Feature Extraction of Face Value Through Gray-Level Co-Occurence Matrix

S.Yamuna, S.Abirami

Abstract— **Human Face Recognition is hastily improving in day-to-day life. Digital Image Processing (DIP) is a rapidly evolving field with blooming applications inScience and Engineering. The accuracy of human face recognition system is mostly affected by varying lighting conditions. To overcome the illumination invariant problems and different poses and details, wavelet decomposition method was used. At various scales and frequencies the facial features are extracted by multi-resolution property of Discrete Wavelet Transform (DWTs). The wavelet sub bands are used to represent the well-lit face images. Fusion of match scores depends on low and high frequency which is based on the human face representation to improve the accuracy in varying lighting conditions. For obtaining better performance and accuracy in human face recognition under different illumination conditions, here this project contributes by using adaptive face recognition. Wavelet decomposition was performed to attain the image accuracy and efficiency. GLCM algorithm was enriched for calculating texture features of an image. For effective classification of different human faces, K-Nearest Neighbour classifier was used. The recognition rate of K-NN is 91%.**

Keywords— **Biometric, Face Recognition, GLCM, K-NN classifier.**

I. Introduction

Human Face Recognition (HFR) has become a world wide application in concern with the hotspot research. Owing to the need of information security [1] such as human identity authentication, to counter identity international terrorism, theft, logging the system, surveillance etc. face recognition plays a vital role. Recognition of human face is a challengeable task in an uncontrolled environment due to lighting conditions, poses such as looking in different angles, facial expressions like smiling, crying, closing eyes or mouth, opening the eyes or mouth and the details of faces such as wearing spectacles or without spectacles. Quality of an image is well-lit by the approximation of wavelet subband in luminance distortion.

This project contributes with wavelet decomposition in various levels by collecting 400 images as a dataset from AT&T "The Databases of faces" which is formerly called as Olivetti Research Laboratory (ORL) face database. Image taken as an input have high dimensionality, thus to reduce the dimension of an image, resizing method was proposed. K-NN Classifier was used to recognize the human face by calculating nearest neighbours through distance method.

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S.Yamuna is working as an Assistant Professor/CSE at SNS College of Engineering, Coimbatore. (e-mail: yamuna205@gmail.com).

S.Abirami is working as an Assistant Professor/S&H at SNS College of Technology, Coimbatore. (e-mail: abi_omega@yahoo.co.in).

II. Dataset collection from AT&T (ORL) Face Database

AT&T (ORL) face database is a collection of face image which consists of 40 subjects. Each 40 subjects contain different set of facial images; ten images in a count with different angles and in distinct background say illumination conditions [5]. 40 subjects are captured in various times with dissimilar poses (frontal image, side movements or changes in angle), facial expression (open/close eyes, amused/not smiling), and facial details (with spectacles/ without spectacles) [2].The dataset files of facial images are in PGM format. Moreover, each image size is 92x112 pixels and a grey level per pixel is256. An example set of subject is represented below in the Fig 1.

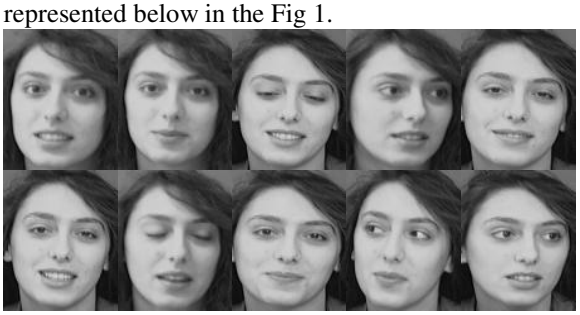

Fig.1. Sample example from AT&T (ORL) face database

III. Data Flow Diagram

The working process of face recognition dealt with three various stages as in the data flow diagram. The stages involved are as follows.

