Image Recognition Using Shape Descriptor: Eccentricity and Color

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ABSTRACT

With the rapid increase of multimedia information, there is a growing importance for facilitating automatic image searching and retrieval. Generally, low level visual features of the images are used in Content Based Image Retrieval (CBIR) to segment, index and retrieval of the image from the image database. Such methods may require more computational time and inefficient indexing and retrieval performance. Shape feature is among the important feature of an image since it is reflective of the human perception. Hence shape description or representation is an important issue both in object recognition and classification. Therefore an attempt is made in this paper to focus on the shape descriptor-eccentricity and color features for achieving efficient and effective retrieval performance by using kNN classifier. Experiments are carried out on proposed algorithm with 2732 images and achieved an accuracy of 98.52%.

Keywords: Canny Edge Detection, CBIR, Eccentricity, kNN, RGB, Shape Descriptor.

Introduction

Content-based image retrieval, a technique which uses visual contents to search images from large scale image databases according to users' interest. It has been an active and fast advancing research area. Many advanced techniques evolving in CBIR. Applications like medicine, entertainment, education etc. make use of vast amount of visual data in the form of images. The features such as luminance, shape descriptor and gray scale texture are some natural features since they correspond to visual appearance of an image (Gary and Mehrotra, 1992, Grgic and Ghanbari, 2003 and Mente, Dhandra and Mukarambi, 2011). Shape is one of the most important image feature since it is reflective of the human perception. Shape similarity using shape descriptors have been found to be a difficult in CBIRs. A popular CBIR developed at IBM. It uses eccentricity, circularity, shape area, major axis orientation and a set of algebraic moment invariants for shape representation (Flicknet, Sawhney, Niblack, Ashley, Huand, Dom, Gorkani,

Hafner, Lee, Patkovic, Steele, Yanker, 1995, Hiremath and Pujari, Datta, Joshi, Li and Wang, 2008, Smeulders and Gupta, 2000). An image retrieval system recognizes an image from the database similar to that of query image in terms of shape, color and texture (Mamatha, Ananth, 2010, Hiremath and Pujari. By considering only the color features in different regions of an image, the image retrieval accuracy achieved is up to 93.53 percent (Mente, Dhandra and Mukarambi, 2011). Shape is an important feature for perceptual object recognition and classification of images. It has been used in CBIR in conjunction with color. For achieving efficient and effective retrieval performance and to increase the accuracy in the image retrieval, the proposed method in this paper uses the shape descriptor-eccentricity and mean of pixel values in the red, green and blue color space.

*Edge Detection***:** Edges define the boundaries between regions in an image (Singh, Kathane, 2011). It detects the edges of the objects. Edge detection is used in image segmentation and object recognition (Kitti, Jaruwan and Chaiyapon, 2012). Edge detection produces an edge map which contains important information about the image. There are many ways to perform edge detection. One of them is gradient based edge detection and second one is Laplacian based edge detection (Oram, McWilliams and Stolzenbach, 2007). Various popular edge detection techniques are available, for example Sobel Edge Detection, Prewitt Edge Detection, Robert Edge Detection, Canny Edge Detection etc. (Al-amri, Kalyankar, Khmitkar, 2010). However, Canny's Edge Detection algorithm performs better than Sobel and Prewitt Operators (Nandernejad, Sharifzadeh, Hassanpour, 2008). The Canny Edge Detector is widely considered as the standard Edge Detection algorithm in image processing (Ding, Goshtasby, 2000). Therefore during experiments before calculating the eccentricity Canny Edge Detector algorithm is applied to find the edges in an image.

*Feature Extraction***:** In this paper an attempt is made to compute similarity of images based on the shape descriptor – eccentricity and the mean of intensities values in red, green and blue color space. The eccentricity and the three mean values are used as the features of query image and the training images. Following are some terminologies used to describe the shape of the image –

1. *Major Axis*: It is the straight line segment joining the two points on the boundary farthest away from each other.

2. *Minor Axis* : It is perpendicular to the major axis and of such length that a rectangle with sides parallel to major and minor axes that just encloses the boundary can be formed using the lengths of the major and minor axes.

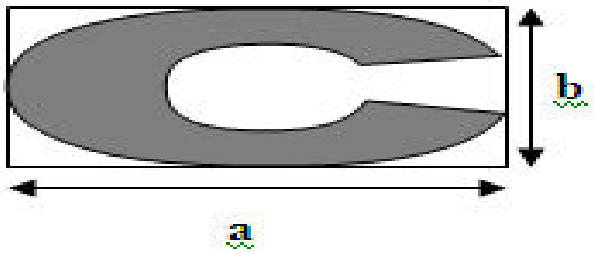

Figure-1:-Shape Description

3. *Eccentricity*: The ratio of the major axis to the minor axis is called eccentricity of the region. The value of eccentricity is between 0 and 1. (Fig. 3.1)

Eccentricity = a / b.

Algorithm 3.1 : Following algorithm is used to extract the features of training / test images –

Step 1 : Start.

Step 2 : Input the color training / test image.

Step 3 : Convert this image into gray.

Step 4 : Filter out the noise from the image using median filter.

Step 5 : Apply the Canny's Edge Detector method to find edges.

Step 6 : Calculate the eccentricity of the image.

Step 7 : Calculate mean of each color space i.e. red, green and blue.

