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Image Retrieval Based on Eten Fuzzy Color Histogram and place location



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Abstract

Image retrieval based on content, includes a group of methods, in which low level features like shape, texture, color, or high level semantic features are applied for image retrievals. One of the strong tools that today is widely used in CBIR systems, is fuzzy color histogram. Since fuzzy logic has been used widely used in determination of image effect, in this paper, we try to determine the color of each pixel in color fuzzy histogram more effectively, by use of eten fuzzy color histogram, suitable fuzzy rules, and color weight vector, and by use of place location feature for each color, increase the system's efficiency in order to extract good images from database. The results presented in this paper, show the high efficiency and accuracy of this method in suitable image retrieval from database.

Key words: fuzzy color histogram, eten fuzzy color histogram, color weight vector, place location

1. Introduction

Image retrieval based on content is one of the hot issues in recent decade. The retrieval process in these systems take place based on low level visual features and high level semantic features.[1] As the accuracy of retrieval systems highly depends on low level visual features. Today, color histograms is widely used as a good feature for image retrievals in systems [2].Whereas color histograms are calculated easily, but result in production of a feature vector with large dimensions, which increase the volume of calculations.

Many methods were suggested in order to decrease dimensions of feature vector, like applying of staring colors and color moments, and etc. [3] [4] [5] [6] [7]. Although some of these methods result in squeeze of feature vector, but have their own drawbacks.

Fuzzy color histogram, is another method that is used in retrieval systems, recently [8] [9] [10] [11] [12] Many techniques based on fuzzy color histogram, for the purpose of image retrieval are suggested. In these histograms, various color spaces like HSV, HIS, l^*a^*b ,..., and different membership functions like trapezoidal membership function and triangular membership function, are applied. In all of these methods, this opportunity is prepared for user to express his needs in a natural way and use retrieval, because of application of fuzzy logic [13] [14] [15] [16] [17] [18].

Konstantin suggested a method based on fuzzy color histogram, although his method resulted in decline in dimensions of feature vectors, and decrease in calculation costs, but this method was poor in assessing color of pixels that had compound color. As it is possible in this method, for 2 images with so insignificant differences, visually very little similarity results. Because Konstantin's method can not exactly determine the color of pixels by use of eten fuzzy color histogram, good fuzzy rules, and color weight vector, in this paper and improve the operation of retrieval system, and thus, images with little color differences, have little differences with each other. Although fuzzy color histogram has many advantages in retrieval systems, but still it is a simple color feature, as it does not produce any kind of information. Many methods are suggested for image retrieval that use both color and place data as a feature to determine similarities between images [19] [20]. In this paper we use place feature of color besides color feature as to improve operation of systems, in determining user's expected images. In section 2 of paper, we describe eten fuzzy color histogram and in section 3 tests and results will be considered and suggested method will be compared to Konstantin's method.

2. Eten fuzzy color histogram

Fuzzy color histogram is one of the features of a color image that shows, which color is used in an image designing of fuzzy color histogram include 3 stages, stage one, to determine the color space, stage two fuzzy membership functions, and the last stage is to determine the fuzzy rules, we apply Konstantin's method to determine color space and fuzzy membership functions. We applied $l^*a^*b^*$ color space, because it is close to the way that human eye recognize color, so in this color space, factor l^* is lightness, factor a^* is the portion of greenness to rubicund, and b^* is the portion of blue to yellow, and all colors can be exposed as a compound of these 3 factors. For effective use of these color components in CBIR, each of a^* and b^* components are divided into 5 areas and l^* into 3 areas [21]. Areas related to these color components are shown in [21]. Thus by means of this color space and triangular membership functions in [21] we will determine the amount of each pixel's membership ratio to each color weight vector and eten fuzzy color histogram, determine fuzzy rules(stage 3) more effectively. Whereas human eye is sensitive to its surround colors, as if number of pixels that are blue be more than green, that pixel seems to be blue. Thus the number of adjacent pixels that have different colors in image are very effective for determining the exact color of pixels that have compound colors. So we will determine weight vector of each color, after determining the amount of fuzzy membership. Whereas equation 2, weight vector for each color results from the number of pixels with desired color divided on the number of total image pixels...

