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An Evaluation of Dominant Color descriptor and Wavelet Transform on YCbCr Color Space for CBIR

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***Abstract*—** Content based image retrieval (CBIR) presents an effectual strategy to probe the pictures from the databases. The function extraction and homogeneous attribute measures are the 2 key parameters for retrieval efficiency. A uniform attribute measure performs a paramount function in picture retrieval. "content-based" designates that the quest analyzes the contents of the image alternatively than the metadata equivalent to keyword phrases, tags, or descriptions associated with the picture. In this study, present an evaluation of dominant color descriptor (DCD) and wavelet transform in YCbCr color space for CBIR. In this work, color, feature is extracted using DCD for RGB and HSV color space and auto correlogram (AC). Texture feature is extracted using discrete wavelet transform (DWT) and Gabor Filter. Shape feature is extracted with the use of Kurtosis and Skewness. We take Corel-1000 database-African, Flowers, Food, Elephant and Horse images. Also calculate the Euclidean distance (ED), relative standard deviation (RSD), Correlation, Canberra distance (CD) and Jaccard distance (JD) between giving image and database images. For classification, used support vector machine (SVM) to organize the categories without time consuming. The performance analysis is evaluated on precision and accuracy.

***Index Terms*—**DCD, Histogram Equalization, DWT, CBIR, Precsion, Gabor filter

I. INTRODUCTION

The development in digital photography, storage limit and speed of network made possible in storing a high quality large amount of images. Applications of digital images include military, medical, virtual museums and individual photograph collections. However, users have few troubles in establishing and searching huge numbers of images in the databases, as the present commercial database systems are designed for text document and not well suitable for the digital images. [1]

Image retrieval is becoming ever more important as the amount of available multimedia data increases. Growing database sizes also implies that guide annotation of image databases turns into prohibitively steeply-priced. Manual annotation has additionally the concern that it is rather subjective and consumer stylish regardless of the fact that often it is the most effective approach to retrieve pictures when semantic similarity is favored. In this work we deal with CBIR the place the intention of the approach is to lead the consumer to the favored pictures simplest by way of computerized processing of the query pictures that the user has to offer. One solution to look at image Retrieval is that it is established round an inspiration of a "user question thought", which stands for the sort of graphics that the user of the system is looking for. The intention of a CBIR system then is to be trained this query inspiration and provides suitable pictures to the consumer. The questionable idea is ordinarily semantic (e.g. Images of evening sun setting in the back of a beach), even as the elements that can be currently extracted from normal databases are frequently visual and cut down level. This results in the so-called semantic hole which is the largest show-stopper for the wide-scale adoption of CBIR systems. Happily, this semantic gap will also be quite reduced by using exceptional systems. At one end, one tries to reap (part) semantic matching of pre-segmenting the entire pictures in the database into meaningful regions, possibly singular objects. The comparison of 2 pictures then is outlined by way of the similarity of their segmented regions. The success of this approach is of course very dependent on the quality of the segmentation process. A different process to lessen the semantic gap is by means of so-called as relevance suggestions where the user presents feedback in regards to the initial outcome within, the hope of getting better outcomes on the foundation of this suggestion [2].

II. CBIR COMPONENTS

Query image

This is the image inputted by the user. This picture experiences function removal. Eventually similarity is used to retrieve similar pix from the feature database.

B. Image database

This consists of all the images present in the database. Each image is subjected to the feature extraction process. This information is then stored in a feature database.[3]

Colour feature

Color features are the most intuitive and most dominant low-level image features which are very stable and robust in comparison with other image features such as shape and texture. In this work the color feature that are used are DCD or and Color statistics of RGB and HSV model. In DCD, 1st, each color, is split to the quantity of partitions named course partitions. The center of every partition is calculated. Then, all points in the same partition are assumed to be similar and near to each other. Partition centers are the average value of all pixels in each partition. In this research the DCD features are extracted in both RGB and HSV domain. For each and every picture, because the simplest statistic points, the primary order (mean, denoted my M) and the subsequent order (standard deviation STD) are calculated. [4]

