Content Based Image Retrieval using Color, Shape and Texture

Dwipal Parmar[1] Bhumika Gohel[2]
[1,2]P. G. Student
[1,2]Department of Computer Engineering
[1,2]GTU PG School, Ahmedabad

Abstract— in today's growing world every single person is with at least one single digital device. Due to the use of digital device the image world is as well growing. Images are very important part of every single human being, it makes human's daily life easy, it helps person to understand any theory, it makes communication easy. So it is necessary to store the images. But the storage capacities of images are growing day by day. We need a system that store large capacity of images and even retrieve images efficiently. There already exist image retrieval systems that retrieve and store images using keyword It is impossible process for large image database. For large image database there is a basic need of image retrieving system. This problem is solved by Content Based Image retrieval (CBIR) System, it is the system that store and retrieve images based on image content (shape, color, texture). In this paper we have used Fourier descriptor method for shape, HSV histogram for color feature and Gray Level Co-occurrence matrix for texture feature to retrieve the images from the image dataset.

Key words: CBIR, HSV, Fourier Descriptor, GLCM

I. INTRODUCTION

Images are produced from digital imaging devices. As the uses of digital devices are growing same way images are also growing. Images are the way to capture the every moment of daily routine life in a single unit. It makes communication easy, understandable and interesting for every single human being. It is a basic need to store these large amounts of images and retrieve these images. Traditional Image Retrieval system is based on manual annotation. It describes every single image using keywords and store the image in database based on that and at the time of retrieving image from the database use these keywords. It is a system that search, store, retrieve image using manual annotation. It is impossible to describe image accurately, even person by person this description may vary. It is not possible to store large image database using this keywords as they are time consuming and inaccurate. In 1992, by T. Kato it is originated to describe to store the images based on image's color and shape content. This system is known as CONTENT BASED IMAGE RETRIEVAL (CBIR) as it is using only contents of images. These contents are color, shape and texture. Every single image is stored in database using these features. It is automatic image retrieval system. The CBIR system first extract feature of image, than store image based on its feature. And at the time of retrieving image it uses image as a query, the system extract feature of query image than based on that retrieve the images from the database the images that have best similarity matching that are shown in the GUI of the system as a resultant images.

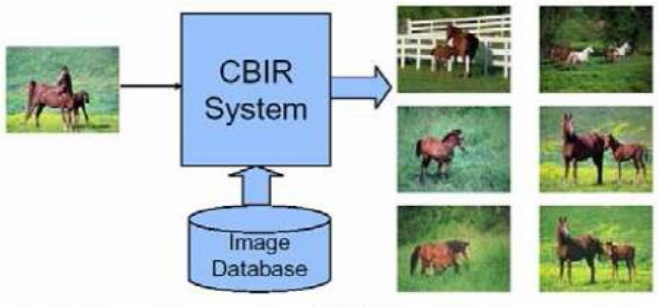

Fig. 1: Content Based Image Retrieval (2)

CBIR system is used in various applications as image database are for various purpose. Every image database is created for various purpose so according to that purpose CBIR need to retrieve image. CBIR used is Intellectual Property, Crime Prevention, Medical Diagnosis, Remote Sensing , Security, Medicine diagnosis, Architectural and engineering design, Fashion and publishing, Geographical information and remote sensing systems, Home entertainment.

II. COLOR FEATURE

Color is the most important feature of image content. It is easily recognise by every human eye. It is very easy and simple to retrieve images based on its color feature. When two or more feature are used to retrieve image that color feature is always applied first to extract its color feature and then other feature are applied. Color feature are expressed using different color model. The most basic and common model is RGB (RED GREEN BLUE) model. The other models are HSV, CMY, and YIQ etc.

In our proposed system we have used HSV color model to retrieve the color feature of an image. HSV stands for Hue Saturation Value. HSV color model is used by most people who are selecting colors from wheel/palette. This model is using hexacone coordinate system.**H**ue is expressed as a number from 0 to 360 degrees in a cone. Hues of red (starts at 0), yellow (starts at 60), green (starts at 120), cyan (starts at 180), blue (starts at 240), and magenta (starts at 300). Saturation is expressed as the amount of gray is present in color. Its value is start from 0% to 100%, and Value is represented as brightness or intensity of color from 0% to 100%.

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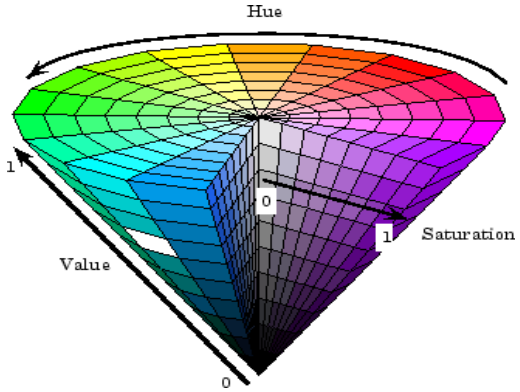

Fig.2: HSV Color Model

In the following example we used one color image than we plot histogram of that image, the amount of RGB color is present in image. Histogram acts as a graphical representation of the lightness/color distribution in a digital image. It plots the number of pixels for each value. After that we have applied hue, saturation and value to the color image and even plot the histogram of them. From this following example it is easy to understand what actually hue saturation and value means.

