Querying Images by Content Using Color, Texture and Shape

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Abstract: *The existing system uses a keyword to search an image. Suppose we have to search for an image of an apple, keyword should be "apple" & images related to apple will be displayed accordingly. These images are stored in a database and are displayed according to the keywords. The objective is to extract visual content of an image automatically like color, texture and shape. In proposed system, the user input a query image and then the system extracts the image feature and measure the distance with images in the database. An initial retrieval list is generated. The user can choose the relevant image to further refine the query and this process can be iterated many times until the user find the desired images. In this, the color is retrieved using RGB color space and histogram method. The edge detection method is used for finding shape or edges of an image. The Euclidean Distance is used for similarity measure between query image and database images. Finally, images are successfully retrieved for query image.*

Keywords: CBIR, histogram

1. Introduction

Query By Image Content (QBIC) is also called as Content Based Image Retrieval. Content based image retrieval is oppose to the Concept Based approaches [19]. „Content-Based" means the search analyze the actual contents of the image rather than the metadata such as tags, keywords or descriptions associated with the image. The „Content" is refer to the colors, shapes, textures or any other information that can be derived from the image itself. Most of the web based image search engines rely purely on metadata and this produces a lots of garbage in the results, so as compared to this CBIR desirable. Human manually enter keywords for images in the large database that can be inefficient, expensive and may not capture every keyword that describes the image. So the system can filter images based on their content provides better indexing and return more accurate results.

Searching

This module performs intensive searching of images from the database. User gives his query image and based on various algorithms a set of images are generated. The query is taken up and according to the algorithm given a set of related images is generated. This module searches for the images in the database according to the specified algorithm. To generate more relevant images, the number of search images can be decreased. Now if the user is not satisfied by the images generated, he/she can perform the search test again and again, until it generates the desired image.
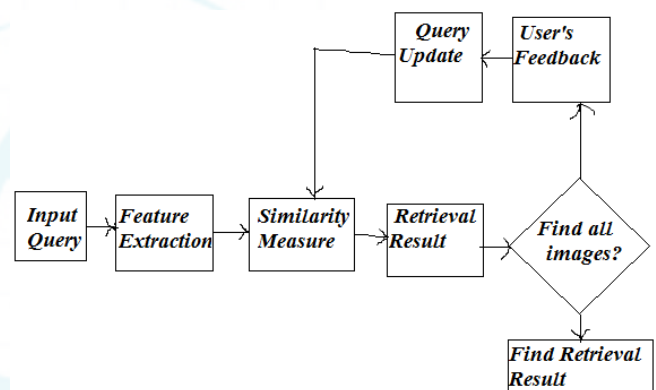

Figure 1: Working of the CBIR System

Filter

Filtering refers to accepting(passing) or rejecting certain frequency components. For example, a filter passes low frequencies is called a Lowpass Filter. The net effect produced by a lowpass filter is to blur(smooth) an image. We can accomplish a similar smoothing directly on the image itself by using spatial filters(also called spatial masks, kernels, templates, and windows).

In this, Lowpass filter is used. The lowpass filters are used for blurring and for noise reduction. Blurring is used in preprocessing tasks, such as removal of small details from an image prior to (large) object extraction, and bridging of small gaps in lines or curves.[15]

Histogram

In a gray level image the probabilities assigned to each gray level can be given by the relation below :

$$P_r(r_k)=n_k/N \quad 0< r_k <1 \, , \, k=0,1,2……L-1 \qquad (1)$$

Where r_k is the kth intensity value and n_k is the number of pixels in the image with intensity r_k .N are the row and column dimensions of the image.

Use of Histogram

Histogram are simple to calculate. It give information about the kind(Global appearance) of images & its properties. Histogram is used for image Enhancement. Histogram is

used for image Compression. Histogram is used for image Segmentation. It can be used for real time processing.

2. Related Work

Edge Detection
It is the process of identifying and locating sharp discontinuities in an image. The discontinuities are changes in pixel intensity which characterize boundaries of objects in a scene.

