Face Image Retrieval using Tchebichef Moments

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Abstract

Image Retrieval is a field of study concerned with searching and retrieving images from a collection of database. Face image retrieval is still a challenging task since face images can vary noticeably in terms of facial expressions, lighting conditions etc. In this paper we propose a face image retrieval method using Orthogonal Moments (Tchebichef Moment). This method extracts the feature from images by orthogonal moments to retrieve images from a large database. This method has been extensively assessed with YALE face database and FERET image Database. This method shows a noticeable performance compared to other methods.

I. INTRODUCTION

The image retrieval is to find effectively the image data interested by the users from a large collection of image databases [1, 2]. In this paper, the focus is placed on building a competent and precise image retrieval system. To date, several feature based image retrieval systems have been proposed [3-18]. Automatic face analysis which includes, face detection, faces recognition, and facial expression recognition has become a very active topic in computer vision research. Different holistic methods such as Principal Component Analysis (PCA) [19], Linear Discriminant Analysis (LDA) [20], and 2D PCA [21] have been studied widely but lately also local descriptors have gained attention due to their robustness to challenges such as pose and illumination changes. One of the first face descriptors based on information extracted from local regions is the eigen features method proposed by Pentland et al. [22]. This paper proposes to employ Orthogonal moment to extract moment features and obtain higher retrieval rate. The remainder of the paper is organized as follows. Section II exemplifies the Extraction of Orthogonal Moment features. Section III describes the Image Retrieval Algorithm. Section IV details the experimental evaluation and Section V presents the Conclusions.

II. EXTRACTION OF ORTHOGONAL MOMENT FEATURES

Moments have been extensively used in image processing, pattern recognition and Computer vision [23-29]. Teague proposed continuous orthogonal polynomials as the basis functions to calculate continuous moments [30]. These orthogonal polynomials include Zernike polynomials, Legendre polynomials, pseudo-Zernike and Tchebichef polynomials. Since Hu (1962) introduced moment invariants, moments and functions of moments due to their ability to represent global features of an image have found wide applications in the fields of image processing and pattern recognition [31], image indexing [32] robust line fitting [33], and image recognition [34]. Among the different types of moments, the Cartesian geometric moments are most extensively used. It was shown [35] that the discrete orthogonal moments perform better than the conventional continuous orthogonal moments in terms of image representation capability. In this paper, we present a new set of discrete orthogonal polynomials, namely the Tchebichef polynomials, which are orthogonal on a non-uniform lattice. The Tchebichef polynomials are scaled, to ensure that all the computed moments have equal weights, and are used to define a new type of discrete orthogonal moments known as Tchebichef moments. It is significant that although the Tchebichef polynomials are orthogonal on a non-uniform lattice, the discrete Tchebichef moments defined in this paper are applied to uniform pixel grid image.

A. Computation of Tchebichef Moments

The Scaled Tchebichef polynomials are defined [36] as

$$\tilde{t}_n(x) = \frac{t_n(x)}{\beta(n,N)} \quad (1)$$

where $t_n(x)$ is the discrete Tchebichef polynomials of degree n given by [38] and β(n,N) is suitable constant which is independent of x.

To avoid numerical instability in polynomial computation, the Tchebichef polynomials are scaled by utilizing the square norm according to the formula

$$\tilde{\rho}(n,N) = \frac{\rho(n,N)}{\beta(n,N)^2} \quad (2)$$

The $(p+q)^{th}$ order Tchebichef moments are now defined as

$$T_{pq} = \frac{1}{\tilde{\rho}(p,N)\tilde{\rho}(q,N)} \sum_{x=0}^{N-1}\sum_{y=0}^{N-1} \tilde{t}_p(x)\tilde{t}_q(y) f(x,y)$$

p,q = 0,1,2,…N-1. (3)

III IMAGE RETRIEVAL ALGORITHM

The value of parameter *a* influence the selection of exact order moment in image retrieval. i.e we have analytically set a=c and b=a+N. It is observed that, the Dual Hahn Polynomials, with increasing value of *a*, steadily increases. Several cases with different value of parameter are tested and the patterns are reconstructed with a moment order from 10 to 40. It is also observed that, the reconstructed images with a=c=9 and b=49 is better. The accuracy of reconstructed image is found by calculating the reconstruction error. When the maximum order of moments is high (M>25) the reconstruction error with different value of parameter are almost the same. Hence the relevant moments of lower order are taken as a feature in retrieving the image from the dataset. Here in our work, we take the moment of 23 order as the feature to retrieve the face images.

