



Image Retrieval by Using Colour, Texture and Shape Features

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ABSTRACT: Image retrieval based on color, texture and shape is a wide area of research scope. In this paper we present a framework for combining all the three i.e. color, texture and shape information, and achieve higher retrieval efficiency. The image and its complement are partitioned into non-overlapping tiles of equal size. The features drawn from conditional co-occurrence histograms between the image tiles and corresponding complement tiles, in RGB color space, serve as local descriptors of color, shape and texture. We apply the integration of the above combination, then we cluster based on alike properties. We also create the co-occurrence matrix. Co-occurrence matrix calculate the feature vector for texture. Canny algorithm is use for edge detection to calculate the feature vector for the shape. Invariant moments are then used to record the shape features. The combination of the color, shape and texture features between image and its complement in conjunction with the shape features provide a robust feature set for image retrieval. The experimental results demonstrate the efficacy of the method.

KEYWORDS: Global color histogram, local color histogram, RGB, HSV, co-occurrence matrix, Canny algorithm.

I. INTRODUCTION

The "Content-based" means that the search analyzes the contents of the image other than the metadata. Metadata refers to keywords, tags, or descriptions associated with the image. Here, the term "content" refer to colors, shapes, textures, or any other information that can be derived from the 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. Also having humans manually enter 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.

There is a growing interest in CBIR because of the limitations inherent in metadata-based systems, as well as the large range of possible uses for efficient image retrieval. Textual information about images can be easily searched using existing technology, but this requires humans to manually describe each image in the database. This is impractical for very large databases or for images that are generated automatically, e.g. those from surveillance cameras. It is also possible to miss images that use different synonyms in their descriptions. Systems based on categorizing images in semantic classes like "cat" as a subclass of "animal" avoid this problem but still face the same scaling issues.

Image retrieval system is a computer system for browsing, searching and retrieving images from a large database of digital libraries. The use of Metadata such as captioning, keywords or descriptions to the images stored in the database along with the images or the low level feature extracted from the image like shape, color, texture etc. have been used till now for the image retrieval from the existing search engine. A user formulating a query usually has in mind just one topic, while the results produced to satisfy this query may belong to different topics. Therefore only parts of the search results are relevant for a user.



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II. RELATED WORK

Most of the search engines (ex.google, yahoo, etc..) are based on a semantic search, i.e., the user types in a series of keywords and the images are also annotated using keywords. Thus the match is done primarily through these keywords. In the recent years CBIR system have been developed to handle the large image database effectively. Basically color, texture and shape have been used for extracting similar images from an image database. Different CBIR techniques have adopted different techniques. Some techniques have used global color and texture features (3,4,5) where as some have used local colors and texture features (6,7,8). After that the method of segmentation is proposed, where the image is segmented into regions based on color and texture features. And then region to region similarity is done. The regions are closed to human perception and are used as basic building blocks of computation of feature and similarity measurement. These systems are known as region based image retrieval. But image segmentation algorithm is difficult in the human perception point of view. To ensure robustness against such inaccurate segmentation region maintaining algorithm is used. Color space is divided into small rongs. Each interval is regarded as a bin. Then matching techniques are carried out (1).

Shape is another important feature for perceptual object recognition. Various applications proposed techniques including the chain codes, characteristic, circumference, area and circular degree(9). N Grace Selvarni and Dr. S. Annuradai (12) used genricfourier shape descriptor technique. High rate of computation is observed here. Combination of edge histogram and fouries transforms for computing edge image is proposed in literature (11). Gradient method for shape feature extraction and retrieval of similar image from image database is reported in literature (2). The literature (2) proposed the gradient method for extraction of shape features from the image and to retrieve the similar image from the database. This paper uses color, texture and shape information for image retrieval to enhance the image retrieval results to a better efficiency.

III. SYSTEM OVERVIEW AND PROPOSED METHODS

1. Colour feature extraction:

The color feature is one of the most simple and widely used visual features in content-based image retrieval. It is relatively robust to background complication and independent of image size and orientation. There are different color spaces, the most commonly - RGB (Red, Green, Blue) - and the more effective to measure the color similarity between images – HSV (Hue, Saturation, Value) and HLS (Hue, Lightness, Saturation). To represent color features in CBIR system there are many techniques, such as:

- ColorHistogram ;
- Color Coherence Vector ;
- ColorCorrelogram

The most universal method is color histogram. That technique describes the proportion of pixels of each color in an image. 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. In a CBIR system, a query image is compared with the histograms of all the images in database.

1.1 Local versus global colour histogram based CBIR:

Colour histogram is divided into global colour histogram and local colour histogram. Here, we are using both the local and global colour histogram and then we are comparing their results. As our one of the aim is to show how the enhancement of image retrieval can be done by using local colour histogram instead of global colour histogram.

