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A Survey On Various Feature Extraction Techniques Followed By Image Retrieval System

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Abstract

There is a tremendous use of internet worldwide, users probably deals with multimedia data. There are in all three types of search engines such as text retrieval system, image retrieval system and multimedia retrieval system. Image retrieval system are very much in demand in today's era. The existing image retrieval systems available on web are google image retrieval, yahoo image retrieval, Altavista image retrieval etc. Users are not satisfied with the old image retrieval systems like the one with relevance feedback. Users today prefers systems which has good speed, gives security and most importantly users don't want to get involved in the processing, they just want an accurate results on just one click. In this paper we are going to focus on different methods which are used by image retrieval systems so far.

Keywords:- Content Based Image Retrieval (CBIR), Red Green Blue model (RGB), Global Color Histogram (GCH), Local Color Histogram (LCH), Cyan Magenta Yellow model (CMYK), Hue Saturation Value (HSV), Hue Lightness Saturation (HSL).

1. INTRODUCTION

There are many image retrieval systems available which follow different techniques. Traditionally image retrieval was based on captions provided with the image. But using captions of image in image retrieval was not appropriate because anyone can alter the caption, and also the fact that caption cannot cover all the information related to image. Then came the image retrieval system which focuses on the relevance feedback. In relevance feedback, every time a result is displayed we have to give a feedback manually that, out of the result displayed which are more matching to our input image. In this way, this feedback is taken as a new input and again enhanced result is displayed. But users soon found out that giving such feedback every time is very tedious and time consuming job. After this came CBIR, which proved a boon in area of image retrieval. CBIR system deals with the actual content of images rather that metadata such as caption, tags, keywords etc. The word 'content' in CBIR refers to features of image like color, shape, texture, edges etc., which can be extracted from that image itself. Thus a system which uses features of image will give better indexing and give accurate results.

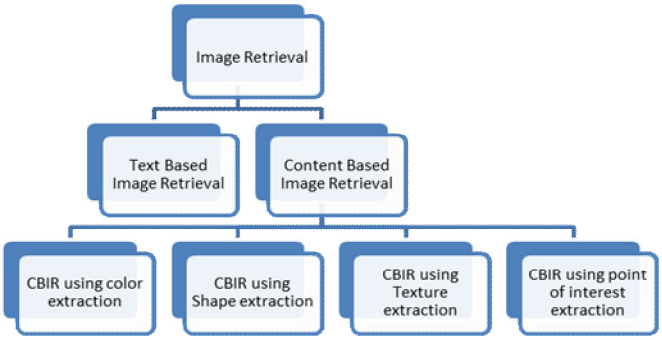

Figure 1. Types of Image Feature Extraction Techniques.

There is also a system known as text based image retrieval which is present in almost all image retrieval systems. In text based image retrieval system, text is given as an input. For example, if we want images of yellow flower to be retrieved, we will enter the query as "yellow flower images". In response to this we will get the images of yellow flower

2. TECHNIQUES FOLLOWED BY IMAGE RETRIEVAL SYSTEMS

a) Text Based Image Retrieval

In this images were searched based on metadata of image such as caption, tags etc. In this their was a misconception that image search was based on image's content.

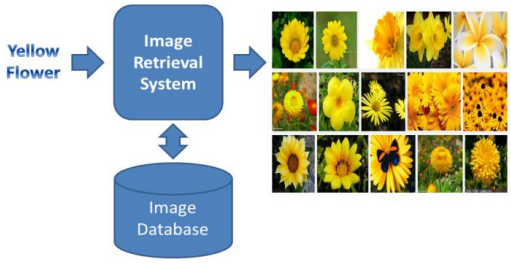

Figure 2. Text Based Image Retrieval System.

b)Content Based Image Retrieval

In Content Based Image Retrieval, visual content of image is used for matching similar images. Visual content refer to image's characteristics such as its color, shape, texture, object or any other information which can be derived from image itself. CBIR is desirable because most web-based image search engines rely purely on metadata and this produces a lot of garbage in the results.