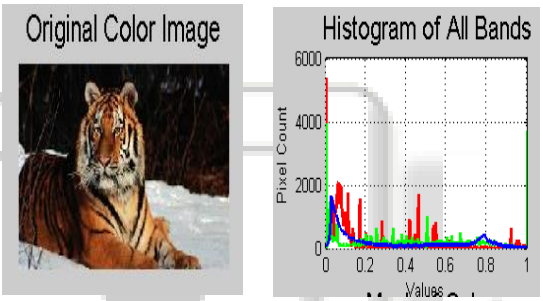

Fig.3.Original Color Image and Its Histogram

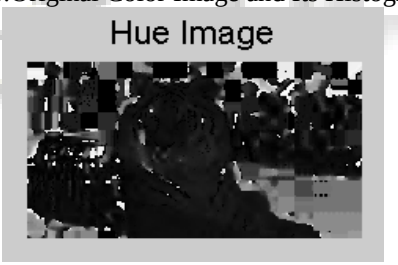

Fig. 4: Hue Image

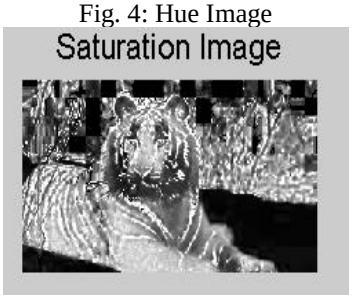

Fig. 5: Saturation image

Fig. 6: Value Image

III. SHAPE FEATURE

Shape is the representation of any object. Shapes which are found perceptually similar by human have the same features that are different from the others. Shape is an outline of an object. Shape based image retrieval is the measuring of similarity between shapes represented by their features. Shape can be recognized as two types one is boundary based and other is region based. In boundary based only the outer border of shape is consider to retrieve and store any image. In region based, the specific region of any image is consider, when user select specific region of image than based on that region only images are retrieved from the database that have similar shape as that specific region. Recognition of a shape by its boundary is the process of comparing and identifying shapes by analyzing the shapes boundaries but the local structural organization is always hard to describe(8)(9)(10).

In our system we have used Fourier descriptor to extract shape feature of an image. Fourier descriptor is boundary based image retrieval method. Fourier descriptors are a classical method to shape recognition and they have grown into a general method to encode various shape signatures. When we are using shape feature in CBIR then, first we convert color image to gray scale image and then shape feature extraction method is applied. Fourier Descriptor represents the boundary as a sequence of coordinates. We select one coordinate (xi,yi) and center point (xc,yc). Now we calculate the distance between center point and one coordinate point, it is known as centroid distance.

i=0,1,….,N-1 ---- (3)

Where

The Fourier transform of d(i) is,

----- (4)

The co-efficientn=0,1,…N-1 is used toderive FD of the shape.

IV. TEXTURE FEATURE

Texture is visual feature that refers to natural object surface properties and their relationship to the surrounding environment.Texture based image retrieval is the measuring of similarity between textures represented by their features. Texture properties not only presence of only color or intensity but they have properties of homogeneity. The method used for texture feature descriptor are statistical method, model based and transform based method.

In our system used GLCM method for texture feature extraction.GLCM stands for Gray Level Co-occurrence Matrix.It describea pixel with the intensity value i occurs in a specific relationship to a pixel with the value j.GLCM is a symmetry matrix and its level is determined by the image gray-level.GLCM is fusion of the probability value; it is defined as expression the probability of the couple pixels at θ direction and d interval.Four GLCM texture features are commonly used which are given below, Energy, Contrast, Correlation, and Homogeneity.Matrix elements are calculated by below equation:

$$P(i,j/d,\theta) = \frac{P(i,j/d,\theta)}{\sum i \sum j\, P(i,j/d,\theta)}$$

There are mainly four texture property are considered out of many. They include energy, contrast, correlation and homogeneity.

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$$\text{Energy } E = \sum x \sum y\, P(x,y)^2$$

$$\text{Contrast } I = \sum x \sum y (x-y)^2 \;\; P(x,y)$$

$$\text{Correlation } C = \sum x \sum y \;\; P(x,y) \log P(x,y)$$

$$H = \sum x \sum y \frac{1}{1+(x-y)^2} P(x,y)$$

V. IMPLEMENTATION & RESULTS

A CBIR system is efficient and effective image retrieval system. In CBIR process the measurement of its result is based on two most important parameters. These two parameters are Precision and Recall. Precision means the ratio of relevant or similar images to the total no. of images retrieved. Recall is percentage of relevant images among all possible relevant images in the database [6]. The performance of CBIR is evaluated using these two parameters.

$$\text{Precision} = \frac{\text{Number of Retrieved Relevant}}{\text{Total Number of Retrieved}}$$

$$\text{Recall} = \frac{\text{Number of Retrieved Relevant}}{\text{Total Number of Possible Relevant}}$$

In our system we have used **Wang Image** Database. In this image database there is 10 different image dataset. Each dataset has 100 images.

