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A Hybrid Approach for Image Retrieval Using Visual Descriptors

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Abstract— Retrieval of images using visual features is a hot research field in image processing used in various utilizations like in the business field, medical image, geographical images etc. In this research work, we propose and implement a fused approach for image retrieval technique using HSV Histogram color feature, LBP and SFTA texture feature of an image. Standardized Euclidean distance is operated as similarity check method. Wang image repository is used having 1000 images categorized into 10 classes of images for experimental evaluation. Experimental outcomes clear that the proposed system gives improved result of precision than the other conventional methods which is also presented in this paper.

Keywords— CBIR; HSV histogram; LBP; SFTA; Standardized Euclidean distance.

I. INTRODUCTION

In this digital world, there is an explosive growth of multimedia data. This multimedia data may be in any form of texts, voice, images and videos. Among from all these data mostly information in the form of pictures take a vigorous role. Instead of text form, we can effortlessly convey the information with the aid of images. So retrieval of images become a crucial task.

Two tactics which are used for extracting the features of images one is based on Text Image Retrieval method and another is Content based Image Retrieval method. In the traditional retrieval system of images are based on text based approach. In this approach, systems are on the basis of manual exegesis of the image for retrieving but there is some constraint in traditional based approach. But there are some limitations in TBIR so to overcome the disadvantage of TBIR we are used CBIR technique. By the CBIR method, we can extract lots of feature of a single image on the basis of low level descriptors extraction of images such as color, texture and shape features. From the enormous collection of image database, there is a need to extract the useful information which is called Image Mining. There are several techniques of Image Mining in which Image Retrieval is one of the techniques of Image Mining.

Suppose, If a user wants to find the flower images then he can give the existing flower images from the database as an input image then the system will extract visual features like color, textures, shape or fusion of two features or more etc. It

will match these visual features with that of other images present in the database; then the germane images will be shown to the user.

II. CBIR: AN OVERVIEW

A flow chart of CBIR is shown in fig 1. For retrieving the images from huge database firstly extract the features of images using color, texture and shape either take it individually or combined these. A user provides the input image to a system then it extracts the features of input image and store in a feature vector. The similarity comparison between the feature vector dataset of the query image and feature image database are then measure and retrieval image are performed.

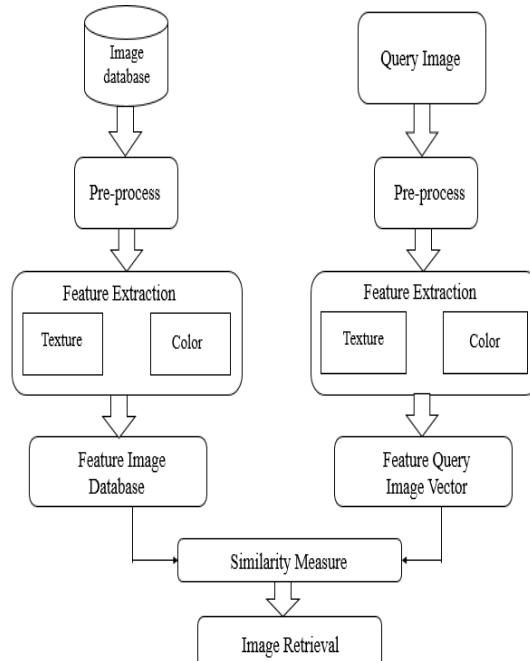


Fig. 1. Flow Chart of CBIR System

III. LITERATURE SURVEY

TABLE I In this tabular representation, we take some research papers and conclude their work.