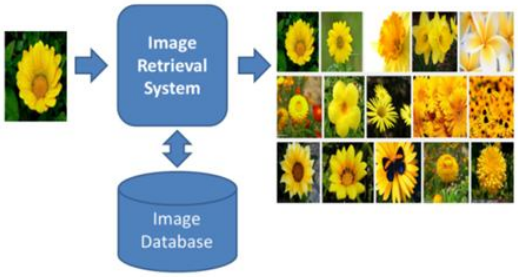

Figure 3. CBIR.

Humans manually entering keywords for images in a large database can be inefficient, expensive and may not capture every keyword that describes the image. Thus a system that can filter images based on their content would provide better indexing and return more accurate results. Figure.3 shows working of CBIR. A CBIR consists of two main parts as follows

1) Offline Part The offline part deals with building the database for images. All the images are analyzed, their features are extracted and according to their features images are clustered and indexed.

2)Online Part In Online part, user gives the image as an input. The image features are extracted and those extracted features are matched with the features present in database. If the features get matched then, image corresponding to that feature is similar to the input image. In this way matching images are retrieved and they are displayed on output screen in descending order.

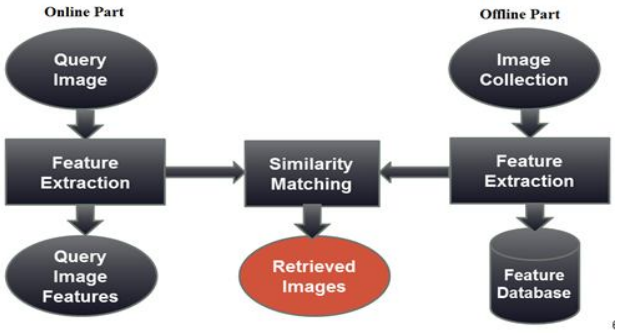

Figure 4. Architecture Diagram Of CBIR.

Figure 4 shows the architectural diagram for CBIR. Different techniques followed by CBIR are as follows:

a) CBIR Using Color Feature Extraction

Color is very crucial aspect which is used by humans to differentiate things. Color feature extraction can done in following ways:

1. Color Histograms
2. Color Moments
3. Color Correlograms

Elaboration of each color feature extraction techniques is as follows:

1. Color Histograms Color is most important aspect for humans, because through color they can distinguish things properly. Color of an image is generally expressed through color model. Color model is defined in three dimensional color spaces as follows :

a. RGB: RGB colors are known as primary colors, they are additive. New colors can be prepared by combining them differently. [3]

b. HSV: The HSV space is derived from RGB space cube with main diagonal of RGBl model with vertical axis in HSV. As saturation varies form 0.0 to 1.0, the colors vary from unsaturated (gray) to saturated (no white component). Hue ranges from 0 to 360 degrees, with variation beginning with red, going through yellow, green, cyan, blue and magenta and back to red. [3 , 4] Information about color is expressed through color histograms. In Color Histogram, every image is analyzed and its histogram is produced. In that histogram, color proportion for each pixel is shown. Color Histogram is the most universal method for color based image retrieval. The color histogram is obtained by quantizing image colors into discrete levels and then counting the number of times each discrete color occurs in the image. Color Histograms are further divided into two types:

a. Global Color Histograms In GCH, a single image will have a single color histogram.[4]

Advantage: Less computation is required. Disadvantage: In GCH, less information about an image is extracted. GCH is considered as traditional method for color based image retrieval. Sometimes we can get inconsistent results.

b. Local Color Histograms In LCH, an image is divided into segments, and further color histogram of those segments are calculated. [4]

Advantage: In LCH, more information about an image is extracted. Disadvantage: More computation is required because, every segment has to be computed. Accurate results are obtained.

