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CBIR: Repossession of Analogous Pictures exhausting Median Vector Algorithm

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Abstract: In content based image retrieval (CBIR) system, target images are sorted by feature similarities in terms of related query. Image classification is the important field in applications like security, biometrics, and in medical applications. An efficient image retrieval system is Hue, Saturation and Value (HSV) color space. This Classify the image into n number of areas based on different selected ranges of hue and value, then each area is partitioned into m number of segments based on the number of pixels it contains, the area which has more pixels will be partitioned into more segments and which has less pixels will be partitioned into less number of segments. This is used as a feature vector. Here color feature is one of the important features for image retrieval and content based image retrieval of clustering is the best method to sort the similar images. The proposed algorithms, inverse, inverse of engrave, double emboss, 3D shape detection, edge detection, gray scale, gray scale extended, color reduction and high color mode are used in the image enhancement process and color median vector algorithm is used to retrieve the similar images.

Keywords: Content-Based Image Retrieval (CBIR), HSV color space, image classification, color feature vector, similarity measure, image retrieval.

I. INTRODUCTION

Content based image retrieval system aims to retrieve the most similar images as related to the given query image. Assume there are a large number of color images in the database. Given a query image we would like to obtain a list of images from the database which are most similar in color to the query image. Solving this problem two concepts need to be developed, first the feature which represents the color information of the image and the second one is similarity measure to compute the similarity between the feature values of two images. Research on image retrieval is of high importance as it has applications in various domains such as bio-medical, remote sensing, digital library, and astronomy.

A. Previous Work

Previously retrieval systems were mostly text based only. Text based retrieval system (TBIR) needs huge amount of keyword descriptions for a single image entry in the database. TBIR gives the worst performance on the large amount of database. Thus becomes necessary to retrieve similar images for a given input query image.

B. Proposed Concept

There are two major categories of features. One is concerned with extracting boundaries of the image and the other one is logical which defines the image at various levels of details. Regardless of which approach is used, the retrieval in content-based image retrieval is done by color, texture, sketch, shape, volume and motion. Color is considered for retrieving the similar images. Fig.1 illustrated, the query image is given as input and the related images of that given query image are retrieved. The reference query image as input is converted to HSV color space. Then the adaptive segmentation is performed in which HSV color space is partitioned into m number of segments and it is used as a feature vector. This feature vector is used for comparison with the images in the database and matching for each image. Then finally retrieve the similar images of cluster.

II. HSV COLOR SPACE

A. Color

Color is the visual perceptual property corresponding in humans to the categories called red, blue, green (RGB) and others. It is a very useful attribute for image matching and retrieval. It is visible to the human eye, which represents a small range (4000 to 7000 angstroms) of the entire electromagnetic spectrum that represents everything from cosmic rays to x-rays to electric waves. All other waves ranging from cosmic rays from the stars to the FM waves to our radios cannot be perceived by the human eye.

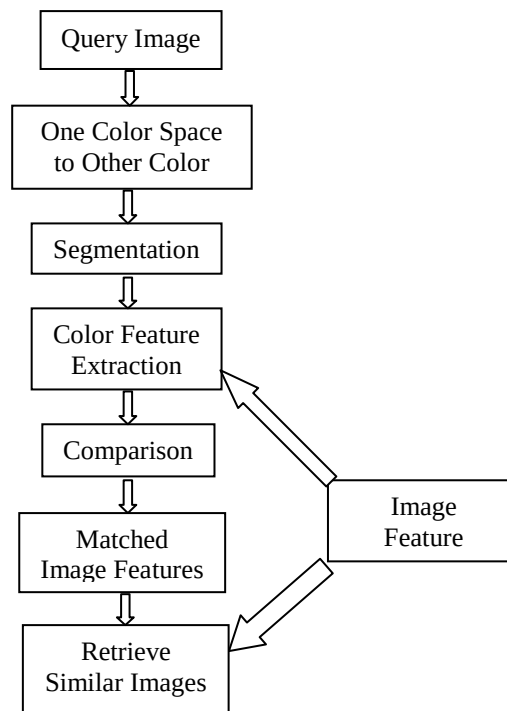
A1. Color Space: The models of human perception of color differences are described in the form of color spaces. The two primary color spaces are HSV and CIE models.

First, the HSV model represents color in its distinct components of hue, saturation, and value. The primary colors are identified as the primary set of colors that when combined together can create all of the other colors

within the visible human spectrum. Equal mixing of RGB colors produces the secondary colors of cyan, magenta, and yellow.

