Efficient Gender Classification Using DCT and DWT

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Abstract-- In this paper, we proposed an efficient technique for classification of gender. Improvement in the existing gender classification methods will result in high performance. The dataset has facial images with similar appearance across different classes and varying appearance within a class. Also, the images are of different poses under varying lighting conditions. First, the face part of the image is detected using Viola and Jones face detection technique [1]. Discrete Cosine Transform (DCT) is used for feature extraction, K-Nearest neighbor (KNN) is used for classification. Here the Discrete Wavelet transform (DWT) and Chirp Z-Transform (CZT) [17] has given the efficient classification results when compared to DCT.

Key Words-- Classification, Histogram equalization, Gender classification, Face detection, Feature selection, DCT, DWT, CZT, KNN.

I. INTRODUCTION

Developing a system for classification of gender is a difficult task because of considerable similarities among different classes and also due to a large intra-class variation. Gender classification problem is an active research area which has attracted a great deal of attention recently. It is a challenging pattern recognition problem. The Gender classification problem involves a process of determining the gender of a subject from face images. The face images analysis plays an important role in computer vision. This analysis has been successfully used in many applications. Like Biometrics and robotic-human interaction. Gender classification systems do not offer same level of performance and accuracy. The key components here are feature extraction and classification. Architecture of Gender classifier is shown in Figure.1.

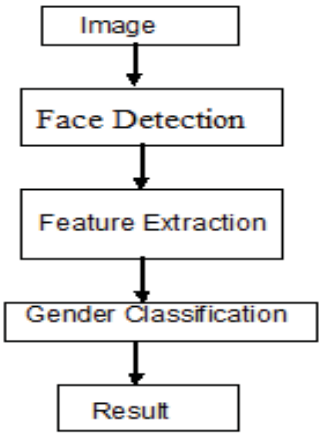


Figure 1.Architecture of Gender Classification

II.RELATED WORK

Here the couple of works carried out in this direction, but search for improved gender classification is still going on. Shakhnarovich et al. combined the cascaded face detector by Viola and Jones [1] with threshold Adaboost (Freund and Schapire, 1997) trained classifiers for gender and ethnicity classification. Baback et al. (2005) [5] applied the SVMs to gender classification with low-resolution thumbnail faces (21-by-12 pixels) processed from 1,755 images. Tolba et al [6] has proposed gender classification using two techniques with different neural network classifiers i.e. Learning Vector Quantization (LVQ) and Radial Basis Functions (RBF). The problem with any neural network method is that they are computationally expensive.

ZiyiXu, Li Lu and Pengfei Shi, A Hybrid Approach to Gender Classification from Face Images.Zhiguang YANG1, Ming LI2, Haizhou AI1, An Experimental Study on Automatic Face Gender Classification.Zehang Sun, Xiaojing Yuan, and George BebisSushil J. Louis, Neural-Network-Based Gender ClassificationUsing Genetic Search for Eigen-Feature Selection.GregoryShakhnarovich Paul A. Viola BabackMoghaddam, A Unified Learning Framework for Real Time Face Detection and Classification.

A. Majid et.al [11] uses SVM classifiers with different kernel functions for training and combination is performed using Genetic Programming (GP). They proved there Optimal Composite Classifier outperform individual SVM classifiers. They claim that combining the different kernel functions can explore feature space efficiently and can select optimal kernel function for SVM through GP. Maximum performance achieved was 98.8% after 60 generations with 1000 features. They have optimized classifiers input parameters using GP. Genetic algorithm is an efficient evolutionary optimization tool to solve complex problems but no matter how good the classifier is its wrong combinations can lead to undesirable results [12].

N.P.Costen, et.al [13] in their paper uses SVM for feature selection and maximization of classification margin. They have used 300 images of different genders of Japanese individuals with age between 15-60 years and with fixed frontal poses. PCA is used for feature selection which is optimized using SVM. They have compared their results with other existing methods and show comparable performance of their method. The whole approach is dependent on a single regularization parameter θ. Success of this method is highly dependent on the appropriate selection of θ because its incorrect value leads to high error rate.

