A Survey on Content Based Image Retrieval

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Abstract— There is large amount of digital data floating all over the world today. If we want to search a particular image or file, we get a lot of results. CBIR are the systems which search an image or article on the bases of their content. Therefore, Content-based image retrieval has become one of the most active research areas from last few years. This paper gives a review of features used in content based image retrieval, a general model for CBIR and its applications.

Keywords-CBIR; Content Based image retrieval; feature extraction cloud computing

I. INTRODUCTION

Previously images were searched on the basis of text based approach. With this user has to face some problems like: It fails to search data from large volumes of databases, It is valid only for one language, it suffers from problem of human perception etc.

CBIR systems overcome all these problems. It takes the responsibility of forming the query away from the user. Images are searched on the basis of their own features and contents rather than its name [1, 2]. As name suggests content based means during searching it will analyze the content of the image and not the Meta data of image. In this image is searched on the basis of color, texture shape and any other feature of image, and not on the basis of name of image, date of image taken etc. Therefore it is also called query by image content (QBIC).

II. FEATURE EXTRACTION

The feature is defined as a function of one or more measurements, each of which specifies some quantifiable property of an object, and is computed such that it quantifies some significant characteristics of the object [3]. Feature extraction is the basis of content-based image retrieval. It is the process of extracting features from the image such as color, shape and texture. It computes a numerical or alphabetical representation of some attribute of digital images. This representation is further used to derive information about the image contents. Then images are searched on the basis of this derived information. Important features used in content based image retrieval are as following:

A. Color

Color feature is one of the most widely used features. Color is perceived by humans as a combination of three color stimuli: Red, Green, Blue, which forms a color space [4]. Color of an image is defined in RGB space or HSB space. Color adds more information in an image. On the basis of color you can search an image by giving a query like retrieve all images whose color is similar to image that are given in query by you.

B. Color Space

Color is defined in a 3D color spaces. It can be RGB (Red, Blue, Green) or HSB (Hue, Saturation, Brightness).In RGB model colors are defined as a unit cube having 3 axes red, green, and blue. A color is defined RGB space by 3 coordinates [1]. When all three coordinate values are set to zero then we get black color and when all three coordinates are set to 1 we get white color. Rest all colors are also defined by these three coordinates, but have different values. In HSB colors are defined on the basis of Hue, Saturation and brightness. Similarly like RGB and HSB we have different more color spaces like CIE L*a*b, and CIE L*u*v. However, for CBIR systems require a color space that provides perceptual uniformity. HSB, CIE L*a*b, and CIE L*u*v color spaces provide uniformity.

C. Color Histogram

The most commonly used method to represent color feature of an image is the color Histogram. A color histogram is a represent in the form of a bar graph. Particular color is represented by the height of bar in graph. Bars are represented in x axis. And these are known as bins. The color histogram extraction algorithm can be divided into three steps: partition of the color space into cells, association of each cell to a histogram bin, and counting of the number of image pixels of each cell and storing this count in the corresponding histogram bin. This descriptor is invariant to translation and rotation. The similarity between two color histograms can be performed by computing the L1, L2, or weighted Euclidean distances, as well as by computing their intersection [4].Color Histogram can also be defined as frequency count of each individual color.

D. Texture

Features like regularity, directionality, Roughness, coarseness, smoothness etc. form texture of an image. These are the visual patterns in an image having properties of homogeneity. Textures are classified on the basis of two methods: Statistical and Structural. As there are different forms of textures, so in CBIR which form has to which features accurately can represent spatial distribution of images.

A texture is characterized by a set of values called energy, entropy, contrast, and homogeneity. The following formulas are used to calculate the features and are shown in equations 1to 4 [5].

$$\text{Energy}=\sum_i\sum_j P_d^2(i,j)\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

$$\text{Entropy}=-\sum_i\sum_j P_d(i,j)\log P_d(i,j)\ldots(2)$$

$$\text{Contrast}=\sum_i\sum_j (i-j)^2 P_d(i,j)\ldots(3)$$

$$\text{Homogeneity}=\sum_i\sum_j P_d(i,j)/(1+|i-j|)..(4)$$

E. Shape

Shape is also very important feature in content based. Shape of an image is described after the segmentation has done. As segmentation is of two types, i.e. region based segmentation and region based, shape can also represented boundary based or region based. In region based techniques, all the pixels within a shape are taken into account to obtain the shape representation [4]. In pattern recognition we have many shape similarity measures which can also be used in CBIR to construct shape distance measures.