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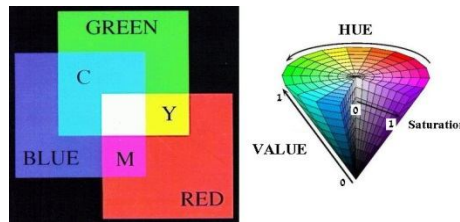
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1.1.1 Global colour histogram based CBIR:

It is colour histogram is the most known colour histogram used to detect similar images. Following algorithm shows the steps for global color histogram based CBIR:

1. Convert the images from RGB space to HSV space.



2. Quantify the images as shown below.

$$H = \begin{cases} 0 & h \in [316, 360] \\ 1 & h \in [1, 25] \\ 2 & h \in [26, 40] \\ 3 & h \in [41, 120] \\ 4 & h \in [121, 190] \\ 5 & h \in [191, 270] \\ 6 & h \in [271, 295] \\ 7 & h \in [295, 315] \end{cases}$$

$$S = \begin{cases} 0 & s \in [0, 0.2) \\ 1 & s \in [0.2, 0.7) \\ 2 & s \in [0.7, 1] \end{cases}$$

$$V = \begin{cases} 0 & v \in [0, 0.2) \\ 1 & v \in [0.2, 0.7) \\ 2 & v \in [0.7, 1] \end{cases}$$

3. Count each feature value.
4. Calculate similarity by Euclidean distance.

$$D = \sum_{i=1}^n (A_i - B_i)^2.$$

A and B are two feature vectors. n is the dimension of A and B.

1.1.2 Local colour histogram based CBIR:

In a Local colour histogram based CBIR, the image is divided into NXN tiles. The size of the tile should not be too large or too small. Here, the size of the tile considered as 3x3, as it is found to be more effective. Now for each block we repeat the same steps as explained in global colour histogram based CBIR. By comparing the results of Global colour histogram based CBIR and Local colour histogram based CBIR, it can be observed that local colour histogram based CBIR is more accurate in image retrieval. Global colour histogram based CBIR calculates frequency of colour. So, the spatial distribution of colour information is lost. So, the Local colour histogram based CBIR is found to be more effective than Global colour histogram based CBIR. Following algorithm shows the steps for local color histogram based CBIR:

1. An image is separated into 3x3 blocks
2. For each block, carried out the calculation of color space conversion and quantization
3. The normalized color feature for each block is calculated.
4. Calculate similarity by Euclidean distance.



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2. Texture feature Extraction:

Texture is a repetitive tone in an image. For calculating texture feature, co-occurrence matrix are to be computed. The flow chart shows the steps for extracting the texture feature from the images. Following algorithm shows the steps for texture feature extraction:

1. Image color conversion.

$$Y = 0.29 \times R + 0.587 \times G + 0.114 \times B$$

Y- Grey scale value

R,G, B- Red, Green and Blue colour

2. Grey-scale quantification.
3. Feature value calculation.

$$P(i, j/1, 0) = \# \left\{ \begin{array}{l} [(k, l), (m, n)] \in (Zr \times Zc) \\ |k - m| = 0, |l - n| = 1, f(k, l) = i, f(m, n) = j \end{array} \right\}$$

$$P(i, j/1, 90) = \# \left\{ \begin{array}{l} [(k, l), (m, n)] \in (Zr \times Zc) \\ |k - m| = 1, |l - n| = 0, f(k, l) = i, f(m, n) = j \end{array} \right\}$$

$$P(i, j/1, 45) = \# \left\{ \begin{array}{l} [(k, l), (m, n)] \in (Zr \times Zc) \\ (k - m) = 1, (l - n) = -1 \\ \text{or } (k - m) = -1, (l - n) = 1, f(k, l) = i, f(m, n) = j \end{array} \right\}$$

$$P(i, j/1, 135) = \# \left\{ \begin{array}{l} [(k, l), (m, n)] \in (Zr \times Zc) \\ (k - m) = 1, (l - n) = 1 \\ \text{or } (k - m) = -1, (l - n) = -1, f(k, l) = i, f(m, n) = j \end{array} \right\}$$

K, M and L,n are changes of selected calculating windows, # is the pixel logarithm.

4. Internal normalization.

$$h^{i,j} = \frac{h^{i,j} - m_j}{\sigma_j}$$

Where,

m_j- mean

σ_j- standard deviation

3. Shape feature Extraction:

Shape is another important content of the image. In shape based image retrieval first the image is converted from colored to gray scale image, as colors are of no use here. So to reduce complexity image is converted into gray scale image. Then edge detection is carried out to detect the sharp edges from the images. Edges characterize boundaries and are therefore a problem of fundamental importance in image processing. Edges in images are areas with strong intensity contrasts – a jump in intensity from one pixel to the next. Edge detecting an image significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. Here, edge detection is done by using Canny algorithm. Then moment is calculated as the moment is the feature for shape content. Following algorithm shows the steps for texture feature extraction:

1. Image color conversion.

$$Y = 0.29 \times R + 0.587 \times G + 0.114 \times B$$

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2. Edge finding by CANNY method
3. Calculate moment.
4. Calculate similarity by Euclidean distance.