IV EXPERIMENTAL STUDY

The efficiency of this image retrieval system is tested on YALE and FERET image database. Results for the retrieval of the 10 most similar image from a query image is illustrated in Fig 1. The image 1.a) is the query image taken from the FERET image data set. Image 1.b) is the 10 most similar image retrieved using our algorithm.

The retrieval rate for the query image is measured by counting the number of images from the same category which are found in the top k matches. The retrieval rate is provided in Table 1.

Images	Retrieval Rate
FERET Database	91%
YALE database	84%

Table 1. Retrieval Rate

V CONCLUSION

This paper proposes a new approach for face recognition using discrete orthogonal moments. Two different databases have been used to evaluate the proposed method. The orthogonal moment features prove to be efficacious for the image retrieval task.

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Fig 1.a) Query Image

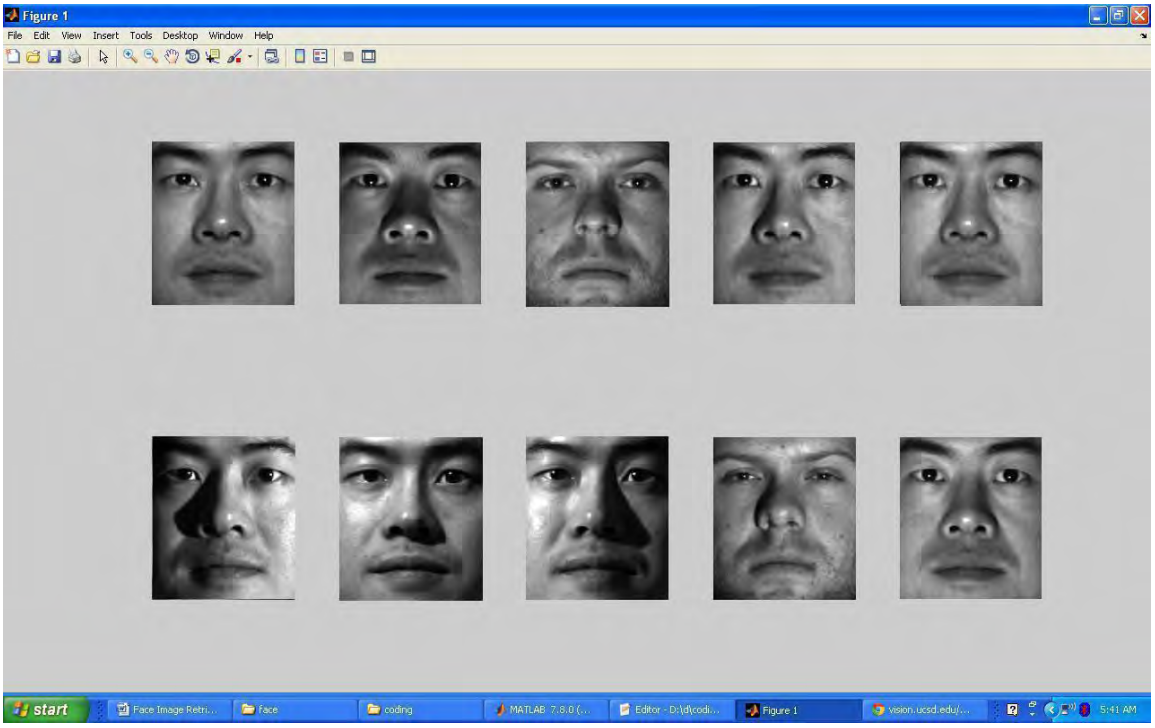

Fig1.b) Retrieved Images