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Color String Based CBIR for Image Retrieval

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Abstract- Content-based image retrieval (CBIR) system used in many fields of research nowadays, such as the medical field, the research field, internet and any media of communication. A method which is used to retrieved similar images depending upon a query from datasets containing many images called CBIR. A very basic issue to form a content based image retrieval system is to select the appropriate feature from the image. In our proposed method color string coding is evaluated to extract the color feature of the image and we have used this feature in an appropriate manner to find the similar images.

Keywords- CBIR, Query Image, Target Image, Feature Extraction, Color string, Color String Coding, Matching Weight.

1. INTRODUCTION

Images play a very important role in human communication and it is being used long ago. Pictures build the communication method more user-friendly and clear [1]. CBIR is the way toward finding images from huge datasets or a library of computerized images as indicating the images. In different phrases, it is the retrieving of images which have identical content of color, textures, or shapes. Processing with too amount of content commonly required a bulk amount of memory, computational power & time. This overfits the training data and generalizes poorly new samples. So feature extraction is needed to solve these problems, which constructs a combined set of elements still describing the overall information of images with adequate accuracy. In the CBIR system, the image features are mainly grouped into three main classes: color, texture, and shape [2, 3]. Theoretically, those features must be united to produce a better distinction in the similarity measurement process. A basic process of the CBIR system is shown in fig-1

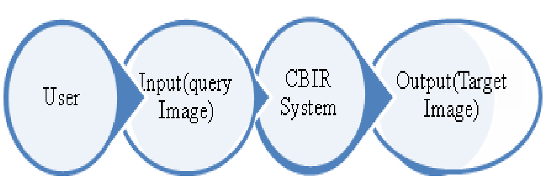

Figure 1: Basic flow diagram of CBIR

Query Image: Query image is an input which is Used in the initial phase when we start CBIR system. Query image decides what type of retrieved image (Target Image) we want.

Target Image: Target Images are retrieved images which we get to the final stage of a CBIR system as a result. Target images are as similar as query images. CBIR is an overall system now a day's which is used worldwide. It is used in many fields like research areas, education fields, hospitals etc. The uses of images reduce the communication gap of humans that's why they are used in different kind of sectors. An overall system which allows a user to retrieve images from a large image collection depends on the content is called Content Based Image Retrieval (CBIR). An image has many types of content like Color, Texture, and Shape etc. [4] by using image content we can easily identify the identical images. Content is differentiating the images from one to another. Figure 2 shows the architecture of a CBIR system.

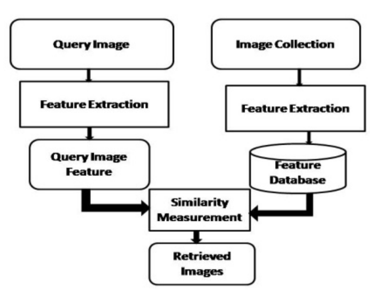

Fig 2: Architecture of CBIR Retrieval

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The overall framework of CBIR starts with the user. Firstly, an input image is put into the system as a query. Then query image as well as all the images which are present in database further process in an identical way for relevant image retrieval. Secondly, a few preprocessing approaches are probably carried out on the images, which regularly depends upon a certain goal for better retrieval. When a query image comes to the CBIR system, firstly its features are extracted, after that similarity measurement is done by using query feature vector and target image feature vector in which Feature space/Feature vector of query the image is compared with those feature space which already exists in the database [5].

2. RELATED WORK

Kommineni Jenni et al. [5] prefer a method which is majorly concentrated on database classification and efficient image representation which helps to raise retrieval time and accuracy of the overall system. Feature extraction is done by using color string coding & comparisons.

Jun et al. [6] proposed a scheme for CBIR using color, texture merge feature of an image. The color space is used in the Global and local histogram of color and both are applied to obtain color feature of the image.

Lakshmi A. et al. [7] use a technique that shows a better retrieval, interpretation using the global distribution of local feature, then this feature which shows the global nature of the image alone. The method combines the global texture (Curvelet) and color feature with local features derived from the salient feature.