<i>S.no</i>	<i>Year</i>	<i>Author</i>	<i>Proposed Method</i>	<i>Dataset Used</i>	<i>Result Analysis</i>
1.	2015	Priyadarshini Patil[1]	Color & texture descriptors are used by using color histogram and radon transform with trace	Wang database having 1000 images consisting ten classes of images.	Average Precision about 0.47 and recall about 0.42
2.	2015	He Zhang[2]	Fuzzy Color Histogram, Gabor and EHD combination is used	Corel, Brodatz and Oxford image database is used.	Curve Plotted and achieve higher precision and recall
3.	2010	B. Syam[3]	Contourlet Transformation, LBP, Color Histogram and spatial features are used to extract features.	Coral Database used	Precision and Recall graph depicts that retrieving images are most similar to given query.
4.	2010	Swati Agarwal[4]	Features extract Color moment and Gabor filter, color feature weight chosen was $W_c=3$, and texture feature weight is $W_t=1$	Wang database used 1000 pictures of 10 classes	Average Precision about 63.6%
5.	2013	M. Babu Rao[5]	Dominant Codebook descriptor as global color feature, scan Pattern Co-occurrence Matrix descriptors & scan Pattern Internal Pixel Difference are used as texture descriptors	Corel Database having 1000 images consisting ten classes of images are used	Average Precision about 0.7513
6.	2016	Padmashree Desai[6]	Wavelet decomposition using threshold, wavelet decomposition using morphology operators and wavelet decomposition using LBP are used as visual descriptors.	Coral database use worked on 5 categories	Wavelet decomposition using LBP gives better precision than the other two methods and wavelet decomposition and LBP provide robust edge detection technique compared to other techniques
7.	2015	Manish K. Shriwas[7]	Integrate Local Tera patterns (LTrPs)with Gabor Transform.	Image Dataset	Accuracy and efficiency will reach a level 93%.
8.	2014	Hadi A. Alnabris[8]	Used Uniform, Non-uniform Color Quantization methods and Similarity measurement approach.	Coral database having 1000 images but retrieved 20 images for each class	Average Precision about 0.76
9.	2014	R. Usha[9]	Extraction of color using HSV, color moment, color correlogram and texture feature is sfta. SVM is used for classify the images.	Coral database contains 400 images.	Average Precision is 0.866
10.	2012	Alceu Ferraz[10]	Segmentation based Fractal Texture Analysis used for texture feature extraction	Lung CT ROIs, KTH-TIPS, Texture Surfaces dataset are used.	SFTA was 3.7 times quicker than Gabor texture method & 1.6 quicker than Haralick in terms of extraction time
11	2016	Muhsina Kaipravan[11]	Feature Extraction using Color Moment based on the whole image in HSV color space and Gabor Filter	Corel Database. Proposed work tested on 5 Classes of images	Bar Graph shows improved retrieval accuracy than other methods.

IV. PROBLEM STATEMENT

The purpose of our proposed methodology is to better retrieval results of the image and to minimize the false retrieval results so that the efficiency of the system for retrieving images is improved through color and texture descriptors.

V. FEATURE EXTRACTION

A. Extraction of Features using HSV histogram color descriptor

Color descriptor is one of the fundamental features of the image and most superior and understandable features of the images. Different types of color spaces are RGB, in which R stands for Red, G stands for Green and B stands for Blue similarly for HSV H stands for hue, S stands for Saturation and V stands for Value and for CMY C stands for Cyan, M stands for Magenta and Y stands for Yellow. Color Space can be characterized into Histogram and Statistical models. There are many Histogram model such as Global color histogram, HSV histogram etc. and color correlogram, color moment etc. are examples of statistical models. Here we used HSV Histogram in this proposed methodology. It is much nearer to human eye view of color but is perceptually not uniform. The Hue indicate the chromatic component and it is the definition of a color by the mixture of the primary colors. The Saturation specify to the prevalence of a particular hue in a color. The value of a color indicates the brightness or darkness of the color. A perfect quantified technique cannot just diminish the complexity of the processing, also will not drop excessively information of color [2].

RGB to HSV can be converted by these equations as follows: [21]

$$\begin{cases} H = \cos^{-1} \left[\frac{(R - B) + (R - G)/2}{\sqrt{[(R - G)^2 + (R - B)(G - B)]}} \right] \\ S = 1 - 3 * \min [R, G, B] / [R + G + B] \\ V = \frac{R + G + B}{3} \end{cases} \quad (1)$$

Dimensional vector of color histogram are 32,64,256,1024...

In this proposed method HSV histogram can be quantized into dimensional vector D=32 color.

H is quantized into 8 levels,

S is quantized into 2 levels,

V is quantized into 2 levels.

From this quantization, HSV color histogram gives 1*32 feature dataset of an image. As the number of bins increases, it gives the better result but also increase the computational time and vice versa.

B. Extraction of Features by Local Binary Pattern(LBP) texture feature

T. Ojala et al. [15][20] suggested LBP. Local image contrast is estimated by the LBP code. It is used to discover the different patterns like edges and points and used in various image processing utilizations such as face and object recognition and image retrieval. LBP is used to determine the local feature representation of the image. LBP representation is computed by the matching each pixel with the adjacent neighboring pixel.

The value of the LBP code of pixel is determined by (x_c, y_c) is given by [3] [20].

$$LBP_{p,R} = \sum_{p=0}^{P-1} s(g_p - g_c) 2^p \quad (2)$$

$$s(x) = \begin{cases} 1, & x \geq 0 \\ 0, & x < 0 \end{cases} \quad (3)$$

Where,

g_c = gray scale value of mid pixel.

g_p = gray scale value of its adjacent pixel

P = number of neighbors

R = radius of neighborhood

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$$LBP = 1+4+128+32=165$$

Fig. 2. Procedure of LBP code

By using a center pixel taking as a threshold value LBP work on eight adjacent pixels. To compute the LBP code, the threshold values weights are multiplied which is come out by powers of two and then add the results as describes above. As the neighborhood size rises, a number of possible LBP codes also rises.