Sun Z. et.al [14] applied PCA to reduce dimension of image as a feature vector. Genetic algorithm (GA) is used to select subset features from reduced dimension which are true representation of gender. They have compared their results with four different classifiers: linear discriminate analysis (LDA), support vector machines (SVM), neural network (NN), and Bayesian decision making and observed that SVM outperform all others. They achieve the accuracy of 91.1%, 82.3%, 85.8, and 77.62 using SVM, NN, LDA and Bayes respectively.

F. Scalzo, et.al [10] proposed a new Feature Fusion Hierarchical (FFH) method for gender classification using Genetic algorithm. FFH model is two levels model. In first level, Gabor and Laplace features are extracted and used as input to feature fusion level. In second level, classifiers fusion uses output of future fusion level to produce a result.

This paper is organized as follows. The proposed method is explained in section III and end experimental results are presented in section IV. Conclusion can be given in section V.

III. PROPOSED METHOD

Gender classification consists of three main steps: Face detection [1], Feature selection/extraction [2], and Classification. There are two phases in classification training and classification phases. In training phase, from a given set of training images the features are extracted and used to train the system using the K-nearest neighbor classifier. In classification phase a given test image is segmented and then the features are extracted for classification. These features are queried to K-nearest neighbor classifier [15] to label the classification image. The block diagram of the proposed method is given in Figure 2

