Content Based Image Retrieval: Survey and Comparison between RGB and HSV model

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Abstract— Content based image Retrieval is an active research field in past decades. Against the traditional system where the images are retrieved based on the keyword search, CBIR system retrieve the images based on the visual content. In this paper the performance of HSV color space is evaluated on the basis of accuracy, precision and Recall. We present HSV based color space image retrieval method, based on the color distribution of the images.

Keywords--CBIR, HSV Color space , RGB

I. INTRODUCTION

Now days, CBIR(Content based image retrieval) is a hotspot of digital image processing techniques.CBIR research started in early 1990's and is likely to continue during the first two decadesof 21st century [1].The growing demands for image retrieval in multimedia field such as crime prevention, Fashion and grapic design and biometrics has pushed application developers to search ways to manage and retrieve images more efficiently. Manual browsing the database to search for identical images would be impractical since it takes a lot of time and requires human intervention. A more practical way is to use Content based image retrieval (CBIR) technology.

CBIR has provided an automated way to retrieve images based on the content or features of the images itself. The CBIR system simply extracts the content of the query image matches them to contents of the search image. CBIR is defined as a process to find similar picture or pictures in the image database when a query image is given. Given a picture of a car, the system should be able to present all similar images of a car in the database to the users. This is done by extracting the features of the images such as colour, texture and shape [1]. These image features is used to compare between the query image and images in the database. A similarity algorithm is used to calculate the degree of similarity between those two images. Images in the database which has similar images features to the query image (acquiring the highest similarity measure) is then ranked and presented to the user.

CBIR refers to techniques used to index and retrieve images from databases based on their visual content. Visual content is typically defined by a set of low level features extracted from an image that describe the color, texture and/or shape of the entire image [2]. CBIR is the retrieval of images based on visual features such as color, texture and shape. Before CBIR was widely used to retrieve images, researchers relied heavily on text-based retrieval. Various image retrieval systems [3], including Query by Image Content (QBIC) and Visual Seek has been built, based on the low-level features for general or specific image retrieval tasks. Both the text and content based techniques have their own characteristics, advantages and disadvantages. By combining them, parts of their disadvantages can be overcome. The existing image retrieval systems are with either text-based or image-based queries, but not both. Hence, a system with integrated methods is highly needed [4].

II. CURRENT IMAGE RETRIEVAL APPROACHES

CBIR is basically a two step process which is Feature Extraction and Image Matching (also known as feature matching). Feature Extraction is the process to extract image features to a distinguishable extent. Information extracted from images such as colour, texture and shape are known as feature vectors. The extraction process is done on both query images and images in the database. Image matching involves using the features of both images and comparing them to search for similar features of the images in the database [5].

Using multiple feature vectors to describe an image during retrieval process increases the accuracy when compared to the retrieval using single feature vector. For example, searching of image based on its colour and texture provides a better result than using a single colour feature since two features are now used as indicator during matching process. In this research we focus on the method and strategies to retrieve images by using both colour and texture feature vectors to produce more accurate results.

CBIR can be classified into four categories: text-based, content-based, composite and interactive approaches. The images are indexed according to the content, like the caption of the image; filename, title of the web page, and alternate tag, etc. and stored in the database. In content-based approach, the processing of a query image involves extraction of visual features and perform search in the database for similar images. A typical CBIR system views the query image and images in the database (target images) as a collection of features, and ranks the relevance between the query image and any target image in proportion to a similarity measure, calculated from the features. The low level image features can be used to compute similarity between images [6, 7].

III. FEATURE EXTRACTION

A *Color feature of HSV*

We evaluate the content based image retrieval HSV color space of the images in the database. The HSV stands for the Hue, Saturation and Value, provides the perception representation according with human visual feature. The HSV model, defines a color space in terms of three constituent components: Hue, the color type Range from 0 to 360. Saturation, the "vibrancy" of the color: Ranges from 0 to 100%, and occasionally is called the "purity". Value, the brightness of the color: Ranges from 0 to 100%. HSV is cylindrical geometries, with hue, their angular dimension, starting at the red primary at 0°, passing through the green primary at 120° and the blue primary at 240°, and then back to red at 360° [8, 9]. The HSV planes are shown as Figure 1.