2) Color Moments Color moments are used to extract color feature from an image. It is a well known method for color feature extraction. In this mean, variance and slewness are three color moments which has to be calculated in order to retrieve image's color feature. The color moment for Kth component is defined by,

$$M_K^1 = \frac{1}{XY}\sum_{x=1}^{X}\sum_{y=1}^{Y} f(x,y) \qquad (1)$$

Where,
f(x,y) : color value of Kth color component of image pixel (x,y) and XY is total number of pixels in an image. The h-th moment, h = 2, 3, . . . of k-th color component is then defined as,

$$M_K^h = \left(\frac{1}{XY}\sum_{x=1}^{X}\sum_{y=1}^{Y} f(x,y) - M_k^1\right)^{1/h} \quad (2)$$

Color moments are very compact color representation compared to other color features.

3) Color Correlogram It deals with color distribution of pixels and spatial correlation of pairs of colors. Let I be an image that comprises of pixels f(i, j). Each pixel has certain color or gray level. Let [G] be a set of G levels g1, g2, .. . , gG that can occur in the image. For a pixel f let I(f) denote its level g, and let Ig correspond to a pixel f, for which I(f) = g. Histogram for level gx is defined as:

$$hgx\ (I) \equiv Pf \in I\ |f \in Igi| \quad (3)$$

Second order statistical measures are correlogram and autocorrelogram. Let [D] denote a set of D fixed distances d1, d2, . . . , dD. Then the correlogram of the image I is defined for level pair (gx, gy) at a distance d.

$$gx,gy\ (I) \equiv Pr$$
$$f1 \in Igx\ ,f2 \in Igy\ \lfloor f2 \in Igx\ ||f1 - f2 = d|\rfloor \quad (4)$$

which gives the probability that given any pixel f1 of level gx, a pixel f2 at a distance d in certain direction from the given pixel f1 is of level gx. Autocorrelogram captures the spatial correlation of identical levels.

b) CBIR Using Shape Feature Extraction

Shape is another crucial aspect related to image feature. It is used widely in CBIR. To extract shape feature steps followed are shown in figure 5. In shape feature extraction color of image is of less importance so it is converted to grey scale image. For converting a color image to grey scale there are certain techniques which are as follows:
A. RGB Averaging formula In this average of RGB is taken.

$$gs = \left(\frac{R+G+B}{3}\right) \quad (5)$$

Above formula can also be written as,

gs=r*0.33+g*0.33+b*0.33 (6)

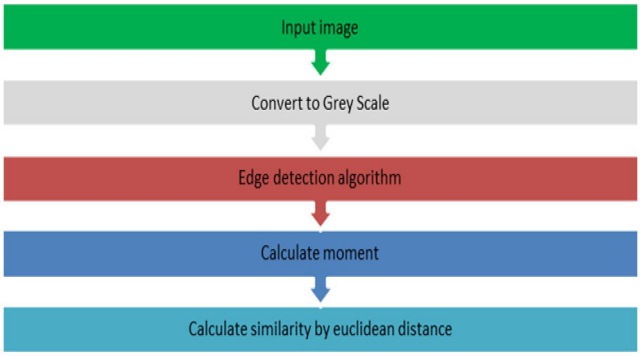

Figure 5. Steps for shape feature extraction.

33% of all colors is used to compose final 100% grey scale component.

B. NTSC formula

NTSC formula is written as,

$$gs = r*0.33 + g*0.56 + b*0.11 \quad (7)$$

NTSC formula takes 56% of green, 11% of blue, since green color has more luminescence or brightness than blue. After converting an image to grey scale we have to perform edge detection on it. To perform edge detection there are certain algorithms [5] available such as:

1. Canny Algorithm
2. Sobel Algorithm

Then moment is calculated as the moment is the feature for shape content.

c) CBIR using Texture Feature Extraction

Texture is a repetitive tone in an image. Texture describes visual patterns. It contains vital information about the structural arrangement of surface such as clouds, leaves, bricks, fabrics etc [5]. Texture feature can combined with other features for increasing the effectiveness of result. For calculating texture many methods are available such as
Texture based differenciation can be done by two different ways :

1) **Structural Method**

Structural methods include morphological operator and adjacency graph. They describes texture by identifying structural primitives and their placement rules. They tend to be most effective when applied to textures that are very regular.

