017.

[7] Akbar, S., Ahmad, A., Hayat, M., & Ali, F. ''Face Recognition Using Hybrid Feature Space in Conjunction with Support Vector Machine''. *J. Appl. Environ. Biol. Sci*, *5*(7), 28-36.2015.

[8] Jung, C., & Yin, J. "SQI-based illumination normalization for face recognition based on discrete wavelet transform". In *Image Processing, IEEE International Conference on* pp. 1664-1668. IEEE. 2016.

[9] Rao, M. K., & Swamy, K. V. "Face recognition using DWT and eigenvectors". *Emerging Technology Trends in Electronics, Communication and Networking (ET2ECN), 2012 1st International Conference.* pp. 1-4. IEEE. 2012.

[10] Mahmud, F., Khatun, M. T., Zuhori, S. T., Afroge, S., Aktar, M., & Pal, B. "Face recognition using Principle Component Analysis and Linear Discriminant Analysis". *Electrical Engineering and Information Communication Technology, International Conference.* pp. 1-4. IEEE. 2015.

[11] Nikan, S., & Ahmadi, M. "Effectiveness of various classification techniques on human face recognition". *High Performance Computing & Simulation (HPCS), International Conference.* pp. 651-655. IEEE. 2014.

[12] Can Eyupoglu" Implementation of Color Face Recognition Using PCA and *k*-NN Classifier".

[13] Ayyavoo, T., &Jayasudha, J. S. "Face recognition using enhanced energy of Discrete Wavelet Transform". *Control Communication and Computing, International Conference.* pp. 415-419. IEEE. 2013.

[14] Jose, J. P., Poornima, P., & Kumar, K. M. "A novel method for color face recognition using KNN classifier". *Computing, Communication and Applications, International Conference.*pp. 1-3. IEEE. 2012.

[15] Sharma, R., & Patterh, M. S. "A new pose invariant face recognition system using PCA and ANFIS". *Optik-International Journal for Light and Electron Optics*. Volume 126. Issue23. pp. 3483-3487. 2015.

[16] Vinay, A., Shekhar, V. S., Murthy, K. B., & Natarajan, S. " Face recognition using gabor wavelet features with PCA and KPCA-a comparative study". *Procedia Computer Science*, *57*, 650-659.2015.

[17] Ghasemzadeh, A., & Demirel, H. "Hyperspectral Face Recognition using 3D Discrete Wavelet Transform". IEEE. 2016.