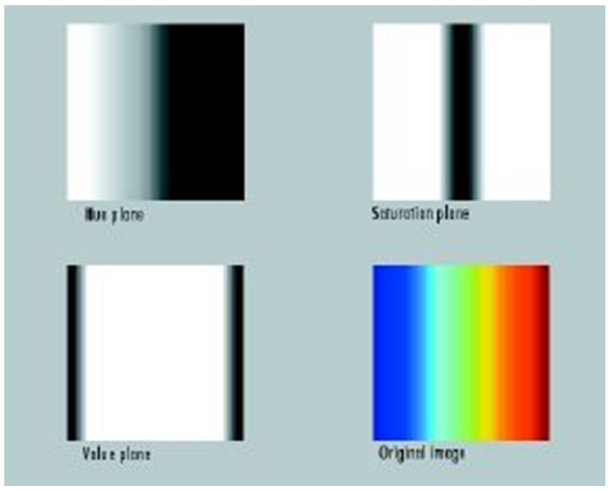

Figure 1: The Different planes of HSV color space

The quantization of the number of colors into several bins is done in order to decrease the number of colors used in image retrieval, J.R. Smith [10] designs the scheme to quantize the color space into 166 colors. Li [11] design the non-uniform scheme to quantize into 72 colors. We propose the scheme to produce 15 non-uniform colors. The formula that transfers from RGB to HSV is defined as below:

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

$$S = 1-\frac{3}{R+G+B}(\min(R,G,B))$$

$$V = \frac{1}{3}(R+G+B)$$

The R, G, B represent red, green and blue components respectively with value between 0-255. In order to obtain the value of H from 0o to 360 o, the value of S and V from 0 to 1, we do execute the following formula:

H= ((H/255*360) mod 360

V= V/255

S= S/255

The various steps to retrieve images are given below:

Step 1: Load database in the Mat lab workspace.

Step 2: Resize the image for [256. 256].

Step 3: Convert image from RGB to HSV.

Step 4: Generate the histogram of hue, saturation and value

Step 5: Quantization of values into number of bins.

Step6: Store the values of database images into the mat file

Step 7: Load the Query image.

Step 8: Apply the procedure 2-6 to find quantized HSV values of Query image.

Step 9: Determine the Euclidean distance of Query image with database.

Step 10: Sort the distance values to perform indexing.

Step 11: Display the result on GUI.

