Image Retrieval with the use of different color spaces and the texture feature

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Abstract. Traditional text based methods are proven to be insufficient for retrieval of images from the large image data base. For large data base assigning the labels to each image using text is extremely time consuming and is valid for only one language at a time. Different users can assign different labels to the same image. To overcome these drawbacks images can be retrieved with the help of contents present in that image. This type of retrieval of image is called as Content Based Image Retrieval. Image contains two types of features High level features and Low level features. These features are nothing but the actual contents present in that image. Extracting these features we can retrieve the images. For low level feature color, RGB space is converted into HSV space and YCbCr space, for getting the better results. For image retrieval using texture, co-occurrence matrix is used. These low level features are used according to applications. In case of natural images color feature gives better result while for textured images co-occurrence matrix gives the better results.

Keywords: RGB; HSV; YCbCr; co-occurrence matrix; Euclidian distance, cityblock distance

1. Introduction

In Content Based Image Retrieval (CBIR) Content-based means that the search will analyze the actual contents (features) of the image. In the image two types of features are present Low Level Features and High Level Features. It is difficult to extract high level features like emotions, or different activities present in that image. But they give relatively more important meanings of objects and scenes in the images that are perceived by human beings. So generally low level features like color, texture, shape are used for retrieval of the image. These features are extracted from the query image; the same features are extracted from the images present in the data base. After comparing these features, closest images to our query image are retrieved. A query image is nothing but an image you already have, rough sketch you draw or symbolic description of what you want. Now a day’s retrieval of the images using content based technique is useful in many areas like medical field, satellite communication, security etc. In this paper section 2 elaborate the block diagram. Section 3 gives different methods for retrieval of the images used in this paper. In section 4 different methods for similarity measurement used in this paper are given. Proposed method with algorithm is elaborated in section 5. Results of proposed method are given in section 6. Section 7 is conclusion and section 8 is acknowledgement followed by the reference.

2. Block Diagram of CBIR
Fig. 1. Block Diagram of CBIR

Fig. 1. [2] represents the block diagram of the CBIR system. There is large number of images present in the data base. Initially query image is given, and then low level features like color, texture, or shape are extracted from the query image. Then feature vector is calculated. The same features are extracted from the images present in the data base. The database is made to store the feature vectors calculated for the images present in the database. After that similarity measurement is done. And the top closest images to our query image are retrieved.

3. Methods for Retrieval of the images using low level features

In order to use a good color space for a specific application, color conversion is needed between color spaces. There are different methods of image retrieval using low level features color, texture, and shape. In this paper two low level features color and texture are used. Converting the color images from RGB into another color spaces like gray, HSV, YCbCr, CMY and processing these images give better results. In this paper two methods are explained for color. In the first method RGB image is converted into HSV and in the second method RGB image is converted into YCbCr. Another low level feature, texture is used for retrieval of the images. In the texture based method co-occurrence matrix is used.

3.1. RGB to HSV Conversion

As shown in the fig.2, the hue of the point P is the measured angle between the line connecting P to the triangle centre and line connecting RED point to the triangle centre. The saturation of the point P is the distance between P and triangle centre. The value (intensity) of the point P is represented as height on a line perpendicular to the triangle and passing through its centre. Where, R, G and B represent red, green and blue components respectively with values between 0-255.

The convergence formulae are as follows:

\[
H = \cos^{-1}\left(\frac{1}{2}\left[\frac{(R - G) + (R - B)}{\sqrt{(R - G)^2 + (R - B)(G - B)}}\right]\right)
\]

\[
S = i - \frac{1}{R + G + B} \min (R, G, B)
\]

\[
V = \frac{1}{2} (R + G + B)
\]

3.2. RGB to YCbCr Conversion

Bitmap images use the R-G-B planes directly to represent color images. But medical research proved that the human eyes have different sensitivity to color and brightness. The eye is more sensitive to changes in brightness than changes in color. Thus there came about the transformation of RGB to YCbCr [3]. The
difference between YCbCr and RGB is that, YCbCr represents color as brightness and two color difference signals. In YCbCr, Y is the brightness (luma), Cb is blue minus luma (B-Y) and Cr is red minus luma (R-Y). While RGB represents color as red, green and blue. The transformation of RGB color model to YCbCr color model is,

\[
\begin{align*}
Y &= (77/256)R + (150/256)G + (29/256)B + 16 \\
Cb &= -(44/256)R + (57/256)G + (113/256)B + 128 \\
Cr &= (193/256)R + (219/256)G + (151/256)B + 128
\end{align*}
\]