Canny Edge Detection Algorithm
The Canny edge algorithm is also called as optimal edge detector. Canny J. F[11] followed a list of criteria to improve current method of edge detection.
1) Low Error Rate-In that, edge occurring in the image should not be missed and there is no response to the non-edgeds.
2) The edge points be well localized- In this, the distance between edge pixels found by detector and the actual edge is to be minimum.
3) One response to a single edge- In this, for the single edge there is only one response. To find edges there are 6 steps are as follows:

Step No. 1:-
The first step is filter out any noise of the original image before trying to locate and detect any edges. In that the Gaussian filter is used with a simple mask. The mask is smaller than the original image. The mask is slid over the image, manipulating a square of pixel at a time. In that the width of mask is larger, lower is the detectors sensitivity to noise. As soon as the localization error in the detected edges increased, the Gaussian width is increased.

Step No. 2:-
After smoothing the image and eliminating the noise, the next step is to find out edge strength by taking gradient of the image. In that, the sobel operator is used to perform 2-D spatial gradient measurement of the image. Then, the edge strength at each point can be found. The sobel operator[17] uses a pair of 3x3 convolution masks, one estimating the gradient in the x-direction(columns) and the other estimating the gradient in the y-direction(rows).They are shown below:

Table 1: The Gradient in x-direction(columns)

-1	0	+1
-2	0	+2
-1	0	+1

Gx

Table 2: The Gradient in y-direction (rows)

+1	+2	+1
0	0	0
-1	-2	-1

Gy

The edge strength of the gradient is then approximated using the formula:
$|G| = |Gx| + |Gy|$

Step No. 3:
In this, the direction of edge is computed using the gradient in the x and y direction. When the gradient in the x-direction is equal to zero, the edge direction equal to 90 degrees or 0 degrees, depending on what the value of the gradient in the y-direction is equal to. If GY has value of zero, the edge direction will be equal to 0 degrees. Otherwise the edge direction will be equal to 90 degrees. The formula for finding edge direction is,
Theta = invtan (Gy / Gx)

Step No. 4:
Once the edge direction is found, the next step is to relate the edge direction that can be traced in an image. So if the pixels of a 5x5 image are aligned as follows:

Table 3: Edge direction for 5x5 pixels images

x	x	x	x	x
x	x	x	x	x
x	x	a	x	x
x	x	x	x	x
x	x	x	x	x

When we look at "a" , there is four possible directions when describing the surrounding pixels-0 degrees(in the horizontal direction), 45 degrees(along the positive diagonal), 90 degrees(in the vertical direction), or 135 degrees(along the negative diagonal). So the edge orientation is resolved in one of these four direction depending upon which direction is closest.(e.g. if the orientation angle is found to be 4 degrees, make it as 0 degrees). The semicircle is divided into 5 region. The diagram explain below:
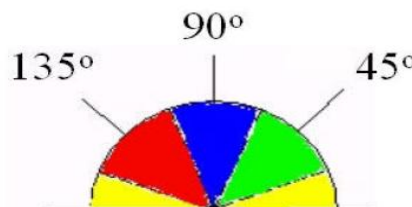

Figure 2: Edge direction falling with their ranges

So any edge direction falling within the yellow range (0 to 22.5 & 157.5 to 180 degrees) is set to 0 degrees. Any edge direction falling in the green range (22.5 to 67.5 degrees) is set to 45 degrees. Any edge direction falling in the blue range (67.5 to 112.5 degrees) is set to 90 degrees. And finally, any edge direction falling within the red range (112.5 to 157.5 degrees) is set to 135 degrees.

Step No. 5:-
After the edge directions are known, the non-maximum suppression is now applied. Non-maximum suppression is used to trace along the edge in the edge direction & suppress any pixel value (sets it equal to 0) that is not considered to be edge. This will be give a thin line in the output image.

Step No. 6:-
Finally, J. canny [12] defines hysteresis is used as a means of eliminating streaking. Streaking is the breaking   of the edge counter caused by the operator output fluctuating above and below the threshold. If the single threshold , T1 is applied to an image and the edge has average strength equal

to T1, then due to noise, there will be instances where the edge dips below the threshold. Also it will be extend above the threshold and making an edge look like a dashed line. To avoid this, hysteresis uses 2 threshold , a high and low. Any pixel in the image that has a value greater than T1 is considered as edge pixel and marked as such immediately. Then, any pixels that are connected to this edge pixel and that have a value greater than T2 are also selected as edge pixels. If we think the following edge, we need a gradient of T2 to start but we do not stop till we hit a gradient below T1.
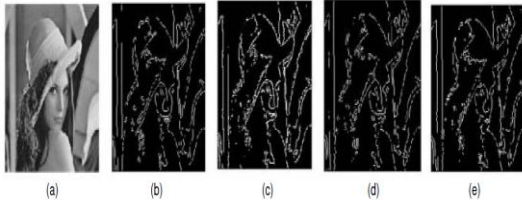