Jing-Ming et al. [8] worked in order- dither block truncation coding ODBTC for CBIR. ODBTC is used to compresses the images into Quantizer and Bitmap image further used to generate the CCF (color co-occurrence feature) and BPF (Bit pattern feature) respectively and together used as a feature vector.

Jing-Ming et al. [9] describes Error diffusion block truncation coding Feature which is applied over images which give two outputs- Color & Bitmap Quantizer. Which are further processed using vector Quantization for generating the image feature descriptor. After that CHF (Color histogram feature) and BHF (Bit pattern histogram feature) is computed by using Color Quantizer & Bitmap image Quantizer.

Anu et al. [10] proposed a method of Image Retrieval Using Local Texton XOR Patterns. The method uses Local Binary Pattern and Texton which shows the overall structure feature of the image.

Liu et al. [11] discussed a deep study inside the CBIR on the unique facts to extra highlight on area-based retrieval of the image, containing low-degree feature extraction of the image, similarity dimension, and puts high-degree of semantic properties.

Priyatharshini et al. [12] have concentrated on a type of technique for analogous based image feature extraction which united visual sign and textual sign and their ranking process used in the area of CBIR. Different studies have shown especially related facts like relevance feedback [13], high-dimensional indexing [14], and image extraction learning [15].

Manno et al. [16] offer existing sketch-based image retrieval (SBIR) systems execute at a decreased level on real-life images, where background information may control image descriptors and retrieval results.

N. Angelescu et al. [17] proposed SQL based CBIR is used to improve the query process on CBIR system. It is a portable solution written in the SQL programming language.

P. Mack et al. [18] work in process for searching images from the large database they use a multi-page hashing scheme. Using the image itself to not only is efficient for identical images but similar images to some degree of fuzziness and degree of similarity as well.

A. Douik et al. [19] based on the Upper-Lower of Local Binary Pattern (UL-LBP) depends on the Local Binary Pattern (LBP) is used to describe global features of the overall image.

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3. PROPOSED WORK

In proposed work we used color string coding and comparison method for CBIR. Color string coding comparison method is based on the color feature of the image. The proposed method mainly consist of three Steps which are shown in figure 3

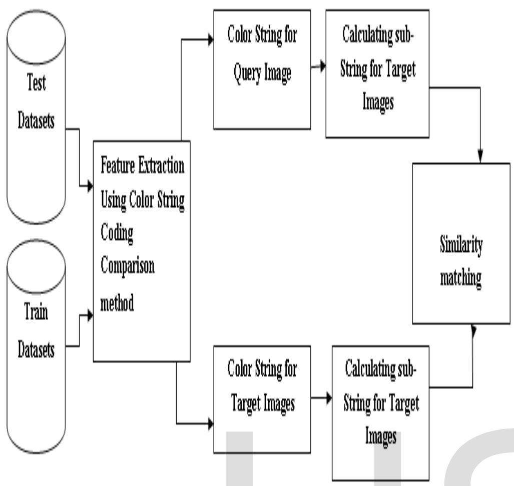

Figure 3: Color string coding and comparison based CBIR

1. **Feature Extraction-**

A. Evaluate RGB value vector of Query Image. RGB Value vector is a 3-dimensional color space. For this we extract the RGB value of each pixel of the image. After that, we apply color string coding over Query Image and find a full length color string

B. Evaluate RGB value vector for each Target Image. RGB Value vector is a 3-dimensional color space. For this we extract the RGB value of each pixel of the image. After that, apply color string coding over Each Target Image and Find a full length color string separately for each target images.