3.3. Texture

Texture [1] is defined as structure of surfaces formed by repeating a particular element or several elements in different relative spatial positions. Generally, the repetition involves local variations of scale, orientation, or other geometric and optical features of the elements. Image textures are defined as images of natural textured surfaces and artificially created visual patterns. It contains important information about the structural arrangement of the surface. E.g. clouds, leaves, bricks, fabric, etc. It also describes the relationship of the surface to the surrounding environment. It is a feature that describes the distinctive physical composition of a surface. In low level feature texture co-occurrence matrix is used for retrieval of the images.

3.4. Co-occurrence matrix

While calculating the co-occurrence matrix [1] the image is first converted into gray scale, and then co-occurrence matrix is calculated called as GLCM (Gray Level Co-occurrence matrix). Co-occurrence matrix describes spatial relationships between grey-levels in a texture image. Each element P with position (i, j) in GLCM indicates the relative frequency at which two pixels of grey level i and j.

\[
p(i,j) = \frac{\#((P_1,P_2) \in P \text{ & } P_1 \neq P_2)}{i \neq j}
\]

GLCM is a square matrix. It has same number of rows and columns as quantization level of the image. While calculating the GLCM it is necessary to specify the size of the GLCM. If necessary mention the offset i.e. angle. To estimate the similarity between different gray level co occurrence matrices, many statistical features extracted from them, like Contrast, correlation, Energy, homogeneity etc.

4. Methods used for similarity measurement

There are different methods for similarity measurement. In this paper two methods are used. First is Euclidian Distance Measurement and second is City Block Distance Measurement.

- **Euclidian Distance**

   Similarity Measurement is done using Euclidian Distance between an image P, which present in the data base and query image Q can be given as,

   \[
   ED = \sqrt{\sum_{i=1}^{n} (V_{pi} - V_{qi})^2}
   \]

   Where, Vpi and Vqi be the feature vectors of image P and query image Q respectively with size n.

- **City Block Distance**

   The City block distance is always greater than or equal to zero. The measurement would be zero for identical points and high for points that show little similarity.

   In 2-D, the city block distance is

   \[
c(a,b) = \sum_{i=1}^{n} |a_i - b_i|
   \]

   Where a and b are vectors, with a = (a1, ..., an) and b = (b1, ..., bn)

5. Proposed Method
In the proposed method we are retrieving the images using low level features color and texture. While retrieving the images using color feature, the RGB image is converted into HSV and YCbCr. Then feature vectors are calculated in the form of HSV and YCbCr. Then the similarity measurement is done using Euclidian distance and city block distance. Then the top closest images are retrieved.

In case of low level feature texture using co-occurrence matrix Energy, Contrast, Correlation, Homogeneity these four features are calculated. Then feature vector calculation is done. On the basis of similarity measurement using Euclidian distance the top closest images are retrieved.

Algorithm of proposed method
- Data base is generated for natural images as well as textured images.
- Give Query image as a input.
- Feature vector is generated for the query image.
- Feature vectors are generated for the images present in the data base and stored.
- For natural images RGB image is converted into HSV and YCbCr images and accordingly feature vectors are calculated.
- For textured images, contrast, correlation, energy and homogeneity these four features are calculated using co-occurrence matrix.
- Similarity measurement is done using Euclidian distance and City Block distance between the query image and the images present in the data base.
- The top closest images, to query image are retrieved from the images present in the data base.

6. Results

![Images retrieved using HSV color space and Euclidian distance measurement](image1)

![Images retrieved using HSV color space and City Block distance measurement](image2)
7. Conclusion

Depending upon the application area, we are using the CBIR method for the retrieval of the images. Only one feature is insufficient for proper retrieval of the image, so in the proposed method along with the low level feature color and another low level feature texture is used. Also, while using the color feature we are using different color spaces. So, for particular application like artistic view HSV color space will give better results or for database containing images having blue or red color will give better results. The time required for retrieval of the images using HSV color space is more than the time required for retrieval of the images using YCbCr color space. In case of textured images co-occurrence matrix will give better results because textured
surface is formed by repeating a particular element or number of elements. Very less time is required for retrieval of the images using co-occurrence matrix.

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9. References


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