$$W=(w_1,w_2,\dots,w_9,w_{10}) \quad (1)$$

$$w_n = \frac{n_r}{N} \quad (2)$$

In equation 2, w_n : is nth color weight and n_r : is the number of expected color pixels, and N : is the total numbers of pixels. The number of pixels in each color will be determined based on fuzzy rules that are listed in appendix A. In our suggested method, besides the amount of fuzzy membership of each color, color weight vector and eten fuzzy color histogram are used, too. By use of eten fuzzy color histogram and by applying the major colors [yellow, blue,

red], it is easy to determine the second degree colors [orange, green, violet, grey] third degree [yellow green, green blue, ultramarine, magenta, vermilion, yellow orange] colors, and color of pixels will be effectively determined by using of these colors besides 2 other factors in fuzzy rules, especially in compound manner. By using of the outcome rules (that are listed in table 2) each pixel will be categorized into 10 color (shown in figure 1,2) which includes black, grey, red, orange, yellow, green, jade, blue, violet, and white.

In figures 1 and 2, 2 query images and their results of fuzzy color histogram are shown. These 2 images are samples of a group of similar images available in database. The columns represented in figures 1 and 2 consist of white, violet, blue, jade, green, yellow, orange, red, grey, and black, respectively. In figure 1b, columns 5 and 6 include more pixels, because these columns, consist of yellow (leaves of trees), green (leaves of trees), respectively that with regard to image 1b, these colors are seen more than other colors in these image.

In figure 2b, columns 1, 4, and 5 consist of more pixels than other columns, because these columns consist of black (background), orange (sky), and yellow (sun) colors. With regard to all advantages that fuzzy color histogram has in retrieval systems, but still it is a simple color feature, as it does not produce any place data.

3. Color place location

With all the advantages in retrieval systems based fuzzy color histogram, but still it is a simple color specification so that does not provide any location information. In this paper, we apply the place location of each color besides the color feature that is assumed as a fuzzy color histogram. To determine the place location of each color, we put the values of x, y into their components and then by determining the average of these components, assume place location of each color as the equation 3 and 4.

$$\overline{y(i)} = \frac{\sum_{c(x,y) \in A_i} y}{N_{A_i}} \quad (3)$$

$$\overline{x(i)} = \frac{\sum_{c(x,y) \in A_i} x}{N_{A_i}} \quad (4)$$

x and y: are place location of each pixel, N_{A_i} : the number of pixels of "i" the color.

4. Experimental results

In this section, fuzzy color histogram is to be compared to Konstantin's fuzzy color histogram. We applied 1000 images in size of 256×384 , in our tests, which include 10 different types of images like flower, view, animals, mountains,... and with jpg format, whereas we applied color and place location features to determine feature vector of images in this paper. Thus the similarity parameter that is used for determining the degree of similarity between images is a combination of color histogram similarity factors suggested by Swain

and Ballard and place similarity factor suggested by Chao-Binhuang. This similarity factor is shown in equation 5.

$$sim(q, t) = \frac{\sum_{i=1}^N \min(H_q(i), H_t(i))}{\min(\sum_{i=1}^N H_q(i), \sum_{i=1}^N H_t(i))} \quad (5)$$

$$+ (1 - (\sum_{i=1}^{N_{Aq}} \sqrt{\frac{(\overline{x_{qi}} - \overline{x_{ti}})^2 + (\overline{y_{qi}} - \overline{y_{ti}})^2}{2}}))$$

In the above equation, H_t , is each image histogram from database and H_q , is query image histogram, N is the total number of columns in each image, that is supposed to be 10 in this paper $\overline{y_{qi}}$, $\overline{x_{qi}}$ are "i" the color place location in query image and $\overline{x_{ti}}$, $\overline{y_{ti}}$ are the average of "i" the color place location at database images.