Color string coding is based on three dimensional RGB color space model [8]-

1. If the values of RGB coordinates for a pixel is **R>G>B** then allocate the pixel as (r(i), g(i), b(i)) = **'R'**
2. If the values of RGB coordinates for a pixel is **R>B>G** then allocate the pixel as (r(i), g(i), b(i)) = **'S'**
3. If the values of RGB coordinates for a pixel is **G>R>B** then allocate the pixel as (r(i), g(i), b(i)) = **'G'**
4. If the values of RGB coordinates for a pixel is **G>=B>=R** then allocate the pixel as (r(i), g(i), b(i)) = **'H'**
5. If the values of RGB coordinates for a pixel is **B>=R>=G** then allocate the pixel as (r(i), g(i), b(i)) = **'B'**
6. If the values of RGB coordinates for a pixel is **B>=G>=R** then allocate the pixel as (r(i), g(i), b(i)) = **'C'**

The meaning of various variables is:

r(i), g(i), b(i): red, green and blue coordinates
i: value for red, green and blue coordinates(between 0-255)
R: pixel color is red
S: pixel color is almost red
G: pixel color is green
H: pixel color is almost green
B: pixel color is blue
C: pixel color is almost blue

2. **Substring Calculation-** after color string coding we will get a large set of characters called color strings. For each image, length of the color string may different. So to equalize the length we Find Substring of Query Image and Each Target Image. This help to easily compare to large string bit by bit.

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3. **Similarity Matching-** Now compares Query Image color string with Each Target Image color string to find the matching weight.

Matching weight-

Matching weight is a resulted value which we will get at the end of CBIR system as a output. For matching weight calculation we compare string bit by bit.

For matching weight calculation-

i. We set a zero array(1*25) called matching weight(MW), because we used zero array so initially value of MW=0
ii. For a query we Compare one character of query string (CVQi) with another character of target string (CVTi) at the same place one by one and doing same for other target images as well.
iii. If characters on both the place are same then we add “1” on MW otherwise “0”.

For example-

Color strings for query image= RGBRRGG Color strings for target image= RBRRGBG

R G B R R G G

R B R R G B G

1 0 0 1 0 0 1

So, Matching weight for above example MW=3

By figure 4 we can see the proposed Color string coding and comparison based CBIR in detail as follows-

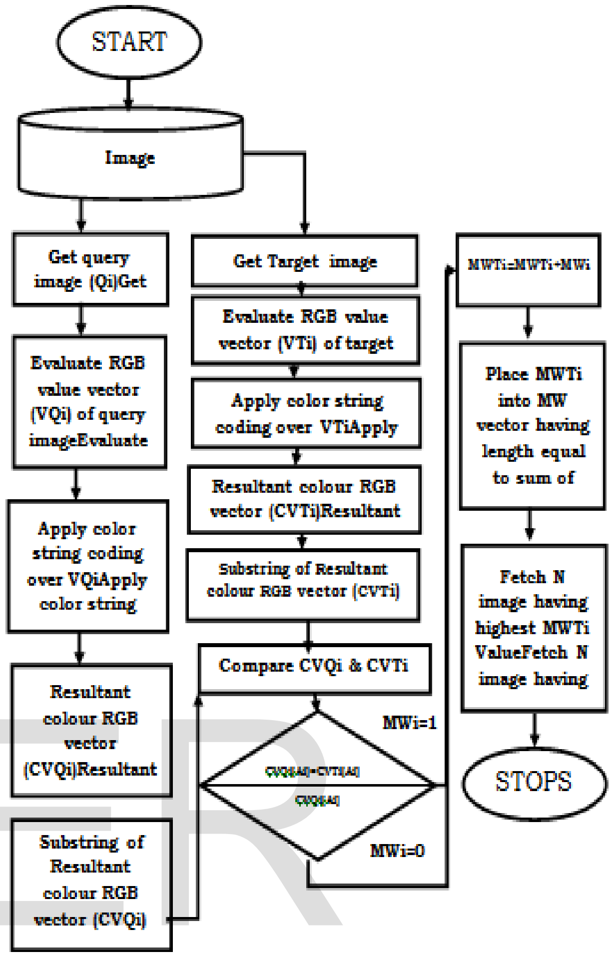

Figure 4 Flow diagram of CBIR using Color string coding

Qi- Qi is a Query image. This image is used as an input in initial step of CBIR.