If we were to represent the primary and secondary colors within a color wheel, you will note that the secondary colors complement the primary colors. For example, the primary colors of red and blue mixed evenly will produce magenta, blue and green create cyan, and red and green create yellow. This process of inter-mixing colors will produce tertiary, quinary or eventually producing a solid ring of colors. This definition of color based on the combination of primary colors is also known as hue.

Figure.1. Block diagram



Saturation refers to the dominance of a particular hue within a color. A less saturated color is closer to white while a more saturated color is closer to the pure color found on the outer edge of the HSV color wheel diagram (toward the pure colors). Meanwhile, the value of a color refers to the intensity (the lightness or darkness of the color). While the two components appear to be similar, they have different effects concerning the visibility of a color.

A color that is highly saturated will have a lower value as noted from the red color. A highly valued color will have less saturation and have a color that is closer to black. Meanwhile, a minimally saturated and minimal valued color will be white.

Hence, the HSV model utilizes its components of hue, saturation, and value to quantify a color. This model's more straight-forward ability to quantify color is the reason why many CBIR'S utilize this method for color analysis.

Second, the CIE color model was developed by the French organization *Commission Internationale de L'Eclairage* developed in the first half of the 20th century. This CIE color model represents the wavelengths (400nm or 4000 angstroms for violet to 700 nm or 7000 angstroms for red) of human visible light. The color white is when all three cones are stimulated evenly.

While the CIE model is a very precise method to measure color, it is not a very practical or easy method to use to examine color. Because of this, many current CBIR'S utilize the HSV color space for image analysis.

A2. Color Histogram: The color histogram represents an image by breaking down the various color components of an image and graphs out the occurrences and intensity of each color. To compare two images, only compare the color histograms of the two images and determine the similarity of the two histograms.

First, Color histograms are a good representation of the colors presented in an image. Second, the image colors are therefore usually quantized, meaning that the number of colors is reduced, often to 64 or 256 colors.

III. PROBLEM DEFINITION

In Section III-A is described existing methodology of text based image retrieval system. In Section III-B is described the content based image retrieval system.

A. Text Based Image Retrieval

The Image Retrieval from the database using text comparison and the similarity of the images found using threshold of keywords matching. Here large number of keywords and descriptions about the image is stored with that image and the image comparison is done using text query. Also the automated annotations are now available to detect the objects in the image and automatically do the descriptions for that image. But the automated descriptions need extra computations and large amount of space rather than simple keywords that describe the image.

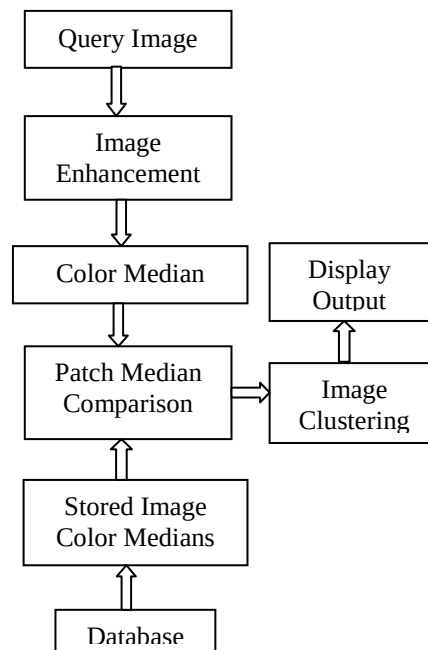
The image descriptions are given by the users and analyst who are interested in that domain. The image descriptions are then converted into text patterns used for faster comparison. The patterns contain the individual keywords extracted from the descriptions. Then the text patterns are formatted and indexed for faster accessing. Then all the formatted and indexed patterns are now stored into the database with that image.

The input text query is given to the pattern matching system. Extract patterns from the input text query and format those patterns. Get the patterns of an image from the database and compare those formatted patterns with that input patterns. If the patterns are matched as per the threshold value, add that corresponding image into resulted set.

B. Content Based Image Retrieval

There were two approaches to content-based image retrieval. The first one is based on attribute representation proposed by database researchers where image contents are defined as a set of attributes which are extracted manually and are maintained within the framework of conventional database management systems. Queries are specified using these attributes. This obviously involves high-level of image abstraction. The second approach which was presented by image interpretation researchers depends on an integrated feature extraction subsystem to overcome the limitations of attribute based retrieval. This system automates the feature extraction and object recognition tasks that occur when an image is inserted into the database.

Figure 2. Data flow diagram



Database images are preprocessed and stored in the format of relational database (RDB). Fig.2 illustrated, the query image given as input is processed to retrieve similar images and to determine the category it belongs, then compared to the relational databases. To categorize the resulted images into various clusters, the high promising images are stored in a single cluster and less promising images are stored in another cluster and the rejected images are stored in another cluster using the color median vector algorithm.