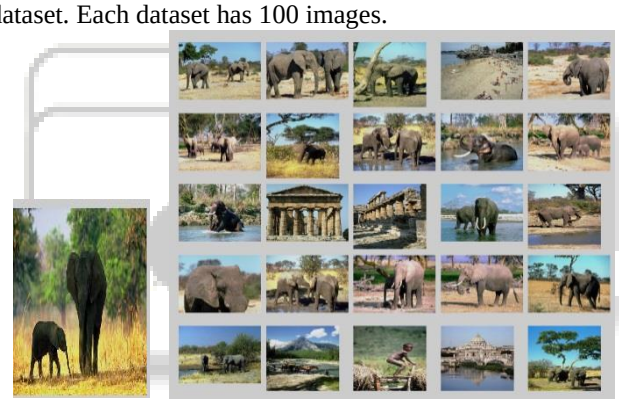


Fig.7 Elephant as a Query Image & Retrieved images

Fig.8: Flower as a Query image & Retrieved Images

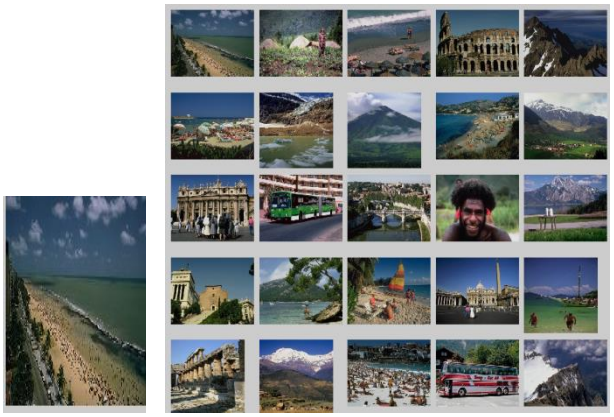


Fig. 9: Beach as a Query Image & Retrieved Images

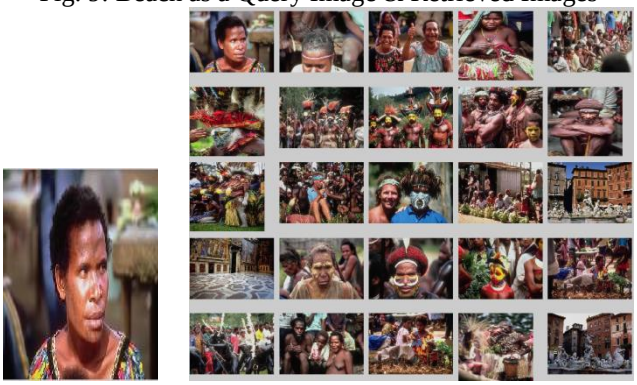


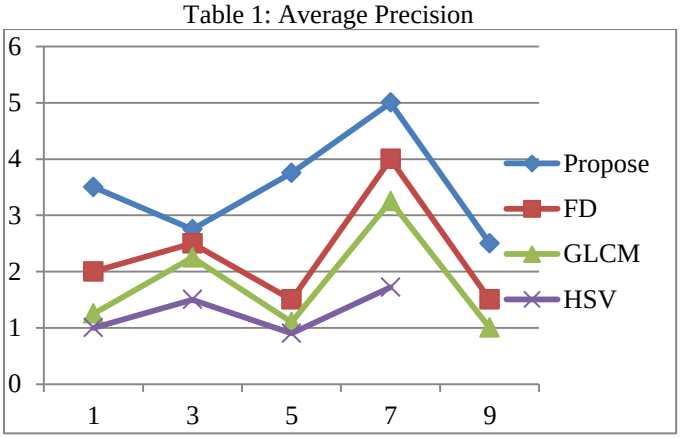
Fig. 10: Arfican Person as a Query Image& Retrieved Images

In CBIR systems (Figure 1-1), the visual contents (color, shape, texture) of the query images are extracted and described by feature vectors. The feature vectors of the images in the database create a feature database to store the specific feature information of an image. Then the similarities /distances between the feature vectors of the query example and those of the images in the database are then calculated and retrieval is performed.

Average Precision

Class	HSV Color	GLCM Texture	Fourier Descriptor	HSV+GLCM+FD
African	0.50	0.61	0.54	1.05
Beaches	0.57	0.65	0.41	0.93
Flower	0.88	0.60	0.64	1.24

Table 1: Average Precision



Various Retrieval System Precision Graph

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VI. CONCLUSION

The purpose of this survey is to provide an overview of the functionality of content based image retrieval systems .This paper reviewed various features of CBIR and various techniques of CBIR. CBIR at present is still very much a research topic. The technology is exciting but immature, and few operational image archives have yet shown any serious interest in adoption. In this paper we conclude that CBIR system used to complement the existing machinery to provide better result. needsa improvement using different technique to provide better result.

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