Gabor Transform

Gabor wavelet proved very useful texture analysis and is mostly adopted in the literature. Present an image retrieval method based on Gabor filter. In present days texture aspects are determined by calculating the mean and version of the Gabor filtered picture,. Rotation normalization is complete via a circular shift of characteristic factors, thus all graphics have the same dominant direction. Quite often the picture indexing and retrieval are prepared on textured pix and natural pictures.[5]

RGB TO YCBCR CONVERSION

Bitmap pictures use the R-G-B planes directly to represent color picture. However, clinical research proved that the human eyes have satisfactory sensitivity to color and brightness. The eye is extra touchy to changes in brightness than changes in color. Consequently, there got here concerning the transformation of RGB to YCbCr. The dissimilarity among YCbCr and RGB is that, YCbCr represents color as brightnees and 2 color variation signals. In YCbCr, the Y is the brightness (luma), Cb is blue minus luma (B-Y) and Cr is crimson minus luma (R-Y).Even as RGB represents color as crimson, inexperienced and blue. The transformation of the RGB color model to YCbCr color model can be derived as, [6]

Y= (77/256)R+ (150/256)G + (29/256)B + 16
Cb = .(44/256)R + (87/256)G + (131/256)B + 128
Cr = (131/256)R + (110/256)G + (21/256)B + 128.

Histogram Equalization

The Histogram of an image is a sequence of number of events of gray levels in the MRI image against the gray level qualities. The histogram supplies a suitable definition of the intensities in a picture, yet it cannot supply any understanding regarding spatial relationships between pixels. The definition of HE is as "Mapping of every pixel of the input image into relating pixel of the prepared output image is defined as Histogram". HE can be described as an equation (1) :

$$Pn = \frac{no.of\ pixels\ with\ intensity\ nk}{total\ no.of\ pixels\ n} \quad (1)$$

n = 0,1,….. L-1

[O ... L-l] is the range of the gray level value image.

Support Vector Machine (SVM)

The main element of SVM is to create hyper planes or a collection of hyper planes with the help of support vectors in a higher dimension space. SVM used for classification. It divides the space into two half spaces. A 'good separation' is reached through hyper planes that have the major closest data distance to the points. Here decent separation means superior the division between two hyper planes gives lesser generalization error. That's by it is known as a maximum margin classifier. If geometric gap between the hyper planes more elevated than classification error are low.[1]

III. LITERATURE SURVEY

In [7, 8] CBIR is a manner of searching proper pictures founded on the aspects that are mechanically extracted from the image itself. An important low-level feature in any image is a dominant color. DCD was proposed by means of MPEG-7 and is broadly utilized in picture retrieval. An development over DCD was Linear Block Algorithm (LBA). In this paper, we endorse an increased similarity measure for dominant color descriptor. We fortify LBA via making 2 large changes. First is improvement within the similarity measure and 2d is a local implementation via vicinity established dominant colors.

In [9] proposed a CBIR method for database classification and efficient image representation. It is based on SVM classifier. Color string coding is used for feature extraction. This string comparison is beneficial in reducing the computational complexity.

In [10] proposed an algorithm situated on designing characteristic vectors for solving the quandary of CBIR in a dynamic atmosphere. They've accomplished satisfactory outcome in case of CBIR.

In [11] proposed a method for CBIR founded on soft computing procedures. They have proposed a framework based on these techniques to reduce semantic. This system engages and receives feedback based on SVM which classifies the images in 2 parts, one is relevant and other is irrelevant. The performance is checked based on precision, recall and accuracy.

In [12] They work on "Content Based Color Image Classification using SVM."They implement classification of images using SVM classifier in the color content of the image. They use an optimal hyper plane technique, thorough SVM. In this paper, they use color picture classification on points extracted from histograms of color accessories. The benefit of using color picture histograms is better effected, and insensitivity to small alterations in digicam viewpoint i.e. Translation and rotation.

In [13] They research on"SVM-founded Multi-textural picture Classification and Its Uncertainty evaluation." This paper offers a managed picture organization system which is more than one and multi-scale texture points and SVM.

In [14] color Histogram situated on HSV and color Moments is widely used in picture retrieval. On this paper, we focus on the study in regards to the picture retrieval and suggest a new color function, known as Cascade color Moments(CCM). By dividing the image into blocks, we add spatial information of the image into the color features. The CCM feature is shaped through cascading the color Moments of every block.