IV. PROPOSED METHODOLOGY

A. Image Preprocessing

The initial process is preprocessing the input image, for better performance. The input image has different contents and different format. Sometimes the same image is given twice with some small change in that image, but the comparison of these two images using pixel by pixel may not give the positive result. So the proposed methods with few enhancement techniques that enhance the image and then compare the image using only the modified images not the original one.

B. Image Preprocessing Techniques

The following techniques are used to enhance the input image to increase the image comparison accuracy.

B1. Inverse of Engrave: If the given input image damaged as scratch or carve for that used this inverse of engrave algorithm. This technique is extended from the engrave algorithm. Here we apply engrave algorithm then apply the image inverse algorithm.

- 1) *Double emboss:* This technique is used as the texture detection algorithm. Here we call twice the standard emboss algorithm[6].
- 2) *Gray scale:* This technique is used when the input image is very high color mode or very low color (Fig. 4) mode[6].
- 3) *3D shape detection:* This algorithm is used to detect the shape of the objects that are in the image. Here the shape is displayed as 3D view[6].
- 4) *Inverse:* This algorithm is used when the input image contains some alpha blended objects or color inversed objects[6].
- 5) *Edge detection:* This algorithm is used to find the edges of the objects in that image. Resultant image contains color lines of edges with corresponding image objects[6].
- 6) *Fine gray scale:* This algorithm is to reduce the high definition color image to fine gray scale image with promising objects alone[6].
- 7) *Fine gray scale extended:* This algorithm is the extended from the above algorithm to reduce the high definition color image to more finely gray scale image with promising objects alone[6].
- 8) *Color reduction:* This algorithm is to reduce the high definition color image (Fig. 8) in to low colored image[6].
- 9) *High color mode:* This algorithm is to increase the darken image into very high brighten, contrasted and colored image[6].

C. Calculate Color Feature Vector

The color based CBIR is used to compute the similarity of images using each pixel color value. The color value of each pixel may not be a single value it is a vector contains all measures to compute similarity. Given the input image and then enhance the input image using these techniques, results a 2D vector with rows containing enhanced image pixels. This is illustrated in the TABLE I.

TABLE I: COLOR FEATURE VECTOR

Enhancement Algorithm	(Pixel 0	Pixel 1	...	Pixel n)
INVERSE OF ENGRAVE	0	1	...	n
DOUBLE EMBOSS	0	1	...	n
3D SHAPE DETECTION	0	1	...	n
INVERSE	0	1	...	n
EDGE DETECTION	0	1	...	n
FINE GRAY SCALE	0	1	...	n
FINE GRAY SCALE EXTENDED	0	1	...	n
COLOR REDUCTION	0	1	...	n
HIGH COLOR MODE	0	1	...	n

Now compute the following for each pixel of the above color feature vector.

- (1) RED, GREEN and BLUE Components [RGB]
- (2) HUE, SATURATION and VALUE Components [HSV]
- (3) Commission International de L'Eclairage [CIE - LUV]

Now we obtain the color feature vector V. This vector is used for image similarity computing.

D. Image Comparison

The similarities of the images are computed using the color feature vector, which is computed using the vector algorithm. The similarity computing algorithm is given below.

Inputs are Threshold Value T, Threshold Range (T/n)

Consider Clusters C [(T/n), T]

Compute Color Feature Vector V for Query.Image;

Compute Median Vector M for Query.Image;

For I ← 1 to All_Images (Database.Images)

Compute Color Feature Vector V for Database.Images (I);

Compute Median Vector M for Database.Images (I);

For J ← 1 to All_Patches (Database.Images (I))

Val ← Comp_Patch (Query.Image.M, Database.Images

(I).M,J);

D ← Threshold_Val (Val, T, (T/n));

C [D, T] ← Database.Images (I);

Next J

Next I

Display_All (C);

E. Median vector algorithm

- 1) **Determining Patches:**
 - a) Divide the image into number of small images as perfect squares.
 - b) Each square is called a patch.
 - c) The patch size was given by the user, but it should be of size $n \times n$.
 - d) 3×3 is the default patch size.
 - e) Also patches are completed correctly to the image. According to the patch size image which should be re-sized initially.
- 2) **Processing Patches**
 - a) The patches are used for computing the median for all the 12 components of all the pixels in the color feature vector.
 - b) The median is computed for each patch to the entire color feature vector.
 - c) The median vector is used to compute the similarity of the images.
- 3) **Compare Using Patches:**

Fig.3 illustrated, threshold value (T), patch size and cluster conditions are given by user only. All the database images are preprocessed, then those preprocessed images are stored in created database, and then RDB is prepared for that created database. The input query image also preprocessed and then compared to the RDB for compute the color feature vectors. Then calculated the matched patches using the comparison.