IV. SIMULATION RESULTS

Results for global color histogram based CBIR:

The results for global color histogram based CBIR is shown in figure. Here, the query image is a red colored rose and all images retrieved are not compulsorily rose but all retrieved images are red in color.

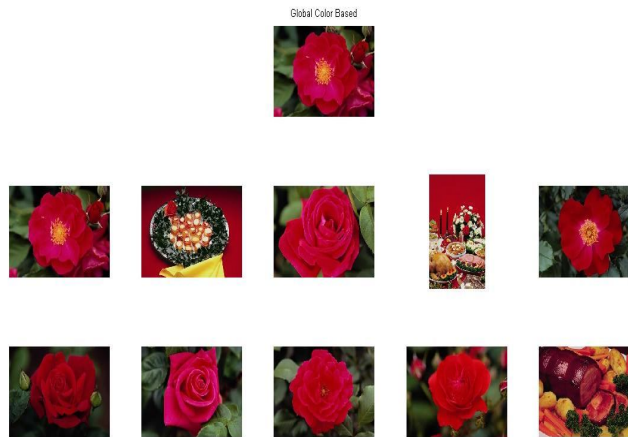


Fig.: Result for Block color histogram based CBIR

Results for local color histogram based CBIR:

Here the image is divided into 3X3 tiles. And then for each tile the features of images are calculated by color histogram. The query image is a red colored rose and all images retrieved are not compulsorily rose but all retrieved images are red in color. Here, the results are better than the results for global color histogram based CBIR.

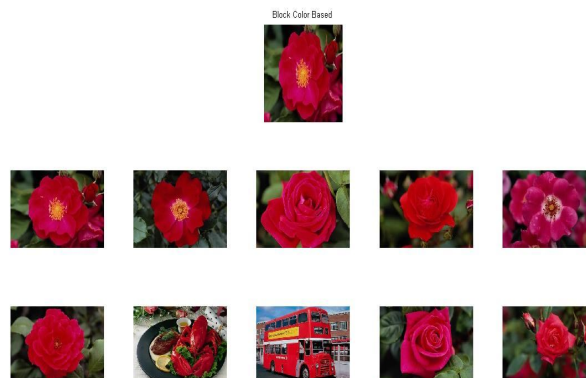


Figure.: Result for Local color histogram based CBIR

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Results for texture based CBIR:

Results for texture based CBIR is shown in figure. Texture is a repetitive tone or pattern. Here, the query image is a yellow colored bus having multiple windows as a repetitive pattern and all of the retrieved images are not yellow colored as repetitive pattern is considered as a feature for image retrieval and not the color. So, the images having repetitive pattern like windows of bus are retrieved.



Figure:Result for Local color histogram based CBIR

Results for shape based CBIR:

In shape based CBIR edge detection is done and the images for edge detection using Canny algorithm is shown in figure(a). And the results for shape based CBIR is shown in figure(b). Here, the images having approximately same shape as that of the query image is retrieved.

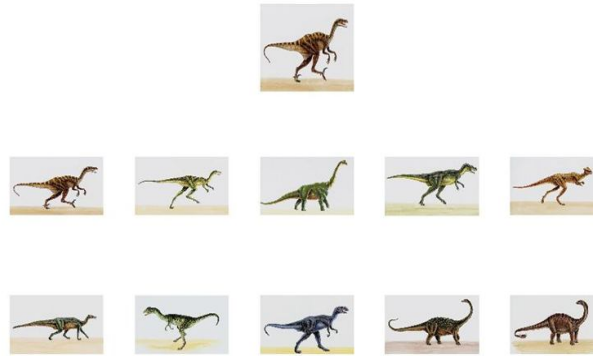


Figure(a): Results for edge detection

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Figure(b): Results for shape based CBIR

Results for texture, color and shape based CBIR:

When we combine the texture, color and shape based CBIR the results are found to be enhanced as compared to the other CBIR based on other CBIR techniques. Here, the query image is a red colored flower and in results we got all the images having red colored flower. So, the results are found to be enhanced. In figures shown above, all the retrieved images were not so accurate as we got in the CBIR based on the combination of all the three features i.e. color, texture and shape feature. So, the main purpose of the project is fulfilled here.



Fig.: Results for texture, color and shape based CBIR



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V. CONCLUSION

On the basis of previous researches, the paper explored low-level features of color, texture and shape extraction of CBIR. After comparing the CBIR based on color, texture and shape features with that of the color, texture and shape fused features, it is observed that CBIR based on color, texture and shape fused features provides better results i.e. results of color, texture and shape fused features are robust than the color, texture and shape features based image retrieval. The main aim of the project is to enhance the CBIR is satisfied in this project.

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