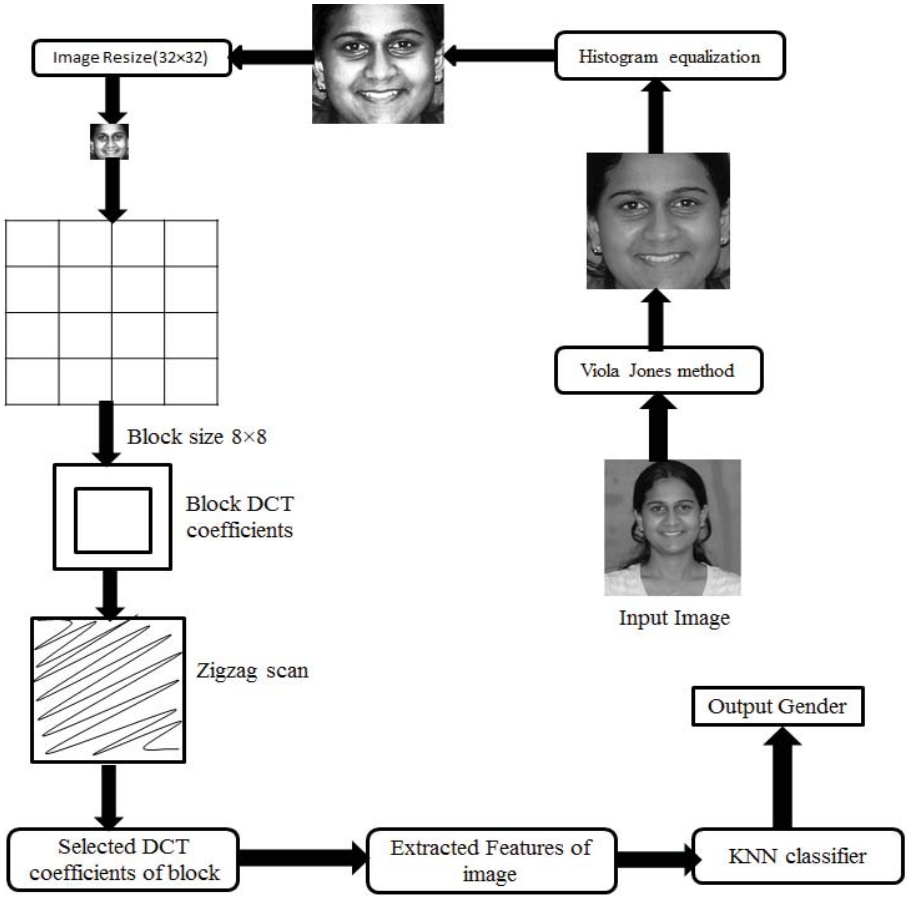


Figure 2.Block diagram of the proposed method

A. FACE DETECTION

In order to exploit uniqueness of faces in gender recognition, the first step is to detect and localise those faces in the images. This is the task achieved by face detection systems. As face detection is one of popular research areas, many algorithms have been proposed for it. Most of them are based on the same idea considering the face detection as a binary classification task [4]. That is, given a part of image, the task is to decide whether it is a face or not. This is achieved by first transforming the given region into features and then using classifier trained on example images to decide if these features represent a human face.

As faces can appear in various locations and can also show themselves in various sizes, often, a window-sliding technique is also employed. The idea is to have the classifier classifying the portions of an image, at all location and scales, as face or non-face. An input facial image is passed to face detector to extract face from the image, Viola and Jones [1] face detection method is used for this purpose.

B. FEATURE EXTRACTION

i) Discrete Cosine Transform (DCT)

Feature extraction is the process of defining a set of features, or image characteristics, which will most efficiently or meaningfully represent the information that is important for analysis and classification. Discrete Cosine Transform (DCT) [2], [3] is a well-known transformation technique used in image compression

applications. DCT can be used for dimension reduction. DCT coefficients are then sorted according to zigzag scan order.

$$D(u,v) = \frac{2}{\sqrt{MN}} a(u)a(v) \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} I(m,n) \cdots$$

$$\cos\left[\frac{(2m+1)u\pi}{2M}\right] \cos\left[\frac{(2n+1)v\pi}{2N}\right] \qquad (1)$$

Where $a(u) = \begin{cases} \sqrt{1/M} & \text{for } u = 0 \\ \sqrt{2/M} & \text{for } u = 1,2,\ldots,N-1 \end{cases}$

And $a(v) = \begin{cases} \sqrt{1/N} & \text{for } v = 0 \\ \sqrt{2/N} & \text{for } v = 1,2,\ldots,N-1 \end{cases}$

A gray image is expressed by f(x,y) of size N× N is defined according to equation (1). The Zigzag scan order of DCT coefficients is shown in Figure3

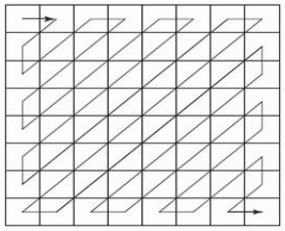
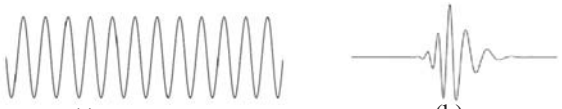


Figure 3. Zigzag scan of DCT coefficients

ii) Discrete Wavelet Transform (DWT)

The transform of a signal is just another form of representing the signal. It does not change the information content present in the signal. The Wavelet Transform provides a time-frequency representation of the signal. It was developed to overcome the short coming of the Short Time Fourier Transform (STFT), which can also be used to analyze non-stationary signals. While STFT gives a constant resolution at all frequencies, the Wavelet Transform uses multi-resolution technique by which different frequencies are analyzed with different resolutions.

A wave is an oscillating function of time or space and is periodic. In contrast, wavelets are localized waves. They have their energy concentrated in time or space and are suited to analysis of transient signals. While Fourier Transform and STFT use waves to analyze signals, the Wavelet Transform uses wavelets of finite energy.



(a) (b)

Figure 4: (a) a Wave and (b) a Wavelet.

A wave and Wavelet are shown in Figure 4.

iii) Chirp Z-Transform (CZT)

This algorithm Chirp Z-transform, by using this we can efficiently evaluate the z-transform at M points in the z-plane which lie on circular or spiral contours beginning at any arbitrary point in the z-plane. The angular spacing of the points is an arbitrary constant, and M and N are arbitrary integers.