1) Pre-processing
2) Feature Extraction
3) Classifier

Pre-processing stage involve with the effective way of suppressing the unwanted distortion of image feature for further processing. In this paper, it involves with image resizing and decomposition of an image which is under illumination conditions [6, 7]. Once decomposition is completed the second stage, Feature Extraction will be involved with texture calculation of a data set by using GLCM algorithm. Classifier is an important part in the image processing. K-Nearest Neighbour plays a vital role in comparing the image with existing database to produce the resultant. The outcome enriches with the recognition rate of

face recognized .The matching method (EuclideanDistance) is performed to obtain the resultant in best of knowledge in concern with the efficiency and accuracy. These activities are processed under the environment of Matlab toolbox R2013a and Matlab toolbox 2007.

IV. PROPOSED SYSTEM

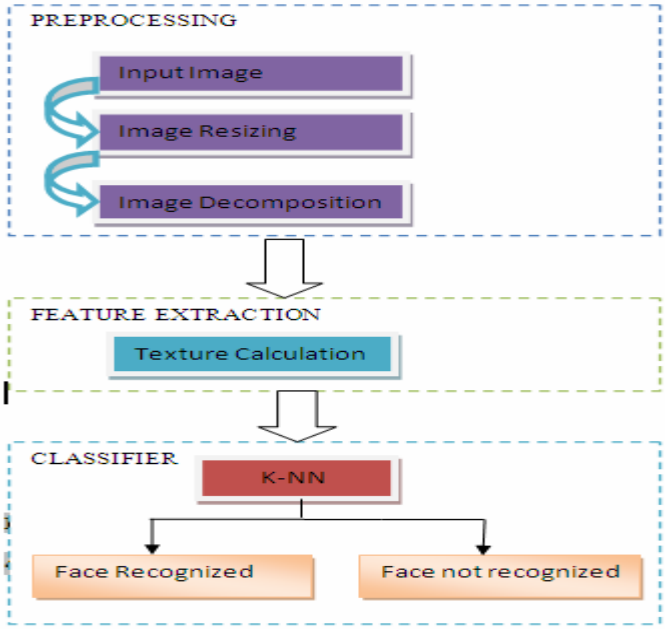

Fig.2. Data Flow of Working Process.

A. *Pre-processing*

Pre-processing stage is an initial stage which involves with the effective way of suppressing the unwanted distortion of image features for further processing. Pre-processing involves with the acquiring the image, resizing of the dataset images and decomposition of an image by using interpolation.

Input Face Image

The input images collected from the AT&T (ORL) face database is a collection of image which consists of 40 subjects with ten images of same person. 40 subjects are captured in various times with dissimilar poses such as looking in different angles, facial expression like smiling, crying, closing eyes or mouth, opening the eyes or mouth and facial details such as wearing spectacles or without spectacles [2].Each image is taken under the dark homogeneous background. The dataset files are in PGM format with 92x112 pixels and a grey level per pixel is 256. Input image from ORL Database is as follows in fig.3.

Fig. 3 Input images from ORL database

Image Resizing

The image acquired from the ORL database has high dimensions of 92*112 with 256 gray levels per pixel. By the method of resizing [3] the images are resized to 60*60 to have better and accurate feature extraction. The fig.4 represents the resized image.

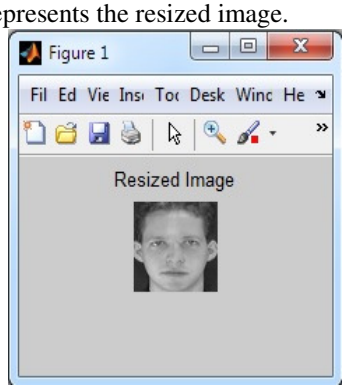

Fig.4 Image resizing

Image Decomposition

The image decomposition may be of various levels. Decomposition is nothing but the compression of an image or resizing of an image without affecting the quality of an image via various wavelets in different levels [4]. It may involve with distinct wavelets such as rbio, db, Gabor, and Haar and so on. In this paper, the contribution is endeavor with reverse biorthogonal spline wavelet [12] of series 3.1 and decomposition level is favoured at 5thlevel. Thus the original image sizes of 128*128 have reduced to the subband of 8*8 by wavelet decomposition, shown in the fig.5.