All tests have been done on the software and processors 3500+ and memory 1MB. We apply 2 groups of 10 image groups available in 1000 images at COREL database, for our test. These 2 groups include images similar to figures 1 and 2. In suggested fuzzy color histogram $l*a*b*$ color space and 27 rule, based on eten fuzzy color histogram and color weight vector are used to determine the exact color of each pixel in image and put out color histogram whereas the retrieval results in figure 3. it is clear that first group of images similar to image 1 (green trees) include 20 view images that green and blue colors are more clear in them.

In second group of images similar to image 2, the results include 20 images of sunset that often include black, red, yellow colors, based on table 1 that shows retrieval results by using of 2 color histogram method for 2 groups of database images, it is clear that both methods do retrieval operation for image group similar to image 2, accurately, but fuzzy color histogram suggested by Konstantin does not operate well for image group similar to image 1, whereas our suggested method has a 95% accuracy(table 1). Thus the results show that by means of eten fuzzy color histogram and color weight vector, and good fuzzy rules, it is possible to achieve to high accuracy in retrieval systems.

The efficiency of retrieval results are measured by precision and recall methods. These values are formulated in the form of:

$$\text{Precision} = \frac{\text{total number of image retrievals}}{\text{number of accurate image retrieval}}$$

$$\text{Recall} = \frac{\text{total number of accurate image retrievals in database}}{\text{number of accurately produced images.}}$$

In most systems precision decrease, means recall increase. So an image retrieval system that results in more precision values against recall values is sufficient, as this result is clear in our suggested method in this paper. For instance, when the retrieval system returned the group of images similar to image 1, only one result was wrong or improper. Whit regard to the efficiency index in figure 4, it is clear that our suggested method, whit regard to eten fuzzy

color histogram and color weight vector and place location was able to achieve higher efficiency in retrievals more than fuzzy color histogram method.

5. Conclusion

With regard to wide application of image retrieval systems, trying to increase these systems' accuracy is one of the researchers' today research topics. Whereas fuzzy logic is useful in all science and user can express his needs in natural language, easily and thus increase the efficiency in each operation, we applied fuzzy logic in this project, as by improving applied rules in it and by using of weight vector and suggested similarity factor, we tried to

Images group	Color fuzzy histogram	Eaton color cycle fuzzy histogram
1(image 3)	85 percent	95 percent
2(image 4)	94 percent	97 percent

improve image retrievals in methods that only applied fuzzy color histogram. The results of tests in this project show higher accuracy of suggested method, than Konstantin's method.

Table 1: retrieval system's efficiency by means of color phase histogram Method and Eaton color cycle fuzzy histogram on the images 1 and 2