IV. EXPERIMENTAL RESULTS

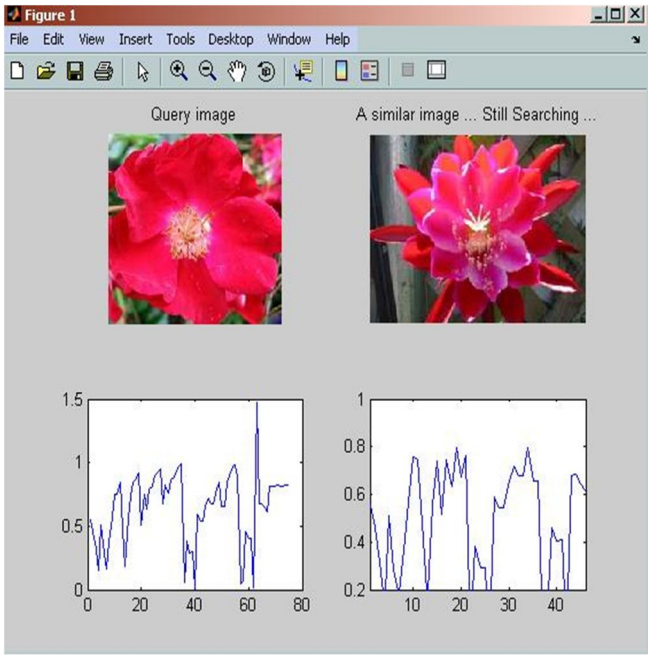

Figure1:Searching similar images

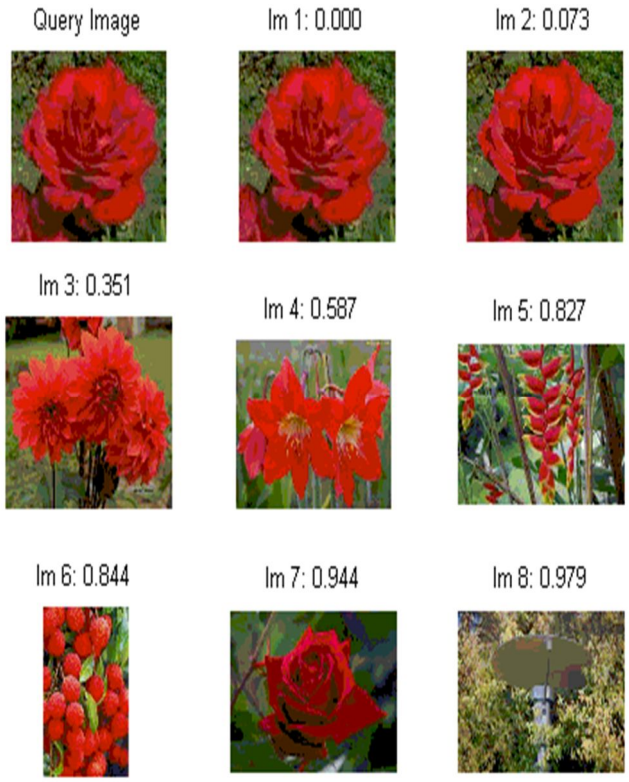

Figure 2:Images according to their closet matching score

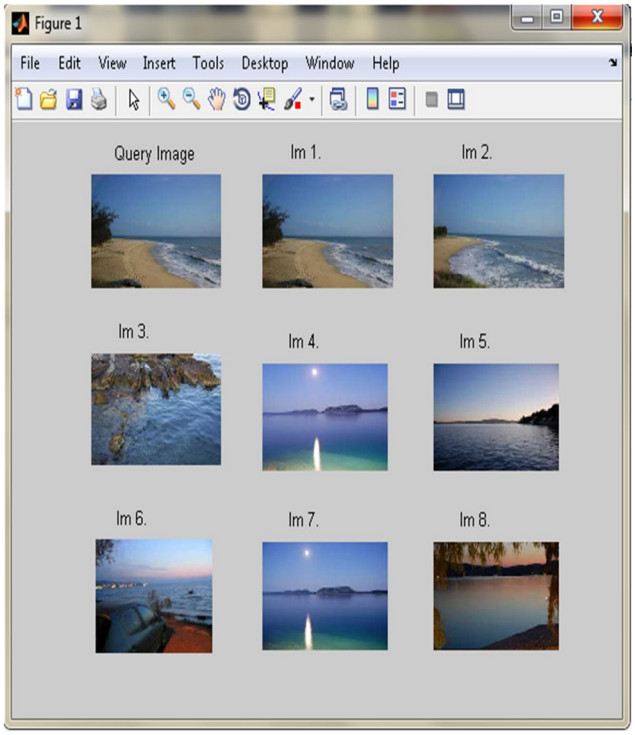

Figure 3: Images retrieved

The experiment al results can be achieved by the apply steps given above. The experimental database contains 500 images including animals, sceneries, plants and flowers taken from internet. Experimental examples are shown as Figure 2 and 3.