C. Extraction of Features by Segmented Fractal Texture Analysis (SFTA) texture feature:

Next, implement another texture feature based extraction technique is SFTA. This algorithm is utilized to break down the query image into an arrangement of binary images from which the Haussdorf fractal dimensions of the regions borders are computed form to depict the segmented texture patterns. In order to break down, the segmented image SFTA applied to find optimal threshold by Otsu thresholding.

Now Two-Thresholding Decomposition (TTBD) is calculated for generating the image in a pair. If the number of thresholds input is 4, there were got 8 images in each input image, in which each binary image has 3 vector features that signify boundaries of fractal dimension. An extracted vector features are fractal dimension, mean gray levels and size of area images [9] [10].

VI. SIMILARITY MEASURE

Similarity measure can be described as the comparison between the user input query image and image database by using effective measurements, like Standardized Euclidean distance, it is appropriate for standardized data [12].

$$\text{Standardized value} = \frac{(\text{Original Value} - \text{Mean Value})}{(\text{Standard Deviation})}$$

$$d = \sqrt{\sum \left(\frac{1}{s_{st}^2} \right) (x_i - y_i)^2}$$

for $i=1,2,3,4,5,\dots,n$ (5)

VII. PROPOSED METHODOLOGY

In this proposed methodology, we make a fusion approach of texture and color descriptors using LBP, SFTA texture and HSV histogram technique which gives the better retrieval accuracy from our image database as comparison to conventional methods.

There are some steps that we follow in our further methodology:-

1. First, select the image database of 1000 images.
2. Second, pre-process is done that is resize our database $384*256$.
3. Third, create the database i.e. extract the features of images using LBP, SFTA and HSV histogram texture and color descriptors techniques.
4. Fourth, load the created database.
5. Fifth, select the user query from the database then resize that image and extract the features of query image using LBP, SFTA and HSV histogram
6. Sixth, similarity is used by Standard Euclidean distance.
7. Finally, retrieve the images which are approx. similar from query image.

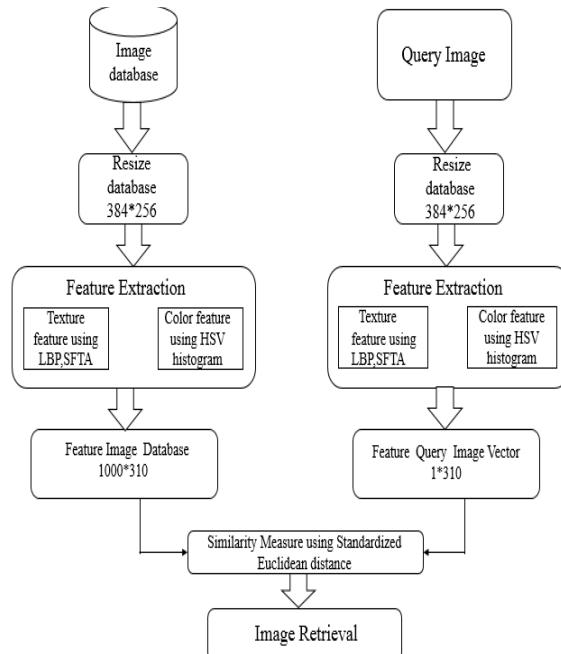


Fig. 3. Flow chart of proposed system

VIII. EXPERIMENTAL ANALYSIS AND OUTCOMES

A. Tool and dataset

This proposed work is implemented in MATLAB. Wang database having 1000 images contain 100 images of each class. Precision and Recall is evaluated by retrieving 50 images from the database when we select query image.

B. Result Analysis

The performance of proposed work is evaluated by precision and recall metric. Precision measures about the relevance of the proposed system and recall measures about the accuracy of the proposed system.

Precision and Recall are calculated as: [1]

$$\text{Precision} = \frac{M_R}{N_R} \quad (6)$$

$$\text{Recall} = \frac{M_R}{N_T} \quad (7)$$

Where, M_R = Number of Relevant Images Retrieved

N_R = Number of images retrieved in output window

N_T = Total number of images present in database

By these metrics, we can evaluate the performance of proposed method and analysis the results with other methods. Randomly 5 images are given one by one for a query image then take an average precision and recall for every class. Finally, average precision calculated for all categories and compare with other previous done method and shows that our proposed method gives better results.

