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Multimodal Weighted Color Histogram based Content based Image Retrieval

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ABSTRACT: Image retrieval has been one of the most important and vivid research areas in the field of computer vision over the last decades. Though many techniques have been proposed and studied for effective image retrieval, the retrieval efficiency of content based image retrieval system is still affected by the background influence of objects in images, complexity of feature vector and sensitivity to scale, rotation and illumination. To overcome these limitations, this work aims at developing efficient content based image retrieval techniques with effective and simplified feature extraction method which reduces the influence of background information and invariant to scale, rotation and illumination. The content based image retrieval techniques have been proposed namely Multimodal weighted color histogram based content based image retrieval.

KEYWORDS: Image Retrieval, Histogram, Content based.

I.INTRODUCTION

Histogram is an important tool for inspecting images and is well suited for image retrieval applications, as it produces a very strong perception to the human eye. Image histograms are very helpful in differentiating the background and foreground objects in image, in addition to identifying the dominance of bright and dark pixels. It is defined in a graphical way of visualizing the predominant intensities of an image and is usually represented in a bar graph where, each bar represents a particular color of the color space being used. The bars in a color histogram are referred to as bins and they represent the x-axis. The number of bins depends on the number of colors in an image. The y-axis denotes the number of pixels in each bin. In other words, it is defined as a count on the number of pixels at certain intensity. Histogram based technique is one of the efficient methods of describing color content of an image.

II. LITERATURE SURVEY

Noriega et al (2006) have explained the use of color histogram in image retrieval applications such as computer vision and visualization in scientific computing as it produces a strong perception of color similarity to the human eye. Color histograms are mainly useful for representing the color content of images. It is frequently used as image feature by many content based image retrieval systems, because of its computational simplicity, the features being invariant to shift and rotation. However, color histogram posses a few technical challenges such as high dimensionality, color shift due to changes in illumination, out of plane rotation, lack of spatial information. Sergyan (2008) proposed a cell based color histogram for effective image retrieval compared to global color histogram. In this technique, the color histogram features are extracted from the quantized cells. Though the above technique is effective in reducing the color space overhead, it is sensitive to rotation and translation. This drawback is overcome by another technique bin of color histogram proposed by Vu et al (2012). Here, the input image is initially quantized and divided into sequence of blocks. Color histogram is constructed for each block and processed for feature extraction. This technique is robust to rotation and translation; however the retrieval performance is degraded by the background color information on the object of interest. Thus, the influence of background is a major problem which needs to be addressed for the effective retrieval. Hence, this research work aims at developing an efficient content based image retrieval system to reduce the influence of background color

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on objects to enhance the retrieval performance.

III. PROPOSED METHODOLOGY

The proposed Multimodal weighted color histogram based content based image retrieval aims to overcome the drawback of the existing technique, modified human color perception histogram based CBIR. Multimodal weighted color histogram based Content based image retrieval aims at developing efficient CBIR technique to reduce the influence of background. In the proposed technique, object in query image is segmented using multimodal histogram. Segmented object is converted from RGB to HSV color space for faster computation. Saturation and intensity values are used to determine the color perception of a pixel. When the saturation is high and intensity is low, a pixel is considered as a gray color pixel otherwise it is considered as a true color pixel. Accordingly, in the proposed weighted color histogram, two components are updated for each image pixel, one true color component and one gray color component. The quantum of update, weight of each component is determined by the saturation as well as the intensity of the pixel. The amount of weight to be distributed is estimated using NBS distance. After distributing the weights to true and gray color components, the color histogram is updated. Updated color histogram is the feature vector of an image. Similarity between the feature vector of query image and each image in database is calculated using Euclidean distance and Manhattan distance. The retrieval performance can be improved in the proposed technique to eliminate the influence of background color information by segmenting the object of interest using peak finding histogram analysis approach. Further, the weighted color histogram is constructed as the feature vector for the retrieval. Hence, the retrieval efficiency in terms of precision and recall has been improved in the propose technique. The proposed multimodal weighted color histogram based CBIR consists of three major steps such as object segmentation in RGB color plane, generation of weighted color histogram in HSV color plane and retrieval using similarity measures.

IV ALGORITHM

Step 1: Find all points that correspond to the local maxima of the histogram.
P_0 = {(i, h(i)) when h(i) > h(i-l) & h(i) > h(i+l), lÇ i Ç 254} where, i is an integer ranging from 0 to 255.

Step 2: The points in set P_0 form a curve which connects the peaks in the histogram. Repeat step 1 to find the significant peaks, P_1 such that P_1 is a subset of P_0. P_1= {(P_i, h(P_i)) when h(P_i) > h(P_i-1) & h(P_i) > h(P_i+1), P_i c P_0}.