IV. PROPOSE WORK

In this algorithm, presented a combined color, shape and texture features. In this method, improve the existing work precision and accuracy. This method includes the following steps: (i) Pre Processing (ii) Feature Extraction (iii) Classification

A. Pre-Processing Stage: At this stage, take a test image which is resized with 384*256 image size. After that, convert an RGB image into a Ycbcr format to process the image, and then enhance the contrast test image using histogram equalization.
B. Feature Extraction Stage: In this stage, the enhanced image feature value on AC, DCD on HSV, DCD on RGB, Gabor Filter, DWT, Kurtosis (K), Skewness are used to extract the feature of color, texture and shape. Texture feature is extracted by using GF and DWT. Finally merged all features. This process is executed also for database images. Store all features into matrix file.
C. Classification and Matching Stage: In this stage, find the distance between two images using Manhattan distance (L1), Euclidean distance (L2), Correlation, Canberra and Jaccard distance. After the feature extraction process, read the stored database of features and test image features. The database is divided into 10 classes: African, Beach, Monument, Elephant, Horse, Building, Food, Flower, Mountain, and Dinosaur. Then randomly select the training data set and test dataset for classification. After that the estimate the value of accuracy, precision and recall.

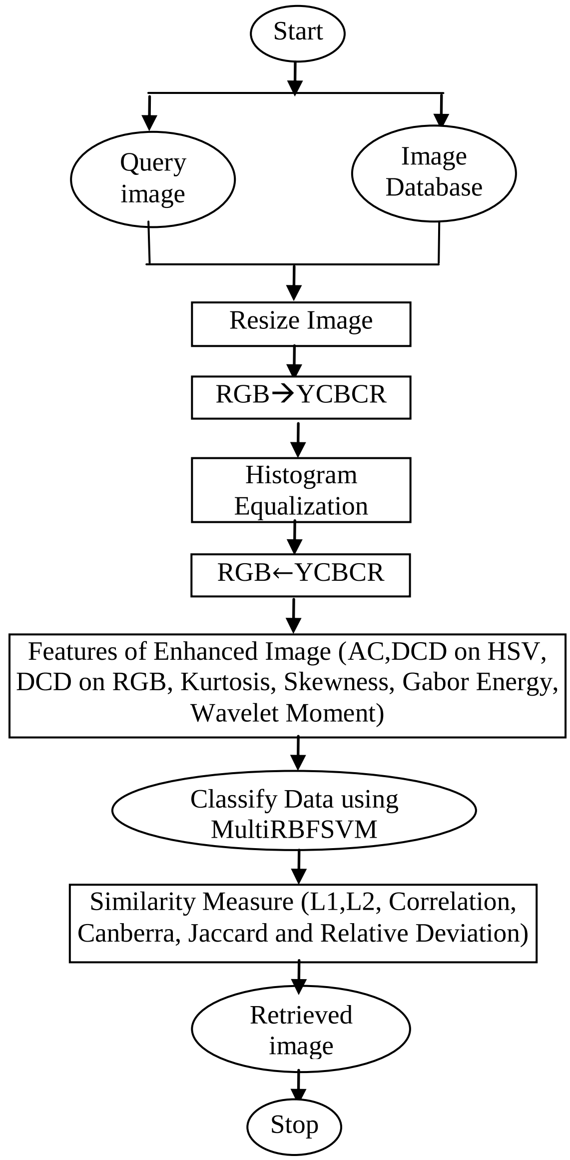

Fig.1. Flow Process of Proposed System

The trial outcomes exhibit that CCM is better than HSV color Histogram and color Moments when taking the retrieval precision into consideration.

Proposed Algorithm

1. Consider RGB image as a test image 'T' with the size of M*N.
2. Convert RGB into Ycbcr format for further processing of the enhancement method using this function $RGB2YCBCR$.
$$YCBCRImg = RGB2YCBCR(T)$$
3. After converting format, then split the Ycbcr image into three components:
$$Y = YCBCRImg(:,:,1)$$
$$Cb = YCBCRImg(:,:,2)$$

$$Cr = YCBCRImg(:,:,3)$$

4. Apply histogram equalization for improving brightness of test image.

$$h(v) = \mathrm{round}\left(\frac{cdf(v) - cdf_{min}}{(M \times N) - cdf_{min}} \times (L-1)\right)$$

where h(v) is afinal contrast image, cdfmin is the minimum non-zero value of the cumulative distribution function (in this case 1), M × N gives the image's number of pixels (for the example above 64, where M is width and N the height) and L is the number of grey levels used (in most cases, like this one, 256).