Figure 3: Comparison of Edge Detection Techniques on (a) Lena Image Original Image (b) Canny Method (c) Roberts Edges (d) LOG edges (e) Sobel.

Similarity/Distance Measures

In Similarity/Distance Measures, we can calculates the visual similarities between a query image and image in the database. Accordingly, the retrieval result is not only a single image but also a list of image ranked by their similarities with the query image. Many similarity measures are based on distribution of image features in recent years. Different Similarity/Distance Measures will affect on the retrieval performances of an image retrieval system.

Euclidean Distance

It is the distance between two points in euclidean space. P and Q are the two points in the two dimensional euclidean space and P with the coordinates(p1, p2), Q with the coordinates(q1, q2). The line segment with the endpoints P and Q forms the hypotenuse of the right angled triangle. The distance between two points p and q is defined as the square root of the sum of the squares of the differences between the corresponding coordinates of the points. The Euclidean Distance between two points a=(ax, ay) and b=(bx, by) is defined as:

$$d(a,b) = \sqrt{(bx - ax)^2 + (by - ay)^2}$$

(2)

Performance Evaluation

To evaluate the performance of retrieval system, there are two measurements called as recall and precision, are borrowed from traditional information[18]. We can take query q and data set of images in the database that are relevant to query q is denoted as R(q) and the retrieval result of the query q is denoted as Q(q).The precision of the retrieval is defined as the fraction of the retrievad images that are indeed relevant for the query.

$$Precision = \frac{Number\ of\ relevant\ images\ retrieved}{Total\ number\ of\ images\ retrieved}$$

$$Recall = \frac{Number\ of\ relevant\ images\ retrieved}{Total\ number\ of\ relevant\ images\ in\ database}$$

$$precision = \frac{|Q(q) \cap R(q)|}{|Q(q)|}$$

(3)

The recall is the fraction of relevant images that is returned by the query:

$$recall = \frac{|Q(q) \cap R(q)|}{|R(q)|}$$

(4)

Objectives

1) This is aims to introduce the problems and challenges concerned with the design and the creation of CBIR systems, which is based on a free Database oriented Image retrieval System.
2) To extract visual content of an image automatically, like color, texture, or shape.
3) With the help of the existing methods, describe a possible solution how to design and implement a task specific descriptor, which can handle the informational gap between a source and images in a Database, making an opportunity for the efficient search hereby.

3. Proposed Work

Relevance feedback is an interactive process that starts with normal CBIR. The user input a query, and then the system extracts the image feature and measure the distance with images in the database. An initial retrieval list is then generated. User can choose the relevant image to further refine the query, and this process can be iterated many times until the user find the desired images. In many cases if we want to search efficiently some data have to be recalled. The human is able to recall visual information more easily using for example the shape of an object, or arrangement of colors and objects. Since human are visual type, we look for images using other images, and follow this approach also at the categorizing. In this case we search using some features of images, and these features are the color, texture and shape. Our purpose is to develop a content based image retrieval system, which can retrieve using features like color, texture and shape in frequently used databases.

4. Result & Discussion

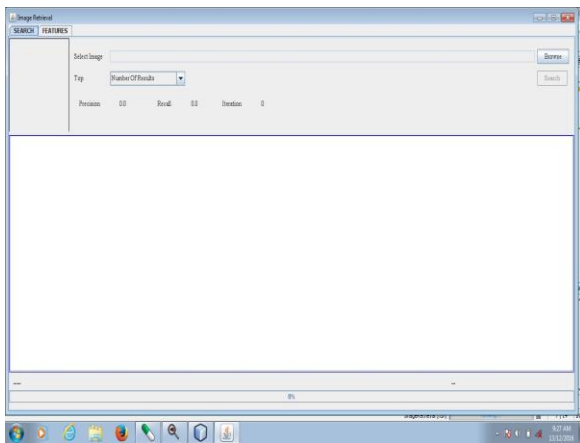The figure 4 shows the startup screen of the CBIR system.