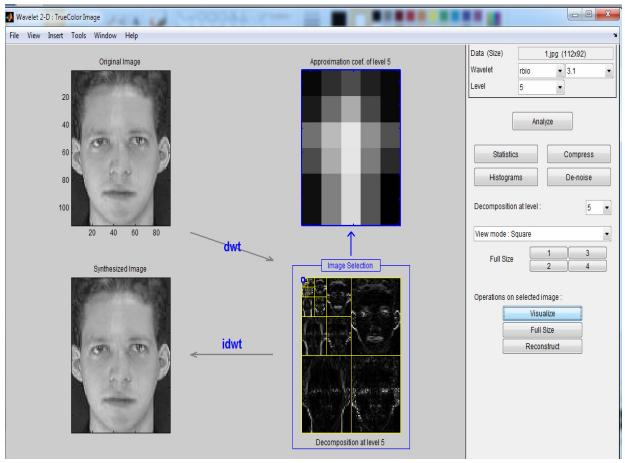

Fig.5 Decomposition of sample image by rbio at 5th level

The original facial image is decomposed to 8*8 [4]. Due to decomposition or compression of an image the size is varied but naturalness of the image makes the process efficiency. Biometric authentication of human face recognition endeavor with the need of facial dimensionality. Dimensionality is reduced for the better efficiency and performance of feature extraction.

B. Feature Extraction

Once the decomposition ends, the feature extraction begun. Wavelet decomposition dealt in extracting the features for better processing. Hereby this paper contributes with the working of GLCM algorithm (i.e.,) Gray Level Co-occurrences Matrix. GLCM algorithm commonly used to extract the feature values such as energy, entropy, contrast, dissimilarity, maximum probability, inverse difference moment [13]. In our paper, the algorithm of GLCM extracted the texture features of ORL database. The features extracted from the Gray Level Co-occurrence Matrix are typically different for all the images.

GLCM Algorithm

One of the simplest approaches for describing texture is to uses statistical moments of the intensity histogram of an image or region called Gray-Level Co-occurrence Matrix texture [12]. Using histograms in calculation will result in measures of texture that carry only information about distribution of intensities, but not about the relative position of pixels with respect to each other in that texture[14]. Table.1 represents the texture value of an image through GLCM algorithm

Table.1 Texture Values

Sample Image	Texture Values
Image 1	7.357624
Image 2	6.059290
Image 3	1.773115

C. Classifier

Once the values are extracted, the classifier role begins. Classification algorithm typically employ two phases of processing: training and testing. In the initial training phases, characteristic properties of typical image features are isolated and, based on these, a unique description of each classification category is created.

K-NN

K-NN classification [8] is one among the most fundamental and simple classification methods. It has physically powerful consistency results with special case of variable bandwidth and kernel density “balloon” estimator. These classifiers are class of non-parametric methods which are used for pattern recognition or statistical classification. K-NN classification classifies based on the similarity to instances in the training data. K-nearest neighbour classification was developed from the need to perform discriminant analysis when reliable parametric estimates of probability densities are unknown or difficult to determine. The confusion matrix [15] used for tabulating test sample class predictions during testing and is denoted as C and has its own dimensions.

Euclidean Distance

Euclidean distance or metric is the distance between two different or similar points which measures with a ruler, and it is represented by the Pythagorean formula. Euclidean Distance Transform (EDT) is essential for the rotation invariance property with time consuming. In most cases EDT are not efficient and also it is tedious to implement and understand. Cuisenaire and Macq [9] proposed a propagation of using bucket sorting and multiple neighbourhoods with fast EDT. EDT is achieved correctly and efficiently by the proposal of a size-independent two-scan algorithm. Euclidean distances are as follows in equation 3.