Step 3: Determine dominant peaks of the histogram that satisfies the following three conditions.

Case 1: If h_i / $h_{max} \leq th_1$, then remove the smaller peaks, i such that h_{max} is the highest peak in the histogram, h_{max}= h (i_{max}).

Case 2: If P_i - $P_j \leq th_2$, then maximum of two peaks, P_i is retained and the smaller peak, P_j is removed from the set.

Case 3: If h_{avg} Ç th_3, then the valley between two adjacent peaks, P_i and P_j is considered as not prominent enough to separate the two peaks and the smaller peak is removed.

Step 4: Valley between adjacent dominant peaks is considered as threshold T of that color plane. With respect to the threshold T, objects and background are classified.

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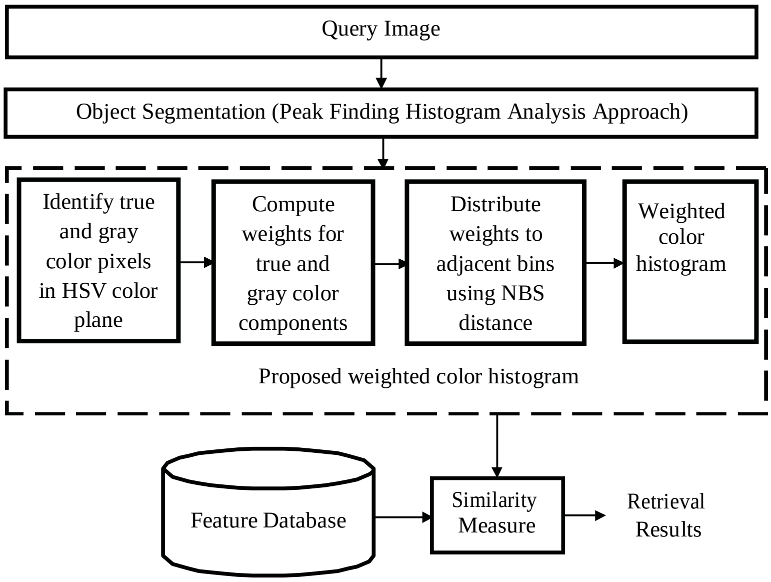

fig 1.1 Proposed Block Diagram

An automatic multimodal histogram threshold with peak finding histogram analysis approach (Cheng & Sun 2000) is used for segmenting the object from background in the query image. Threshold selection depends on the type of pixel distribution in an image and accordingly color histograms are classified as bimodal or multimodal histogram. Bimodal histogram of an image consists of only one object which is distinct from its background and a single threshold is sufficient to segment image into object and background. On the other hand, a multimodal histogram of an image is composed of several distributions if the image has a number of objects that should be distinguished from the background. After object segmentation, the edges of segmented object are smoothed using morphological opening and closing. Mask of each individual object color is fused finally to get the original RGB color of the segmented object. Figure 1.2 shows the input query image.

fig 1.2 Input query image

A major advantage of proposed multimodal threshold using peak finding histogram analysis approach is that the

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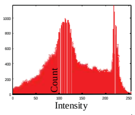
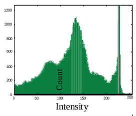
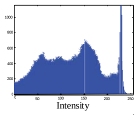
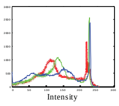
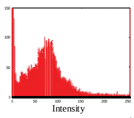
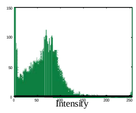
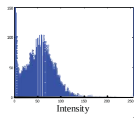
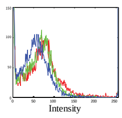
technique does not require prior knowledge about the number of objects in the image.figure1.3 shows the segmented object obtained using peak finding histogram analysis approach for the query image shown in figure 1.2.

Table 1.1 Histogram of query image and segmented object

Image	**Red plane histogram**	**Green plane histogram**	**Blue plane histogram**	**Combined RGB color histogram**
Input 				
Segmented 				

It is observed from the Table 1.1 that the color histograms of all three color planes corresponding to input image contain more number of peaks and valleys and it is difficult to isolate the object and background using simple histogram techniques. However, using peak finding histogram analysis approach, the dominant peaks are identified and the object is segmented from its background. In the histogram of segmented object, the peak corresponding to its background is fully suppressed and only the peaks corresponding to its foreground is clearly visible. After segmenting the object from background, true and gray color components have to be identified based on intensity values. The RGB color plane does not explicitly distinguish between color and intensity components for color based image retrieval. Therefore in the proposed technique, the segmented object is converted from RGB color plane to HSV color plane.