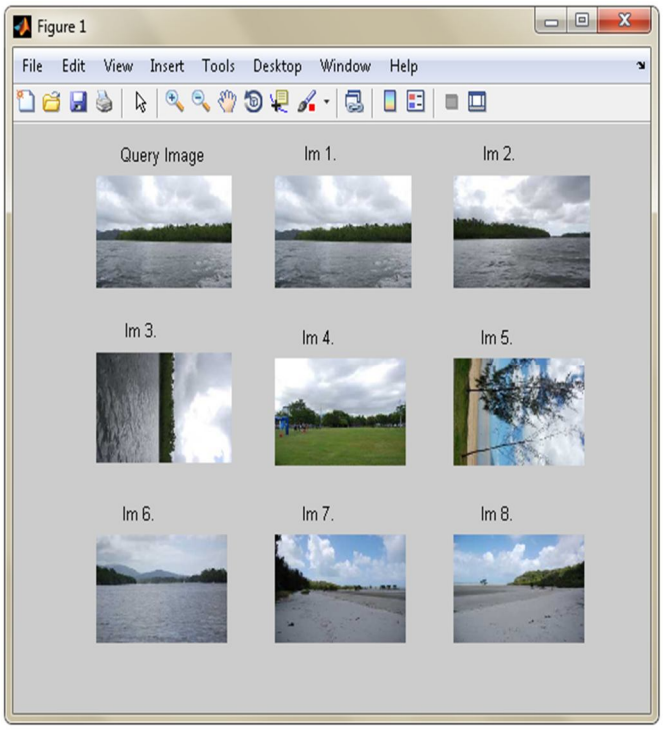

Figure 4: CBIR Recognized Images

The performance of retrieval system can be measured in terms of its recall and precision. Recall measure the ability of the system to retrieve all the models that are relevant, while precision measures the ability of the system to retrieve only models that are relevant. This HSV values has a high recall and precision of retrieval, and is effectively used in content-based image retrieval systems. They are defined as:

Precision = Number of Relevant images retrieved /Total Number of images retrieved.

Recall = Number of Relevant images Retrieved/Number of relevant images in the database.

It is observed that for lower values of recall, the precision is getting higher, which is greater than 65%. Similarly, for higher value of recall, the precision is comparable and the performance of the proposed method is encouraging g.figure 5.11 shows the comparison between HSV and RGB in terms of Precision and Recall it is observed that for lower values of Recall ,Precision is getting higher but if we compare HSV and RGB then at 0.2 precision 0.62 in case of RGB and 0.7 in case of HSV and so on.

Table 1. Accuracy of CBIR with RGB Color Model

Images	No. of Images in Database	No. of Retrieve images	No. of relevant images	Precision	Recall	Accuracy
Nature	12	10	6	0.6	0.5	0.575
	15	10	7	0.7	0.46	0.58
	20	12	9	0.75	0.45	0.6
Red Flower	12	10	7	0.7	0.58	0.64
	15	10	8	0.8	0.53	0.665
	20	10	9	0.9	0.45	0.675
Beach	12	10	5	0.5	0.41	0.455
	15	10	6	0.6	0.4	0.5
	20	10	7	0.7	0.35	0.525

Here in table 1.We have taken different images of Nature, Red Flower, Beach and from this we have calculated the parameters Precision and Recall. Precision is given by number of Relevant images retrieved to the total number of images retrieved, whereas Recall is the number of Relevant images retrieved to the number of Relevant images in the database. After calculating Precision and Recall, Accuracy for the RGB model is calculated which is the average value of Precision and Recall.

Table 2. Accuracy of CBIR with HSV Color Model

Images	No. of Images in Database	No. of Retrieve images	No. of relevant images	Precision	Recall	Accuracy
Nature	12	10	8	0.8	0.66	0.73
	15	12	10	0.83	0.66	0.75
	20	14	12	0.86	0.6	0.73
Red Flower	12	10	8	0.8	0.66	0.73
	15	10	9	0.9	0.55	0.725
	20	12	11	0.91	0.45	0.68
Beach	12	10	8	0.8	0.66	0.73
	15	10	8	0.8	0.54	0.67
	20	10	9	0.9	0.45	0.675

Here, In table 2.Similar images are taken as in RGB model and as compare to that Precision, Recall and accuracy is calculated but this time it is calculated for HSV model and accuracy obtained for HSV model is higher and better as compared to RGB model less Faulty images are retrieved in HSV model as compared to RGB model.