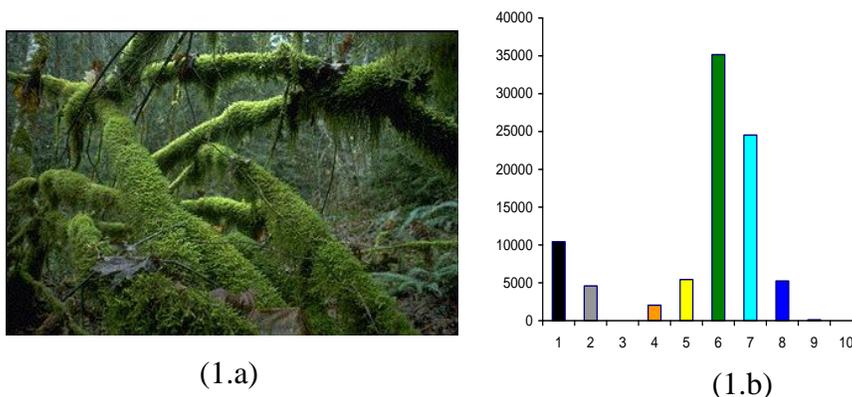


Figure 1. (a) first query image and (b) Eaton color cycle fuzzy histogram

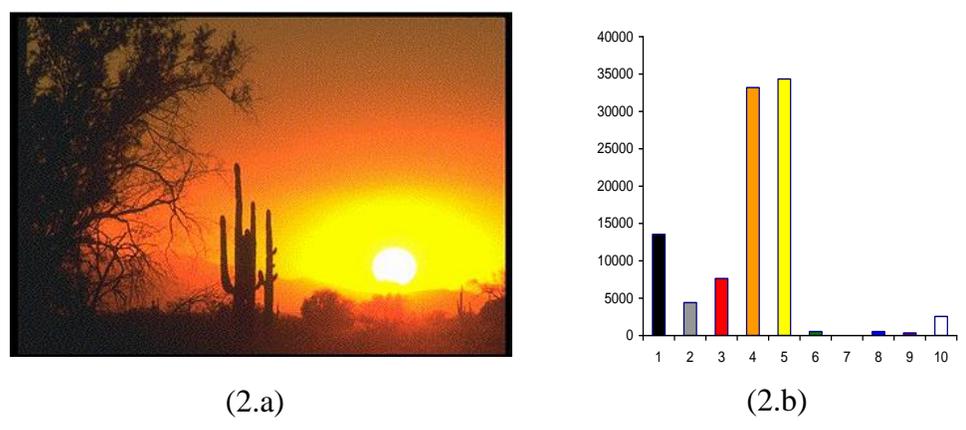


Figure 2. (a) second query image and (b) Eten color cycle fuzzy histogram

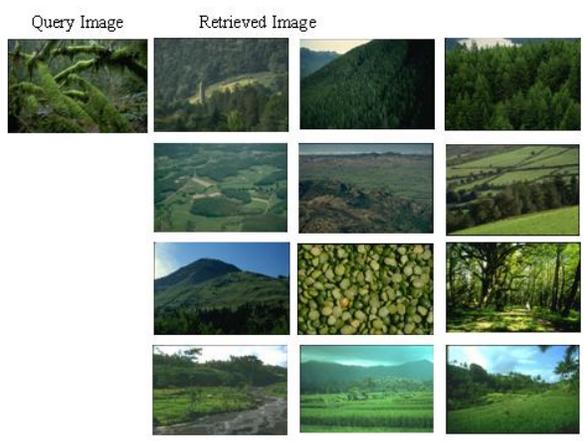


Figure 3 a: retrieval image similar to image 1 (Almost all images are similar to image 1 unless one)



Figure 3b: retrieval image similar to image 2 (all images are similar to image 2)

