Novel Gabor – DCT Feature Extraction Techniques for Face Recognition

Anushi Prabhakar, Kirti Chaudhary, Harshita, Sandeep k.Gupta

***Abstract*— In methodology of face recognition includes the phases of dataset preparation, image pre-processing, feature extraction and classification. In which Feature Extraction step in face recognition is a vital role for accuracy of recognition. There are so many feature extraction technique developed through research but no one technique is sufficient for extracting all the feature of a Face image so that 100% can be achieved. So there are a need of how to increases the recognition rate in face recognition. The research issue of Face Recognition is to select the features which are required to represent a Face Recognition. In this paper we presented new features extraction techniques for face recognition using Discrete Cosine Transform and Gabor Filter.**

***Index Terms*—Face Recognition, DCT, Gabor Filter.**

INTRODUCTION

Human face is a very useful and powerful source of communicative information about human identification. Auto Face Recognition is used for identification of persons in crime diagnosis, person identification. Computer vision based approaches to face analysis discriminate among a large set of facial images of persons. Discrete transform is used for reduction of data redundancy as the primary step of holistic approaches [1]. Discrete cosine transform has strong data decorrelation and there are fast algorithms for DCT [2]. These properties make DCT useful in face recognition in the area of pattern recognition [3]. Ramasubramanian and Venkatesh used a combination of the DCT, PCA and the characteristics of the Human Visual System for encoding and recognition of faces [4]. In [5] To decrease the effect of illumination variation the first three low frequency coefficients or the DC have been truncated. In face recognition Different Channels of Gabor Filter have different Distribution and reasonable combination of these features can improve the performance of face Recognition [6]. Gabor Filter is based on on spatial locality, scale and orientation on facial images. These images are most suitable for Face Recognition and Face Recognition because these are robust to variations, expression and scale [7].

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Related Work

a) **Discrete Cosine Transform feature Extraction**

The 2D Discrete cosine transform of an M*N image is defined as following[8]:-

$$f(x,y) = \sum_{x=0}^{M-1}\sum_{y=0}^{N-1} \alpha(u)\alpha(v)F(u,v)\cos\left[\frac{\pi(2x+1)u}{2M}\right]\cos\left[\frac{\pi(2y+1)v}{2N}\right] \quad \ldots\ldots\ldots\ldots\ldots(1)$$

$$where\ u = 0,1,2,\ldots\ldots\ldots\ldots\ldots M-1\ and\ v = 0,1,2,\ldots\ldots\ldots\ldots\ldots N-1$$

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In both equations (4) and (5) α (u) and $\alpha(v)$ is defined as:

$$\alpha(u) and\ \alpha(v) = \begin{cases} \sqrt{\frac{1}{M}} & for\ u,v = 0 \\ \sqrt{\frac{2}{M}} & for\ u,v \neq 0 \end{cases} \quad (2)$$

In DCT matrix each element represents frequency of an image. Low frequency components are at the top left corner of the matrix contains useful information or pattern about the image and high frequency components are at the bottom right corner of the matrix which represents the redundancy & noise in image. To select the coefficient, static Coefficient selection approach is used for optimum features selection. In this approach the most prominent coefficients are selected from a DC coefficient using zigzag manner diagonally[9] as Figure 1.

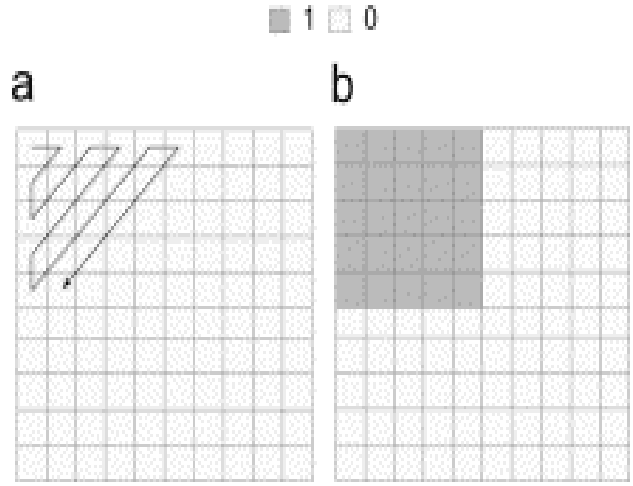

Fig. 1 DCT Feature Extraction process using static zigzag selection process

b) Gabor Filter Feature Extraction

A Gabor filter equation is as follows[10]:

$$\Psi(x, y, \lambda, \Theta) = \frac{1}{2\pi s_x s_y} e^{-\frac{1}{2}\left(\frac{x_1^2}{s_x^2}+\frac{y_1^2}{s_y^2}\right)} e^{j\frac{2\pi x_1}{\lambda}} \quad (3)$$

(x, y), the pixel position in the spatial domain.

λ, Wavelength or a Reciprocal of frequency of pixels.

θ , Orientation of a gabor filter.

S_x, S_y, Standard deviation of the x & y directions.