III. CBIR MODEL

CBIR model contains various components as shown in figure 1.

- Image Database: It is the major component of CBIR system. It contains all the images in it.
- Image Enhancement, Image Segmentation, Image subdivision deals with preprocessing of image.
- After preprocessing feature extraction is performed. Only the dominant segments are considered for feature extraction namely color histogram features, texture features, and image density feature[5] .
- After extracting the main features from the images single feature vector is constructed.
- Single Feature vector is then stored in the feature database.

At the time of searching an image single vector of a query image is also created and then images are searched and retrieved.

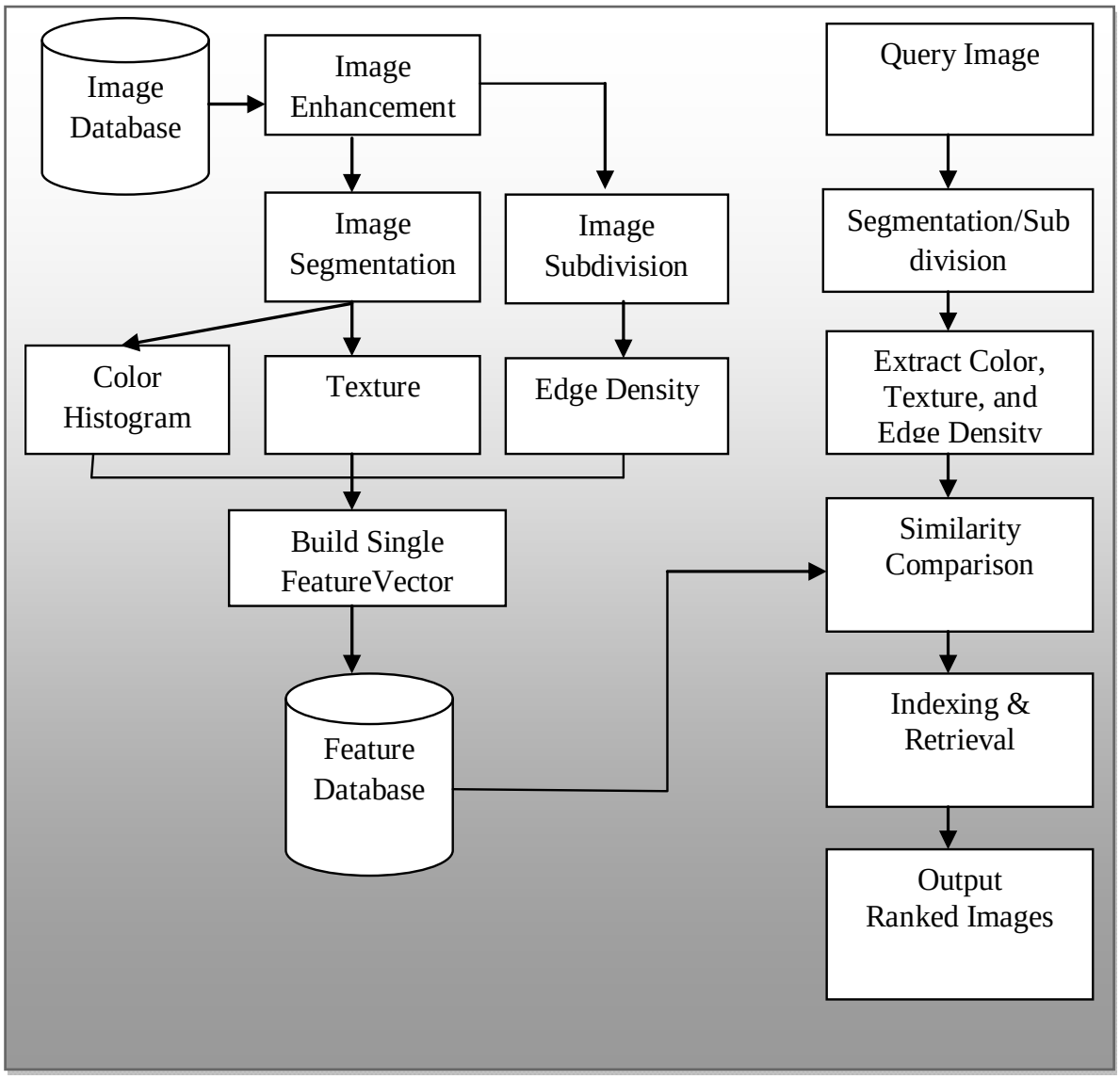

Figure1. CBIR Model [5]