5. Extract the color moment feature with the help of the first moment (mean):

$Mean \sum_{M}^{i=1} \sum_{N}^{j=1} \frac{1}{N} \mathrm{h(v)}$

(1)

$STD \sqrt{\sum_{M}^{i=1} \sum_{N}^{j=1} \frac{1}{N} \times a}$

(2)

Where $Mean$ is the mean value of image and STD is standard deviation, a=$(\mathrm{h(v)} - M)^2$

6. Apply AC for measuring the space between 2 colors.
7. Apply (DCD) 1st, each and every color is divided right into a number of partitions named direction partitions. The middle of each and every partition is calculated. Then, all points in the same partition are assumed to be similar and near to each other. Partition centers are the average value of all pixels in each partition. In this work, DCD is applied to RGB and HSV color space.
8. Perform Gabor filter for extracting features of texture. It calculates the energy of an image.
9. Apply 2-DWT to get estimated coefficient and vertical, horizontal and diagonal element coefficients for add-ons.

$$coeff = dwt2(\mathrm{h(v)})$$
$$meancoeff = mean2(coeff)$$
$$stdcoeff = std2(coeff)$$

(3)

Where cuff is the first level coefficient of DWT on segmented image, and mean coeff is a feature vector of M value and STD

10. Find the degree of asymmetry of an image and is known as third moment (Skewness).

$$Skewness = \sqrt[3]{\sum_{M}^{i=1} \sum_{N}^{j=1} \frac{1}{N} \times a} \quad \textbf{(4)}$$

Where a=$(\mathrm{h(v)} - M)^3$

11. Kurtosis is measured for a fourth moment of an image for shape feature.

$$Kurtosis = \sqrt[4]{\sum_{M}^{i=1} \sum_{N}^{j=1} \frac{1}{N} \times a} \quad \textbf{(5)}$$

Where a=$(\mathrm{h(v)} - M)^4$

12. Repeat Step 1 to Step 11 until all images in the database.
13. Determine the similarity matrix of test images and image database using L1 distance, L2 distance, Correlation, Canberra, Jaccard and relative distance.
14. Compute the L2 distance. Given two vectors *T* and D, where

$$\mathrm{d(T,D)} = \sum_{\mathrm{m}} \sum_{\mathrm{n}} \mathrm{d_{mn}\,(T,D)}$$

Where

$$\mathrm{d_{mn}} = \frac{\left|\left(\mu_{mn}^{T} - \mu_{mn}^{D}\right)\right|}{\left|\mu_{mn}^{T}\right| + \left|\mu_{mn}^{D}\right|} + \frac{\left|\left(\mu_{mn}^{T} - \mu_{mn}^{D}\right)\right|}{\left|\mu_{mn}^{T}\right| + \left|\mu_{mn}^{D}\right|}$$

15. Compute the Jaccard distance for distinction or comparison between two vectors.

$$d^{JAS}(i,j) = \frac{J_{11}}{J_{01}+J_{10}+J_{11}} \quad \textbf{(7)}$$

In the equation d^{JAD} is the Jaccard space among the objects *i* and *j*. For 2 data records with *n* binary variables *y* the variable index *k* ranges from 0 to *n*-1. Four different combinations between $y_{i,k}$ and $y_{j,k}$ can be distinguished when comparing binary variables. These combinations are (0/0), (0/1), (1/0) and (1/1). The sums of these combinations can be grouped by:

- J_{01}: the total number of variables being 0 in y_i and 1 in y_j.
- J_{10}: the total number of variables being 1 in y_i and 0 in y_j.
- J_{11}: the total number of variables being 1 in both y_i and y_j.
- J_{00}: the total number of variables being 0 in both y_i and y_j.

As each paired variable belongs to one of these organizations it may be effectively obvious that:

$$J_{00} + J_{01} + J_{10} + J_{11} = n \quad \textbf{(8)}$$

Because the Jaccard similarity is established on joint presence, J_{00} is discarded.