According to threshold value images are formed many clusters.

Now C contains all the clusters and user may try to get the cluster that is required. Also the user views the output images that are systematically similar.

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Fig.3 given as the query image, that image also will be preprocessed. This image in high color mode, so use the color reduction technique image is preprocessed. Fig.4 shown the preprocessed images for given the query image. Fig.5 shown RDB is opened for compare the color feature vectors. Thus comparison is made by $n \times n$ vectors then calculated the matched patches and then images are stored in the appropriate clusters. Finally the high promising images of cluster is retrieved. This is done by VB.Dotnet Environment.

Figure 3. Query image



Figure 5. Open RDB

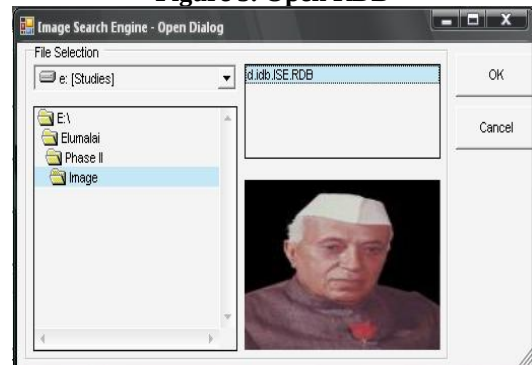


Figure 4. Preprocessed the query image

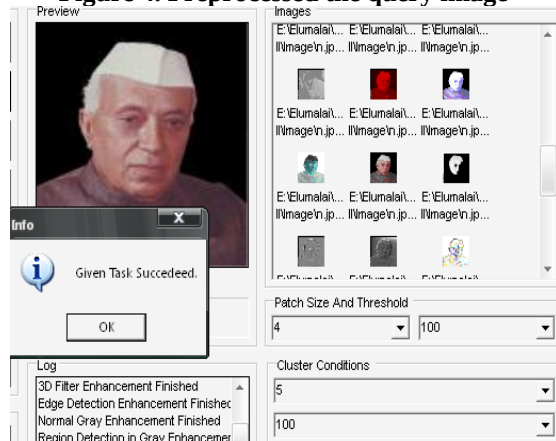
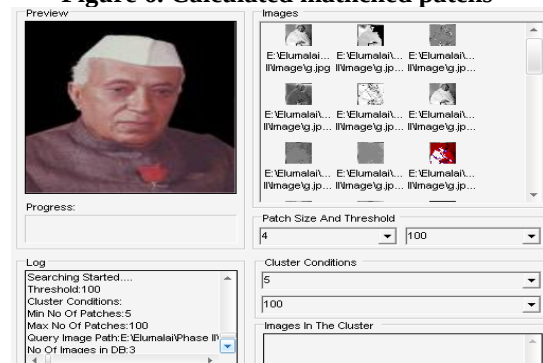


Figure 6. Calculated matched patches



F. Performance Measure

Performance measure for threshold value-50 and patch size-2

Parameters	Database Images				Query Image
					
Patch Size	2	2	2	2	2
Patch Count	1380	1292	1692	1316	1904
Original Width, Height	95,123	120,120	108,125	97,129	113,138
Selected Width, Height	92,120	120,120	108,124	96,128	112,136
Similar Patches	0	322	0	328	324

Performance measure for threshold value-50 and patch size-4

Parameters	Database Images				Query Image
					
Patch Size	4	4	4	4	4
Patch Count	690	646	846	658	650
Original Width, Height	95,123	120,120	108,125	97,129	113,138
Selected Width, Height	92,120	120,120	108,124	96,128	112,136
Similar Patches	0	161	0	164	162

Performance measure for threshold value-100 and patch size-8

Parameters	Database Images				Query Image
					
Patch Size	8	8	8	8	8
Patch Count	165	238	148	188	192
Original Width, Height	95,123	120,120	108,125	97,129	113,138
Selected Width, Height	92,120	120,120	108,124	96,128	112,136
Similar Patches	0	29	0	22	24

V. CONCLUSIONS

All the comparisons are made only with pixel colors; the image enhancement algorithms are very useful to overcome the color based image retrieval system drawbacks. The patch detection algorithm is faster, because it divided the image which has $n \times n$ pixel size into number of sub-images. Using the median vector algorithm, the clusters are formed with the use color feature vector. Finally retrieval of the most similar images of cluster is displayed to the user.

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