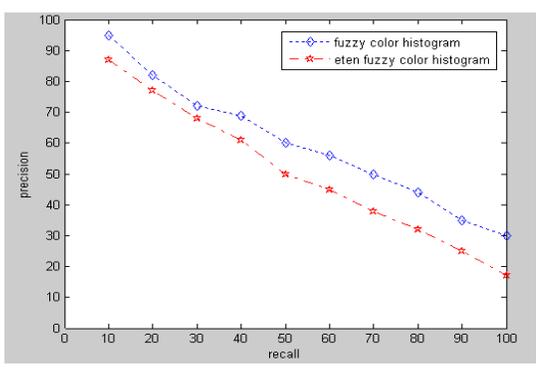


Figure 4.the contrast of 2 suggested methods in retrieval based on image 3

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1. blue+green=cyan
2. bluish+green=
 - If $W_{green} > (3/4) * w_{blue}$ = green
 - If $w_{blue} > (3/4) * w_{green}$ = blue
3. green+bmiddle
 - If $W_{green} > (3/4) * w_{blue}$ and $W_{green} > (3/4) * w_{yellow}$ = green
 - If $W_{blue} > (3/4) * w_{green}$ and $W_{blue} > (3/4) * w_{yellow}$ = blue
 - If $W_{yellow} > (3/4) * w_{green}$ and $W_{yellow} > (3/4) * w_{blue}$ = yellow
4. green+yellowish
 - If $W_{green} > (3/4) * w_{yellow}$ = green
 - If $W_{yellow} > (3/4) * w_{green}$ = yellow
5. green+yellow
 - If $W_{green} > (3/4) * w_{yellow}$ = green
 - If $W_{yellow} > (3/4) * w_{green}$ = yellow
6. greenish+bluish+white
 - If $W_{green} > (3/4) * w_{yellow}$ and $W_{green} > (3/4) * w_{white}$ = green
 - If $W_{blue} > (3/4) * w_{green}$ and $W_{blue} > (3/4) * w_{white}$ = blue
 - If $W_{white} > (3/4) * w_{green}$ and $W_{white} > (3/4) * w_{blue}$ = white
7. greenish+bluish+black= black
8. greenish+bluish+gray= gray
9. greenish+bmiddle
 - If $W_{green} > (3/4) * w_{blue}$ and $W_{green} > (3/4) * w_{yellow}$ = green
 - If $W_{blue} > (3/4) * w_{green}$ and $W_{blue} > (3/4) * w_{yellow}$ = blue
 - If $W_{yellow} > (3/4) * w_{green}$ and $W_{yellow} > (3/4) * w_{blue}$ = yellow
10. greenish+yellowish
 - If $W_{green} > (3/4) * w_{white}$ = green
 - If $W_{white} > (3/4) * w_{green}$ = white
11. greenish+yellow
 - If $W_{green} > (3/4) * w_{yellow}$ = green
 - If $W_{yellow} > (3/4) * w_{green}$ = yellow
12. (yellow or yellowish)+amiddle+white
 - If $W_{yellow} > (3/4) * w_{white}$ = yellow
 - If $W_{white} > (3/4) * w_{yellow}$ = white
13. (yellow or yellowish)+amiddle+black= black
14. (yellow or yellowish)+amiddle+gray = orange
15. (blue+ bluish)+amiddle=blue
16. amiddle+ bmiddle + black= black
17. amiddle+ bmiddle+(white or gray)+
 - (member of green>member of red)
 - If $W_{green} > (3/4) * w_{blue}$ and $W_{green} > (3/4) * w_{yellow}$ = green
 - If $W_{red} > (3/4) * w_{blue}$ and $W_{red} > (3/4) * w_{yellow}$ = red
18. $W_{red} > (3/4) * w_{yellow}$ +(white or gray) + (member of blue> member of yellow)
 - If $W_{blue} > (3/4) * w_{green}$ and $W_{blue} > (3/4) * w_{red}$ = blue
 - If $W_{yellow} > (3/4) * w_{green}$ and $W_{yellow} > (3/4) * w_{red}$ = yellow
19. redish+(yellow+yellowish)+(white+gray) = orange
20. redish+(yellow+yellowish)+(black) = gray
21. redish+bmiddle
 - If $W_{red} > (3/4) * w_{blue}$ and $W_{red} > (3/4) * w_{yellow}$ = red
 - If $W_{blue} > (3/4) * w_{red}$ and $W_{blue} > (3/4) * w_{yellow}$ = blue
 - If $W_{yellow} > (3/4) * w_{blue}$ and $W_{yellow} > (3/4) * w_{red}$ = yellow
22. reddish + bluish +(white or gray)
 - If $W_{red} > (3/4) * w_{blue}$ = red
 - If $W_{blue} > (3/4) * w_{red}$ = blue
23. reddish + bluish + black= black
24. reddish+blue = blue
25. red+ (yellow + yellowish)
 - If $W_{red} > (3/4) * w_{yellow}$ = red
 - If $W_{yellow} > (3/4) * w_{red}$ = orange
26. red + bmiddle
 - If $W_{red} > (3/4) * w_{blue}$ and $W_{red} > (3/4) * w_{yellow}$ = red
 - If $W_{blue} > (3/4) * w_{red}$ and $W_{blue} > (3/4) * w_{yellow}$ = blue
 - If $W_{yellow} > (3/4) * w_{blue}$ and $W_{yellow} > (3/4) * w_{red}$ = yellow

Table2: rule of Eten color cycle fuzzy histogram