16. Classify the images using multi RBF kernel SVM classifier and combine low level features.
17. Calculate accuracy, precision, and recall of retrieved images.

$$P = \frac{No.\ of\ relevant\ image\ retrieved}{Total\ number\ of\ image\ retrieved} \quad \textbf{(9)}$$

$$R = \frac{No.\ of\ relevant\ image\ retrieved}{number\ of\ image\ in\ the\ datebese} \quad \textbf{(10)}$$

V. RESULT ANALYSIS

In this work, the proposed method is performed by conducting experiments on Corel-1000 database. This database included African, Flowers, Building, Mountain and Monuments images. First four categories contain 100 with size of 384*256. The experimental checked by different number of returned images which varies from 10 to 20. In this study, RSD and CD give better result as compared to ED.

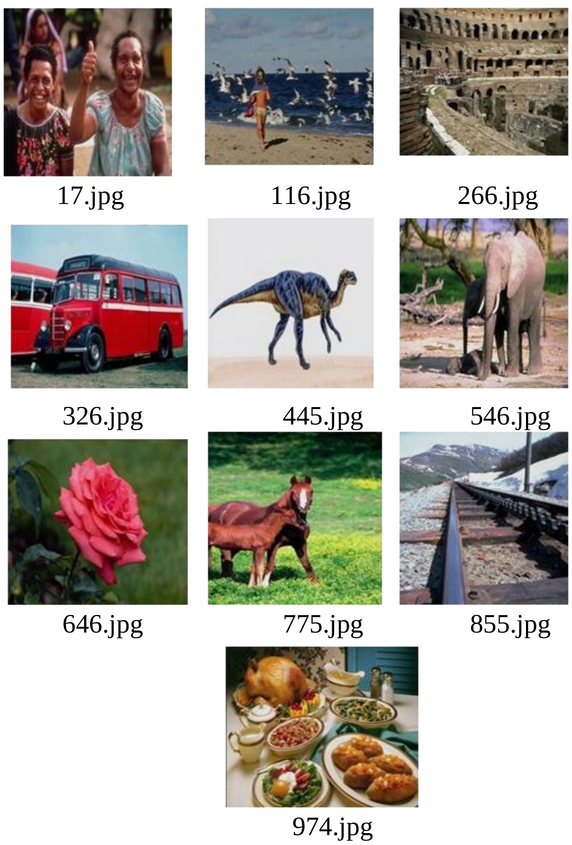

FIG.2. IMAGE DATASET

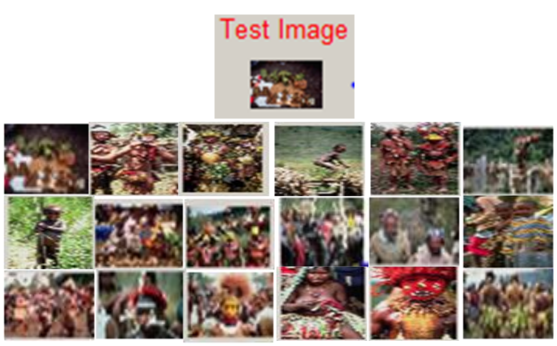

FIG.3. RESULT ON AFRICAN CATEGORY

FIG.4. RESULT ON DINOSAUR CATEGORY

Fig.5. Text Images

TABLE I. SHAPE FEATURES FOR DIFFERENT IMAGES

Image	Shape Feature	
	Kurtosis	Skewness
17.jpg	1.769	0.0475
116.jpg	1.7050	-0.0443
266.jpg	1.6988	-0.00091
326.jpg	1.6947	0.1356
445.jpg	1.6722	-0.0385
546.jpg	1.6797	0.00682
646.jpg	1.7089	0.0217
775.jpg	1.7827	0.1466
855.jpg	1.6916	-0.0338
974.jpg	1.641	0.0620

TABLE II. PRECISION RESULT USING BASE APPROACH

Query Image	Base Precision of Similarity Metrics (%)			
	L1	L2	RSD	Correlation
African	75.55	75.47	80.43	71.73
Beach	74.07	69.09	73.68	76
Monument	75.51	69.23	73.80	72.72
Bus	75.51	69.81	79.59	72.13
Dinosaur	79.20	75	66.66	76.08