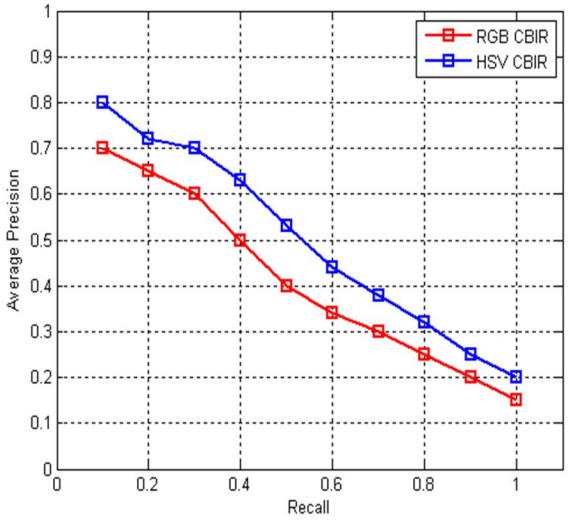

Figure5:Comparision of RGB and HSV in terms of Precision and Recall.

It is observed that for lower values of recall, the precision is getting higher, which is greater than 65%. Similarly, for higher value of recall, the precision is comparable and the performance of the proposed method is encouraging g.figure 5.11 shows the comparison between HSV and RGB in terms of Precision and Recall it is observed that for lower values of Recall ,Precision is getting higher but if we compare HSV and RGB then at 0.2 precision 0.62 in case of RGB and 0.7 in case of HSV and so on.

V. CONCLUSION

The performance of content based image retrieval using HSV color space is evaluated and then RGB and HSV model is compared. It is observed that HSV model accuracy is higher as compared to RGB model. The CBIR using HSV color space scheme transfers each pixel of image to a quantized color and using the quantized color code to compare the images of database.

REFERENCES

[1] Sharma,N.,Rawat,p.,and singh J.,Efficient CBIR using color Histogram Processing, Signal and image processing an international Journal (SIPIJ) Vol.2,No.1,(March 2011).

[2] Deb & Y. Zhang, (2004) "An overview of content-based Image retrieval techniques," Proc. on 18th Int. Conf. on Advanced Information Networking and Applications, Vol. 1, pp59-64.

[3] Sameer Antani, Rangachar Kasturi, Ramesh Jain, "A survey on the use of pattern recognition methods for abstraction, indexing and retrieval of images and video", Pattern Recognition Volume:35, Issue: 4, April, 2002, pp.945-96.

[4] Ying Liu, Dengsheng Zhang, Guojun Lu, Wei-Ying Ma, "A survey of content-based image retrieval with high-level semantics", Pattern Recognition, Volume: 40, Issue: 1, pp. 262-282, January, 2007.

[5] J R Smith, "Integrated spatial and feature image system: Retrieval, analysis and compression "[Ph D dissertation], Columbia University, New York, 1997.

[6] Jain, A & Vailaya,A ,(1996) " Image retrieval using colour and shape", Pattern Recognition, Vol. 29, pp1233-1244.

[7] M. S. Lew, N. Sebe, C. Djeraba, and et al, " Content-based multimedia information retrieval: State of the art and challenges " , ACM Trans. Multimedia Comput. Commun. Appl., Vol.2, No. 1, 1-19, 2006.

[8] D. Feng, W. C. Siu, and H. J. Zhang, " Fundamentals of Content-Based Image Retrieval, in Multimedia Information Retrieval and Management Technological Fundamentals and Applications. " New York: Springer, 2003.

[9] Nezamabadi-pour, H. & Kabir, E., (2004) "Image retrieval using histograms of uni-colour and bicolour blocks and directional changes in intensity gradient", Pattern Recognition Letters, Vol. 25, pp1547-1557.

[10] Vadivel A. ,Majumdar A. K. & Sural Shamik, (2003) "Perceptually Smooth Histogram Generation from the HSV Colour Space for Content Based Image Retrieval", International Conference on Advances in Pattern Recognition, Kolkata, pp 248-251.

[11] J R Smith, "Integrated spatial and feature image system: Retrieval, analysis and compression "[Ph D dissertation], Columbia University, New York, 1997.

[12] Li, Liu and Cao, "An Image Retrieval Method Based on Color Perceived Feature", Journal of Image and Graphics, 1999.