Euclidean Distance Formula:

d=sqrt(sum((hn1-hn2)).^2)) (3)

Precision

In the field of information retrieval, [10] Precision is the fraction of retrieved values that are relevant to the find. Precision takes all retrieved values into account, but it can also be evaluated at a given cut-off rank, considering only the topmost result returned by the system. This type of measure is called as precision. Equation of precision is at eqn.4.

Precision=(relevant value + retrieved value)/retrieved value (4)

Recall

Recall in information retrieval is the fraction of the documents that are relevant to the query that are successfully retrieved. In binary classification, recall is called sensitivity. It is trivial to achieve recall of 100% by returning all values in response to query. Recall equation is defined in the equation 5.

Recall=(relevant value + retrieved value)/relevant value (5)

FMeasure

A measure that combines precision and recall is the harmonic mean of precision and recall, the traditional F-Measure or balanced F-Scores. Eqnuation. 6 represents the formulae of FMeasure.

FMeasure=(precision * recall)/(precision + recall) (6)

Recognition Rate

The accuracy of a facial recognition can be calculated by the ratio of total number of corrected matches to the total number of testing images. The testing image or the probe image plays a crucial role in the accuracy detection. The recognition accuracy is as follows.

Recognition Accuracy = (no. of corrected matches/total no. of. testing images)*/100 (7)

Accuracy of facial recognition is an essential part in the analysis process of image processing. The resultant image will be the lowest distance (i.e.,) highest similarity [3]. Table.2 represents the comparison result of various sets of an image by using K-NN classifier. The comparison result shows about the different outcomes obtained for recall, precision, elapsed time, F measures and recognition rate [11] during the different sets of images.

Table.2 Comparison result

Class	Recall	Precision	Elapsed time(sec)	Fmeasure	Recognition rate
5	100	100	0.01	100	100
10	100	100	0.00	100	100
15	98.66	98.88	0.02	95.72	98.66
20	94.00	94.90	0.01	94.40	94.00
25	94.40	95.40	0.22	94.92	94.40
30	92.90	93.51	0.74	92.90	92.90
35	91.92	92.13	0.09	92.41	91.42
40	91.0	92.46	0.03	91.84	91.00

V. CONCLUSION

Human face recognition under illumination conditions are enriched with the technique of DWT. The challenges of human face recognition in the presence of extreme variation in lighting conditions and poses. Wavelet decomposition of fifth level is applied with rbio 3.1 for all the dataset collected. In the pre-processing stage, the images are resized to reduce the high dimensionality. In concern with the image decomposition the pixel values of the images are decomposed to have better feature extraction. The image was decomposed by wavelet transform. Here, the image was decomposed from 128*128 to the fifth level of 8*8. Image was decomposed by applying the reverse biorthogonal spline wavelet of series 3.1. Once the images are decomposed, feature extraction was deliberated through Gray Level Co-occurence Matrix by calculating the texture values for all images. The Classifier stage will be the final stage. K-Nearest Neighbour classifier classifies the image by calculating the nearest distance value by the Euclidean distance. Training and testing of images were performed to find the recognition rate of human faces. The confusion matrix was also deliberated to obtain the recognition rate of human faces by calculating precision, recall and FMeasure. By the calculated values, the accuracy and the efficiency were found. The human faces were classified based on the criteria that belong to the particular classes. Thus the human face is recognized in an effective and efficiency manner. The recognition rate of human face by K-NN classifier was 91%.The code is completely written in matlab 2010 and tested in Windows 7 operational system.

VI. FUTURE ENCHANCEMENTS

The present system was contributed with the feature extraction by calculating the texture values of ORL dataset by using algorithm called GLCM. K-Nearest Neighbour classifier was used to recognizing the human faces by the help of confusion matrix. Few mismatches were found. Human Face Recognition will be accurate and efficient only if time consumption is better. To make the work to be well-organized, PCA, LBP were taken into the account for enhancing in future cases. For better efficiency and accuracy Radial Basis Function (RBF) and Artificial Neural Network (ANN) will be chosen instead of K-NN classifier for further processing.

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