Ti- Ti is Target images. All the possible resultant images are retrieved at the end of CBIR called target images. Target images are output of CBIR system.

VQi- VQi is RGB value vector of Query image in which we extract RGB values of each pixel for given query image (input).

VTi- VTi is RGB value vector of Target images in which we extract RGB values of each pixel for all the target images which is stored in image repository.

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CVQi- CVQi is color RGB vector (color strings) for query image. It is a set of character and obtained by applying color string coding over VQi.

CVTi- CVTi is color RGB vectors (color strings) for target images and obtained by applying color string coding over VTi. For each target image images we have different color RGB vector.

MWi- MWi is a matching score between two pixels.

MWTi- MWTi is over all matching weight for a particular target image when it compares to query image.

The steps of the proposed method are-

i. Firstly, user gives a Query image (Qi) input on CBIR system.
ii. The feature RGB value vectors (VQi) of this Query image is extracted because we used color feature of the image.
iii. Now **"Color String Coding"** is applied over this RGB value vector (VQi).
iv. We get color RGB vector for query image (CVQi), which a large set of character called color strings for query image.
v. Same as query image now target images are process one by one.
vi. The feature RGB value vectors (VTi) of all the target images are extracted.
vii. Now **"Color String Coding"** is applied over this RGB value vector (VTi).
viii. We get color RGB vector for each target images (CVTi) which is a large set character called color strings for target image. Color strings are different for one of each target image.
ix. After that now we get two type of color RGB vector. One is for query image (CVQi) and another is for Target Images (CVTi). Color RGB vector for target images may multiple depending upon the number of images consist on train dataset.
x. All the images are different from each other so the length of color RGB vector is different. To equalize the length we used substrings for each color RGB vector.
xi. Now we compare color RGB vector for a query image (CVQi) with all the color RGB vector for target image (CVTi) one by one and find the matching weights.
xii. The matching weight is actual result which shows the percentage of similarity among query image and target images. A Target image having high matching weight means that image is most similar to query image.

4. RESULT AND ANALYSIS

Table 1 Simulation Details

Parameter Name	Value
Language used	Matlab R2010a
Processor	Intel (R) Pentium (R)
System Type	32-bit Operating system (Window7 ultimate)
Disk Space	500 GB
RAM	2 GB

Table 2 System parameter

Parameter Name	Value
Feature of image	Colors
Feature Extraction Algorithm	Color string coding
Type of image color	Red, white, yellow, green, orange

Datasets used:

The experimental dataset of images consists 45 images from different type such as fruit (15 images), flower (15 images), and vegetable (15 images). The images are obtained from various website on the World Wide Web. We get flower dataset from [20], it is a website of James Z. Wang research group where datasets download section

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contain huge datasets. As like flower images we get fruit and vegetable images from [21] and [22].

Results Parameters-

We will find the result on the bases of matching weight (MW). For a query, the similar target images having highest matching Wight among all the images. After the image retrieval we will calculate efficacy of the CBIR in the terms of True positive rate (TPR), false positive rate (FPR), true negative rate (TNR), false negative rate (FNR) and Precision.
For each query image a matching weight table is generated. We check the highest matching weight and retrieve relevant highest matching weights from matching weight table. On each matching weight an image number is shown. That means this number of images has highest matching weight among rest of images. Once we retrieve all highest weighed matching image then we calculate TPR, FPR, TNR, FNR, and Precision.
A precision rate can be defined as the number of relevant images retrieved by a search divided by the total number of images retrieved by that search. The equation is as follows:

$$\text{Precision} = \frac{\text{Relevant Correctly Retrieved}}{\text{All Retrieved}}$$

$$\text{Precision} = A / (A+B)$$

Where, A is relevant correctly retrieved and B is falsely retrieved.

True Positive rates (TPR)
True Positive rates are a parameter of a confusion matrix. TPR shows the number of actual images is retrieved which we were wanted to retrieved.

False Positive rates (FPR)
False Positive rates are another parameter of confusion matrix. FPR shows the number of images is retrieved which we were not wanted to retrieved.