The parameters x_1 and y_1 are calculated as following equation 3 and 4

$$x_1 = x \cos\theta + y \sin\theta \quad (4)$$

$$Y_1 = -x \sin\theta + Y \cos\theta \quad (5)$$

The Gabor features are hence obtained through convolution of input digital image with Gabor filter bank. I(x, y) is a grey scale face digital image that is of size a * b pixels. The feature extraction procedure can be explained as a filtering operation for the given face digital image I(x, y), along with the Gabor filter u,v(x, y) with size u and orientation v[10].

$$G_{u,v}(X, y) = I(x, y) * \Psi(x, y) \quad (6)$$

PROPOSED WORK

Every Feature Extraction Technique for Face Recognition has its own advantages. So each technique can take out only limited features with redundancy and a limited recognition rate is possible with its own extracted feature. For achieving higher recognition rate different Feature Extraction Techniques are combined into a single combined technique to maximize the optimum features. By using advantages of combined different techniques are also merged in proposed technique.

EXPERIMENT AND RESULTS

The multiclass AdaBoost classifier is applied for classification of faces. Result of face recognition obtained from above feature extraction techniques on **JAFFE** dataset are shown in Table I

	Feature Extraction Method	**Average Recognition Rate %**
1	Discrete Cosine Transform method	59.5%
2	Gabor Filter method	63.5%
3	Proposed feature extraction technique	73 %

Table 1. Comparison of recognition rate for different technique on JAFEE dataset using Adaboost Classifier

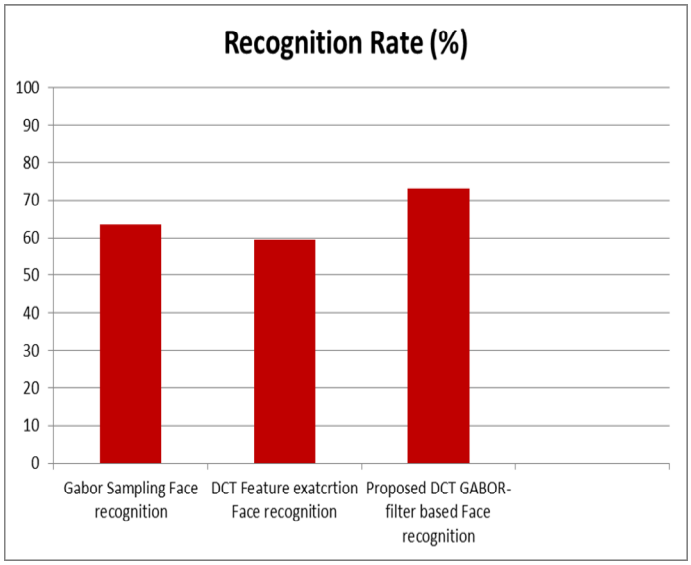

Figure 2. comparative recognition rate of gabor filter, dct and proposed feature extraction based face recognition systems

Conclusion

Feature extraction is the most crucial & important part of face recognition. With a feature extraction a significant recognition rate is achieved in face biometrics recognition. The face recognition using feature extraction through Gabor discrete cosine transform method is proposed and implemented and recognition results corresponding to this technique are also calculated.

Experiment are implemented in MATLAB which show that proposed hybrid techniques based on Gabor discrete cosine transform have 73% recognition rate for

face recognition While discrete cosine transform feature extraction method has 59.5% recognition rate and Gabor filter feature extraction has 63.5% recognition rate for face recognition. The proposed combined feature extraction techniques have higher recognition rate compared to existing individual feature extraction techniques of discrete cosine transform based and Gabor based technique individually

References

[1] A. K. Jain, "Face Recognition: Some challenges in Forensics", in International Conference on Automatics Face & gesture Recognition Workshops, pp.-726-733, 2011.

[2] J. Harguess, J.K. Agarwal, "Is there a connection between face symmetry and face recognition", Computer vision and pattern recognition workshops, pp. 66-73, IEEE, 2011.

[3] S. Ravi, "Face Recognition using substances techniques" in international conference on recent trends in information technology, Page(s): 103 – 107, IEEE, 2012.

[4] G.P., Teja, M.A. Lone, S.M. Zakariya, R. Ali, "Automatic Face recognition systems by combining four individual algorithms ", in international conference on Computational intelligence and communication networks (CICN), pp. 222-226, 2011.

[5] SS Kulkarni, J. moriarty, chih cheng hung, "the impact of image clock size on face feature extraction using discrete cosine transform" in international conference on southeast con , pp. 98-101,2010.

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[6] A. Bansal, K. Mehta, S. Arora, "Face recognition using PCA and LDA algorithm", in international conference , Advanced computing and communication technologies, pp. 251-254, 2012.

[7] Jiying Wu, Gaoyun An, and Qiuqi Ruan, "Independent Gabor Analysis of Discriminant Features Fusion for Face Recognition" SIGNAL PROCESSING LETTERS, VOL. 16, NO. 2, IEEE, FEBRUARY 2009.

[8] Seyed Omid Shahdi, S.A.R. Abu-Bakar, "Varying Pose Face Recognition Using Combination of Discrete Cosine & Wavelet Transforms",in 4th International Conference on Intelligent and Advanced Systems (ICIAS2012), pp. 642-647, IEEE, 2012.

[9] Prathik P., K. Manikantan, S. Ramachandran, Rahul Ajay Nafde, "Feature Extraction using DCT Fusion based on Facial Symmetry for Enhanced Face Recognition", in International Conference on Communication, Information & Computing Technology (ICCICT), IEEE, 2011.

[10] S. Nazari, M.S. Moin, "face recognition and local gabor features", in international conference on electrical engineering (ICEE), pp 1-4, IEEE, 2013.