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VI EXPERIMENTAL RESULTS AND DISCUSSION

The proposed multimodal weighted color histogram based content based image retrieval technique has been implemented using MATLAB R2013a Image Processing Toolbox. The performance of proposed technique is tested with Wang dataset by various experiments. The proposed technique is tested with image samples of Wang dataset and Euclidean distance, Manhattan distance as similarity measures Retrieval performance with different distance measures Query image from various categories of Wang dataset are applied. In Wang dataset, totally ten categories of images are available with each category comprising 100 images. The performance parameters such as precision, recall and computation time are computed for various levels of retrieval from top five to top hundred images. Table 1.1 gives the performance of the proposed technique for top five retrieved images using the Euclidean Distance (ED) and Manhattan Distance (MD).

Query Image	**Top five retrieved images**					
Beach 	Results					
	ED	0	0.95	1.26	2.03	2.07
	Results					
	MD	0	5.17	5.79	12.7	14
Elephant 	Results					
	ED	0	2.41	2.44	2.47	2.57
	Results					
	MD	0	16.0	16.3	16.5	17
Roses 	Results					
	ED	0	2.46	2.55	2.56	2.66
	Results					
	MD	0	15.04	15.81	16.17	16.50

Table 1.2 Performance of proposed technique for top five retrieved images using Euclidean distance and Manhattan distance on Wang dataset.

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No. of relevant images in database under each category = 100						
Query Image	Euclidean distance			Manhattan distance		
	No.of retrieved relevant images	Precision	Computation time	No.of retrieved relevant images	Precision	Computation time
Beach 	4	80%	2.82 sec	3	60%	3.82 sec
Elephant 	3	60%	5.61 sec	3	60%	6.79 sec
Roses 	5	100%	3.92 sec	4	80%	4.12 sec

Table 1.3 Performance evaluation of top five retrieved images for the Query image given in Table 1.1

Retrieval performance comparison with the existing technique-To show the effectiveness in retrieval of the proposed technique, the retrieval results of the proposed technique is compared with the existing Modified Human Color Perception Histogram based CBIR (MHCPH). In existing MHCPH technique, updated color histograms is considered as feature vector which is formed by distributing the weights of true and gray color components using NBS distance.

Category	Existing MHCPH method			Proposed technique		
	No. of relevant images retrieved	No. of irrelevant images retrieved	Precision	No. of relevant images retrieved	No. of irrelevant images retrieved	Precision
Elephant 	6	4	60%	9	1	90%
Dinosaurs 	8	2	86%	9	1	90%
Roses 	8	2	68.42%	8	2	73.27%

Table 1.4 Performance evaluation for top ten retrieved images

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Performance parameters	Existing MHCPH method	Proposed technique
Average Precision	73 %	78.26%
Average Recall	71.3%	77.9%
Average Computation time	15.17 sec	13.44 sec

Table 1.5 Performance comparison of Existing MHCPH method and proposed technique

From the results, it is observed that the performance of proposed technique is better in terms of increased average precision and recall compared to existing MHCPH method.

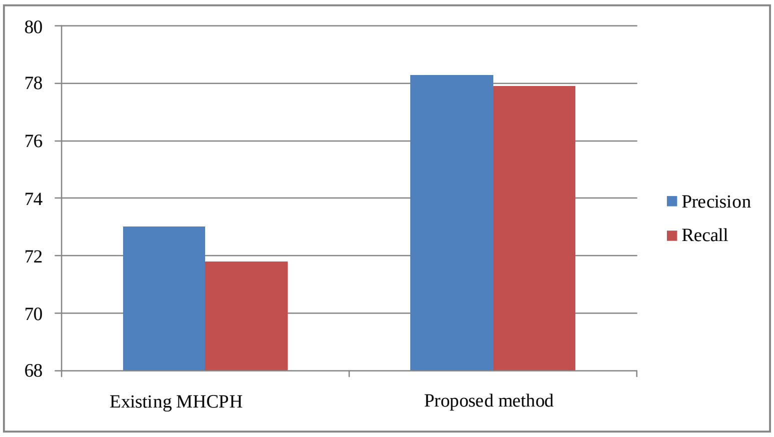

figure 1.4 shows the performance comparison of proposed technique with the existing MHCPH method in terms of precision and recall.

VII. CONCLUSION

A multimodal weighted color histogram based CBIR system has been proposed to improve the retrieval efficiency by reducing the influence of background on images during retrieval. For this, multimodal histogram thresholding using peak finding histogram analysis approach has been used for object segmentation and a weighted color histogram has been constructed and used as a color feature vector. The similarity measures used are Euclidean distance and Manhattan distance. From the experimental results, it has been found that the average precision and recall of proposed technique is better compared to the existing modified human color perception histogram based CBIR technique.

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