False Negative rates (FNR)
FNR shows how many number of images are not retrieved which are actually relevant to retrieved.

True Negative rates (TNR)
TNR shows how many number of images are not retrieved which are actually not relevant to retrieve.

We used image size (100*100), that means a image has 10000 pixel. For each pixel a string is generated, that means for each image we get 10000 long strings. For comparison if 40% of overall string is matched, then we consider that particular image is nearly similar to query image.

Figure 5 shows a retrieval graph for a green color query image and the result for respective query are shown by table 2 and table 3.

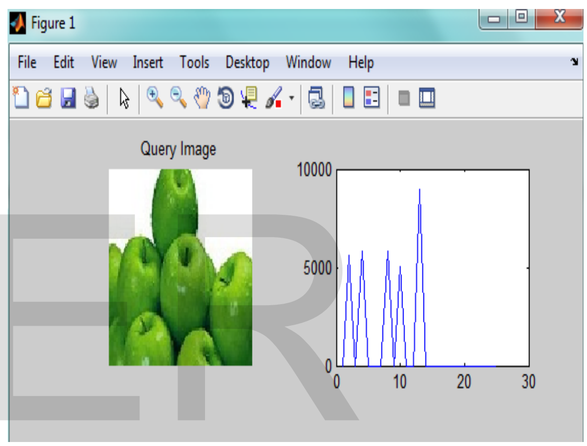

Figure 5: Retrieved images graph for green color query image

In the above image a retrieval graph is shows for a fruit query images. In the graph x axis shows image number and y-axis shows the matching weight for particular image. By the image number we will easily recognize the image from the datasets.

Table 2 top highest matching weighted target images for green color query image (fruit)

S. No.	Image number	Matching Weight	Target Image Color
1.	13	9000	Green
2.	8	5817	Green
3.	4	5797	Green
4.	2	5582	Green
5.	10	5007	Green

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Table 2 shows the highest matching weight among target images for a green color fruit query image (shown by fig. 5). In the table image number (Column 1) represent the image position in datasets. In the datasets each image having a unique number. By the number we can easily differentiate the images. Matching weight (Column 2) shows the matching score between query image and the target images. A target image having highest matching weight means more similar color to query image. And the Image color (Column 3) represents which colors of the images are retrieved.

Table 3 Results for different color of fruit query images

S. no.	Query image color	TPR	FPR	TNR	FNR	Precision
1.	Green	1	1	0	0	1.0
2.	Orange	1	0.9	0.1	0	0.83
3.	Red	0.4	1	0	0.6	1.0

Table 3 shows results in the terms of precision, TPR, TNR, FPR, and FNR for each color of image shown in Column 2 (Query image color). The resultant value is for only one query for each color of image.

Table 4 Precision of proposed color string Coding approach for fruit, flower and Vegetable images

S. no.	Image Category	Precision of Proposed CBIR
1.	Fruit	0.944
2.	Flower	0.840
3.	Vegetable	0.850

As like fruit image we calculate precision for other type of images. Table 4 shows precision among different type of images such as fruit, flower and vegetable.

V CONCLUSION & FUTURE WORK

Content-based image retrieval over large image datasets is popular among communication areas. It is found that the feature of the datasets always takes more time to complete the searching task.
Thus, an effective, relevant image feature extraction is needed to get better results. If we remove the problem associated with time to get proper a feature, then the overall manipulation of the process will be decreased, and it will give a better result for an image retrieval process. For that in the proposed method, we used an enhanced content-based image retrieval system through color string coding and give an effective result based on the color feature.
Future work – Generally, in CBIR, the feature extraction algorithm gives a way how image feature is found for retrieval. If the feature extraction technique is effective, the results of entire CBIR are automatically improved. In the proposed work we used a relevant CBIR method to extract the color feature of image. This method is very useful for those CBIR systems which complete their process by using color feature. Substring calculation provides evenness to the string which is very helpful at similarity matching. Therefore, in future our work is to design a new CBIR using color string which extracts other color feature of images then RGB values.

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