Figure 4: StartupScreen

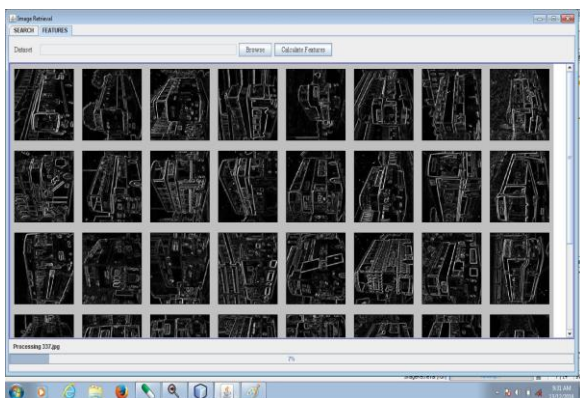The next image file shows the feature calculation for images.

Figure 5: Feature Calculation of Images

The next image file shows searching for images. There are some folder in which images are saved.
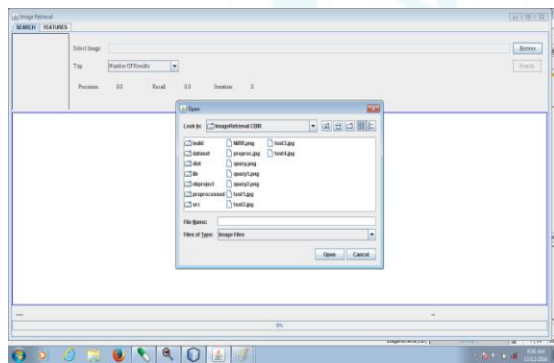

Figure 6: Selection of Image

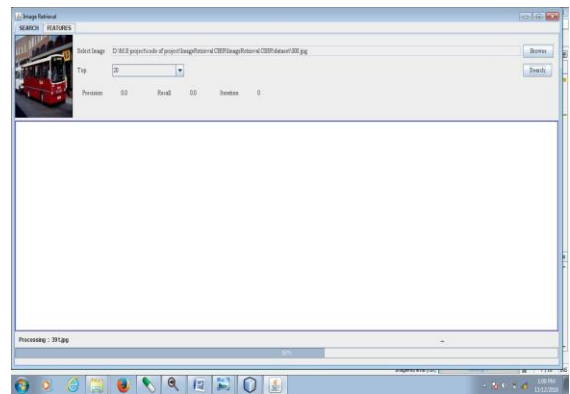The next image file shows the processing state of the system.

Figure 7: Processing of the Image Files

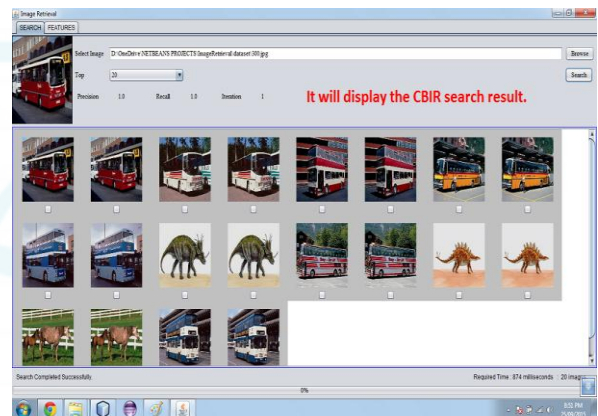The next image file shows the RESULT. This search process continues until the user gets it‟s desired image.

Figure 8: Result (Images are retrieved for given query image)

5. Conclusion

This paper has enabled us to visualize a system that proves to be more accurate in Searching and Extracting Images from databases. Unlike the conventional search methods this technique has enabled us to achieve accuracy in data mining techniques and a feedback system that enables users to get a panoramic view of how and why the specific results were achieved thus making this system more reliable with transparent operations. This paper‟s implementation in the real time Content based image retrieval systems is also of great significance since a fast accurate technique for systems like Hospital records searches, law enforcement agencies databases and government agencies record will not only improve the standards of service but also make it easier for operators to continue their work.

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