The algorithm is based on the fact that the values of the z-transform on a circular or spiral contour can be expressed as a discrete convolution. Thus one can use well-known high-speed convolution techniques to evaluate the transform efficiently. For M and N moderately large, the computation time is roughly proportional to (N+M) log (N+M) as opposed to being proportional to N-M for direct evaluation of the z-transform at M points.

C. CLASSIFICATION

KNN (k-nearest neighbor) is a supervised learning classifier. For 1-NN we assign test sample to the class of its closest neighbor, and for KNN [15] we assign the majority class of its K closest neighbors where K parameter is number of neighbors. It is usual to use the Euclidean distance to find closest neighbors, though other distance measures such as the Manhattan distance could in principle be used instead.

IV. EXPERIMENTAL RESULTS

In this paper the images are grabbed with similar appearance but with different poses are shown in figure 5. By using viola-jones method the face can be detected that is shown in figure 6. And the Classification of input image is as shown in Figure 7. These are the results by using discrete cosine transform. The classification of the images is measured by using Manhattan distance.

Figure 5. Input Images with different poses

Figure 6. Face detection for given input images.

Figure 7. Classification of input images

In figure 8, the face detection can be done from wavelet images for better performance. The feature extraction can be done by using DWT and the classification is performed and results are shown in Figure 9.

Figure 8. Face detection from wavelet images

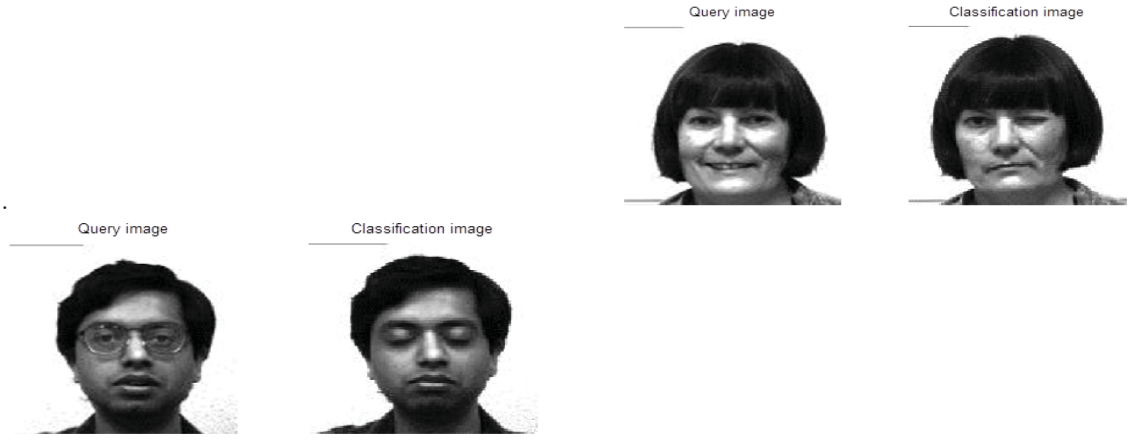
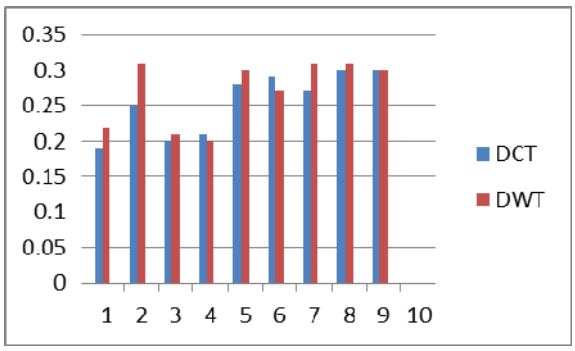


Figure 9. Classification of images when DWT is applied.

Graph



From the graph it is observed that the more features can be extracted in DWT as compared to DCT.

V. CONCLUSION

In this paper, the problem of gender classification is implemented by applying DCT and DWT feature extraction techniques. The main objective is better to extract the features then it is easy to classify images. From DWT method the more features can be extracted as compared to DCT. So, the better classification had done with DWT features. For getting of better results Multiwavelet Transform can use instead of classification it is better

to do in future work

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