3) Statistical Method

Statistical methods include wavelet transform, co- currence matrices, shift-invariant principal component analysis(SPCA), Tamura features, Wold decomposition, Markov random field, fractal model. The co-occurrence matrix, counts co-occurrence of pixels with grey values i and j at a given distance d. The distance d is defined in polar coordinate (d, □). The co-occurrence matrix can be defined as follows:

$$C(i,j) = card\left\{\begin{array}{c}((x1,y\ (2)\ ,y2)) \in (XY)*(XY) \\ for\ f(x,y) = i, f(x2,y2) = j \\ \square \\ (x2,y2) = (x1,y1) + (d\cos\theta, d\sin\theta); \\ for\ 0 < i,j < N\end{array}\right\} \quad (8)$$

Where card{.} denotes the number of elements in the set
The Tamura features are coarseness, contrast, regularity, roughness etc. Coarseness and contrast have earlier been used in applications like photobook and QBIC. Wold features defines texture in form of perceptual properties. The three Wold components, harmonic, evanescent, and indeterministic, correspond to periodicity, directionality, and randomness of texture respectively. Periodic textures have a strong harmonic component, highly directional textures have a strong evanescent component, and less structured textures tend to have a stronger indeterministic component.

d) CBIR Using Point Of Interest

Point of interest is based on Harris detector. The Harris detector gives the point of image that present brutal change in contour directions. We compute these points using Harris matrix. If p1 and p2 are point of interest from image, V1 and V2 are their invariant vector, the Mahalanobis distance is given by,

$$D_m(V1, V2) = \sqrt{(V1, V2)^T M^{-1}(V1 - V2)} \quad (9)$$

If this value is high relatively to the total number of interest point, we have a good similarity. If value is low we have bad similarity.

3.Comparison of techniques followed by CBIR systems

Following is the data table which compares techniques followed by different CBIR systems.

Table 1. Comparison of referred research papers.

Research Paper	Publication and Author	Techniques	Conclusion
Yet Another Content Based Image Retrieval system	14th IEEE, International Conference Information Visualisation Samy Ait-Aoudia, Ramdane Mahiou, Billel Benzaid	Color - HSV Texture – contrast, entropy, energy and inverse differential moment Point of interest - Harris detector	This paper attempts to evaluate the performance of the YACBIR system on sample datasets of images. The system gives good results on the tests conducted.
Content Based Image Retrieval Using Color and Shape Features	IJAREEIE, November 2012 Reshma Chaudhari, A. M. Patil	Color – HSV Shape – Mass, Centroid and Dispersion	In this they have improved the accuracy of CBIR from 44% to 72%
Image Retrieval by Using Colour, Texture and Shape Features	IJAREEIE, April 2014 Prof. C. S. Gode, Ms. A. N. Ganar	Color – Color Histogram(HSV) Texture – Co-occurence matrix Shape – Canny Algorithm, moment.	Satisfactory results
Sketch Based Image Retrieval System Using Wavelet Transform	IJIRD, April 2013 Sonal Shinde, Priya Nanaware, Godavari Kudalikar, Harpreetkaur Nagi	Shape – Wavelet Transform Fuzzy C-Means-Clustering of images Lucene Algorithm – Indexing	Satisfactory results

4.Conclusion

There are many CBIR systems developed across the world. They all use features like color, shape, texture and point of interest individually or in combination. We have focused on some important feature aspects related to CBIR. If these features are used individually they give results accordingly, which means if only color feature is used, images having same color features will be retrieved. From the above research [3, 4 ,5] we have concluded that when we use this features like color, shape, texture, point of interest etc., in combination we yield better results.

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