IV. Sample Query

Google provide application for content based image retrieval. For example, If you have an image of beach and you want to search similar images. In Google you have to browse image of beach that is present in your computer, as shown in figure 2. This image will be treated as query image and similar images will be retrieved.

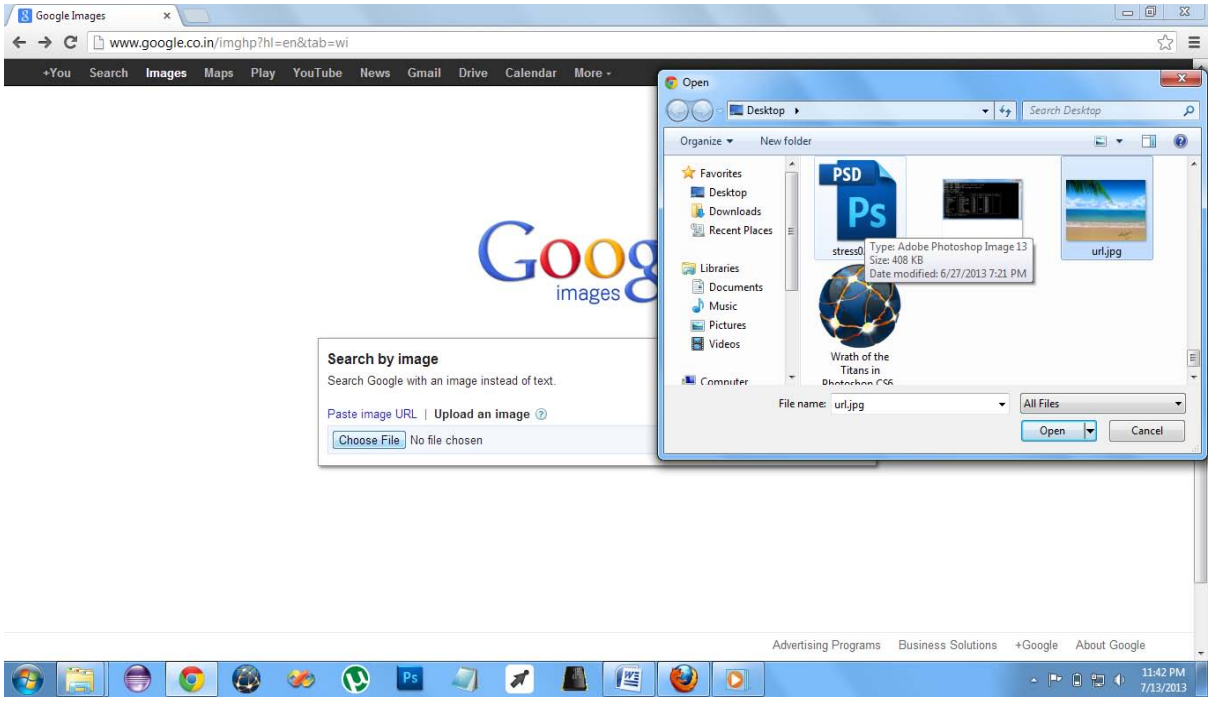

Figure2. Input Image

Result after query processing is shown in figure 3

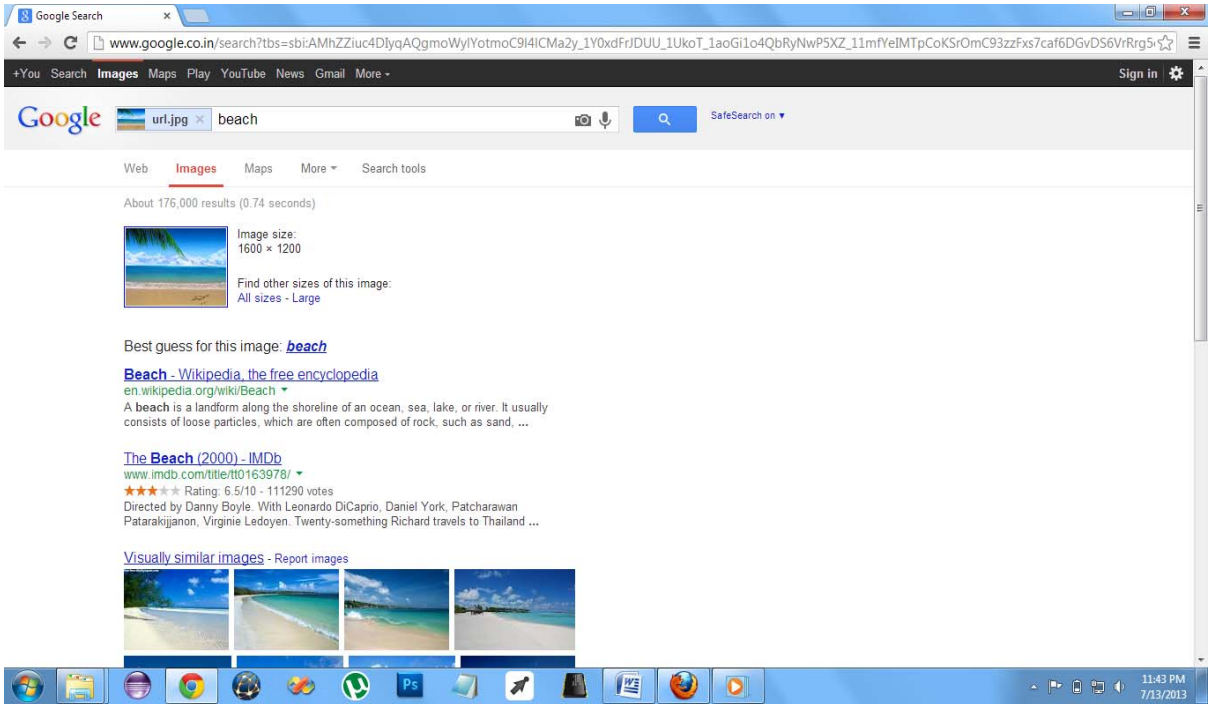

Figure 3. Output Image

V. APPLICATIONS

A. Face Recognition

Face recognition can be done automatically using CBIR systems, with the help of which a person can be identified from a digital image by comparing its content with content of images in database [6].

B. Biodiversity Information System

Biodiversity Information Systems contains large amount of images including images of living beings, ecosystem, biome, planet etc..To enhance the knowledge of researchers and to understand habits and features of spices on the basis of their content CBIR proves as a great tool.

For e.g.: Such a query might start by providing an image as input (e.g., a photo of a fish) and then asking the system to "Retrieve all database images containing fish whose fins are shaped like those of the fish in this photo". A combination of this query with textual and spatial predicates would consist of "Show the drainages where the fish species with 'large eyes' coexists with fish whose fins are shaped like those of the fish in the photo". Examples of initiatives in this area include [3].

C. Art Collections

In field of art collection we have collection of unique objects belonging to different museums. Each object has a accession number. For exhibitions, education, research, etc. To search a piece of art on the basis of its content CBIR systems are used.

D. Scientific Databases

Scientists have a lot of data in their database. They have to search relevant data for scientific purpose. They also group some images on the basis of their content[1,7]. They do not need to type any information for image. They just have to query an image against which they want some other images. To search a document the can input an image and document will be retrieved.

E. Medical Applications

Medical Image Databases contains CT, MRI, Ultrasound etc. CBIR helps in 3 main fields of medical science which are: teaching, research, and diagnostics. From the teaching perspective, searching tools can be used to find important cases to present to students. Research also can be enhanced by using services combining image content information with different kinds of data. Clinicians usually use similar cases for case-based reasoning in their clinical decision-making process. [3]

VI. CONCLUSION

With the increase in digital data present in our computers and over the internet, it is not efficient to search for an image by its name. CBIR systems are used to retrieve image on the basis of its content, with help of which we can find the relevant images within less time than text based retrieval. In this paper a review of CBIR, a general model for CBIR and its application is given.

VII. REFERENCES

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