Step 8 : Label the image.

Step 9 : Store eccentricity and mean of each color space as vector in the feature matrix.

Step 10 : Store label of image and index of image as vector in other matrix.

Step 11 : Repeat step 2 to step 10 for each training / test image.

Step 12 : Stop.

Experimental results

In this paper eccentricity and mean values of each color space is used as image features for image retrieval from the database. The database consists of 2732 different single fruit images downloaded from the internet as shown Table-1 and Table -2.

Table-1:-Some images from various classes

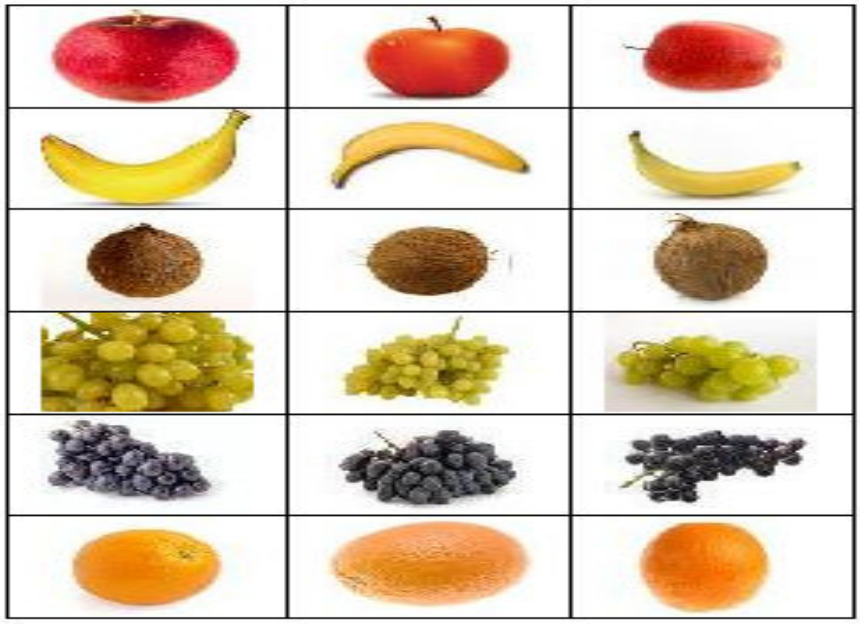

Table-2: Image Classes

Image Classes	Class Name	No. of Images
1	Apple	627
2	Banana	405
3	Coconut	316
4	Grapes	387
5	Black Grapes	538
6	Orange	459
Total Number of Images		2732

For experiment 75% of the images given in table 4.1 are used as training images and 25% images are used as test images. Once the features of training and test images are extracted, the features of test images are compared with features of training images by using kNN with Euclidean Minimum Distance measure. This gives the index of nearest matching features of test image from the feature matrix of training images. The index retrieved and the matrix of labels of training images is used to label the test image. This entire flow is shown in figure 4.1. The retrieval time is faster and at the same time, more accurate. Image retrieval and recognition is

performed for various test and training images. The percentage of accuracy in image retrieval using 75% training color images and 25% test color images is shown in Table-3

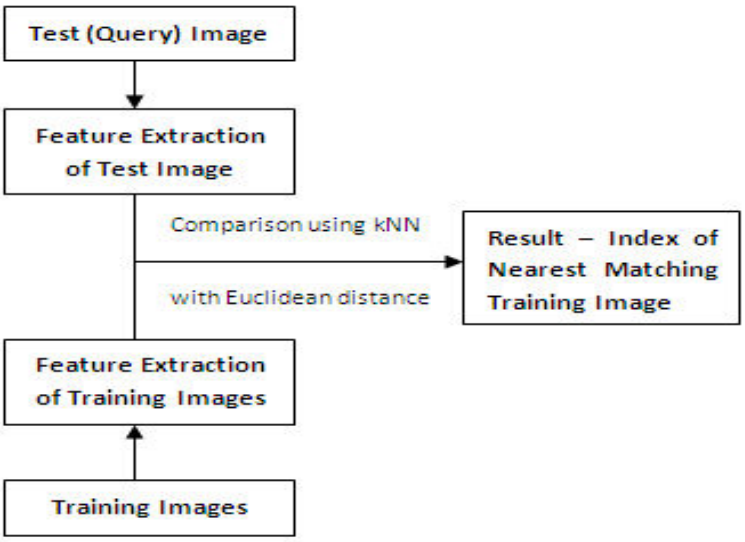

Figure-2:-Flow of computing test image with training

Table-3: Percentage of accuracy in image retrieval using eccentricity and mean of values in color space

Image Class Name	No. of Training Images	No. of Test Images	No. of Matches (k=1)	Percentage of Accuracy
Apple	470	157	155	98.73
Banana	303	102	98	96.08
Coconut	222	94	94	100.00
Grapes	290	97	83	86.57
Black Grapes	403	135	135	100.00
Orange	345	114	110	96.49
Total	**2033**	**699**	**675**	**96.56**

Conclusion

In this paper an image retrieval system is presented based on the shape descriptor: eccentricity and three mean values of intensity values in red, green and blue color space. The percentage of accuracy in retrieval of query images is 96.56%. The results and performance of the method given in this paper shows that it is effective and efficient. It can be further enhanced by including texture features.

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