TABLE III. PRECISION RESULT USING PROPOSED APPROACH

Query Image	Proposed Precision of Similarity Metrics (%)					
	L1	L2	RSD	Correlation	Canberra	Jaccard
African	99.55	99.77	99.77	100	99.55	99.77
Beach	100	99.77	99.55	99.77	100	99.55
Monument	99.77	100	100	99.77	100	99.33
Bus	99.77	100	99.77	99.55	100	99.77
Dinosaur	100	99.55	99.55	100	99.77	99.33

TABLE IV. PRECISION AND RECALL COMPARISON BETWEEN BASE AND PROPOSED APPROACH

Category	Base Results		Proposed Results	
	Precision (%)	Recall (%)	Precision (%)	Recall (%)
African	72.72	68	99.77	93.33
Beach	77.55	80	99.55	91.83
Monument	80	74	99.77	92.57
Bus	77.27	88	100	93.55
Dinosaur	80	70	99.77	91.61
Elephant	73.07	76	99.77	92.76
Flower	78	78	100	92.59
Horse	80	56	100	92.21
Mountain	74.07	80	100	91.64
Food	66.03	70	100	92.02

TABLE V. ACCURACY COMPARISON BETWEEN BASE AND PROPOSED APPROACH

Category	Base Accuracy (%)	Proposed Accuracy (%)
African	81.20	93.8
Beach	82.40	94.6
Monument	79.80	94
Bus	82.20	93.8
Dinosaur	83.00	94.2
Elephant	80.00	93.8
Flower	83.20	94.2
Horse	81.60	94
Mountain	82.60	94.2
Food	81.00	94

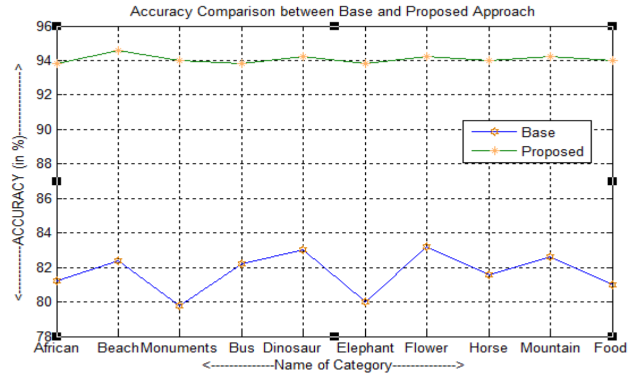

Fig.6. Accuracy Comparison between Base and Proposed Approach

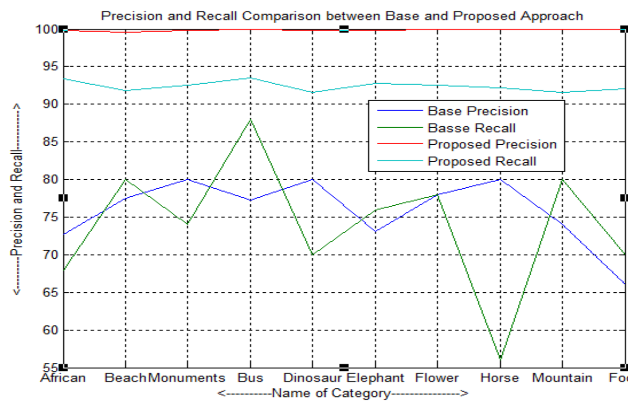

Fig.7. Precision and Recall Comparison between Base and Proposed Approach

VI. CONCLUSION

This work presented an evaluation of DCD and wavelet transform in the YCbrCr color space for CBIR. In this work, color, feature is extracted using DCD and Auto Correlogram method. Texture feature is extracted using DWT and Gabor Filter and shape feature is extracted with the use of kurtosis and skewness. The intention of an image retrieval method is to retrieve a collection of picture from a collection of picture such that this set meets the consumer's requirements. The retrieval performance of the proposed procedure is validated on Corel-one thousand database. For validation, the proposed system is when put next with earlier methods of color retrieval process. The performance of the proposed approach and previous methods are explained utilizing graphs with analysis measures, and results exhibit that the proposed approach outperforms earlier procedure.

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