TABLE II Precision and Recall values using LBP, SFTA and HSV histogram

Image Class	Average Precision using Proposed Method	Average Recall using Proposed Method
Tribes	0.792	0.396
Beaches	0.628	0.314
Building	0.620	0.308
Bus	0.976	0.488
Dinosaur	1.00	0.50
Elephant	0.684	0.342
Flowers	0.976	0.488
Horses	0.716	0.358
Mountains	0.352	0.176
Dishes	0.708	0.354
Total Average	0.7456	0.3724

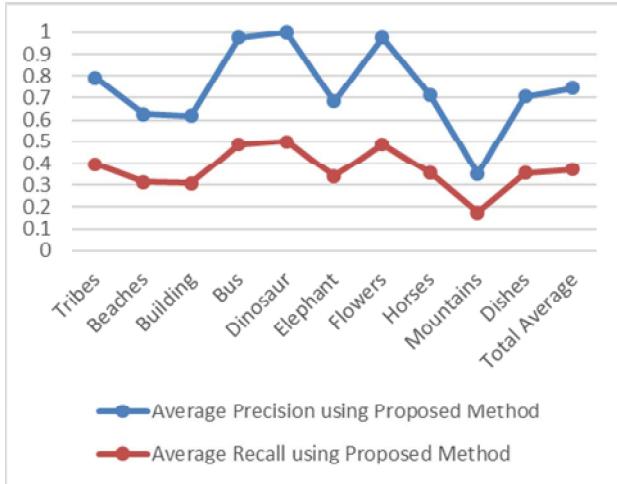


Fig. 4. Variation of Precision and Recall values with the class of Images

TABLE III Comparison with other CBIR Methods by Avg. Precision

Average Precision				
Image Class	Patil's Method [1]	Youssef's Method [13]	Naveena's Method [25]	Proposed Method
Tribes	0.52	0.66	0.4407	0.792
Beaches	0.48	0.71	0.5745	0.628
Building	0.55	0.61	0.6	0.620
Bus	0.33	0.83	0.875	0.976
Dinosaur	0.6	0.94	0.9804	1.00
Elephant	0.58	0.59	0.6552	0.684
Flowers	0.61	0.98	0.9302	0.976
Horses	0.48	0.57	0.902	0.716
Mountains	0.32	0.6	0.5556	0.352
Dishes	0.27	0.54	0.5345	0.708
Total Average Precision	0.47	0.703	0.70481	0.7456

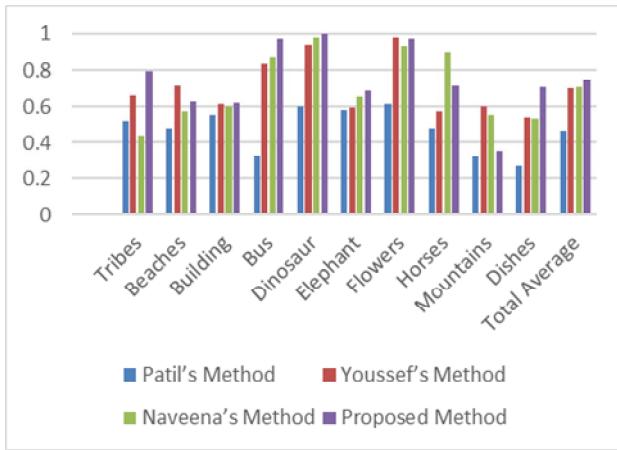


Fig. 5. Bar Graph shows the comparison average precision with other conventional method's average precision

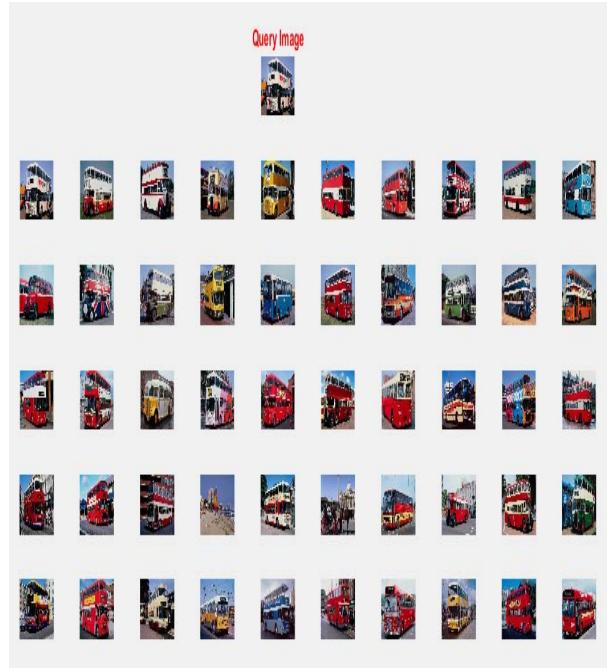


Fig. 6. Retrieval outcomes of Bus images based on query image using proposed method

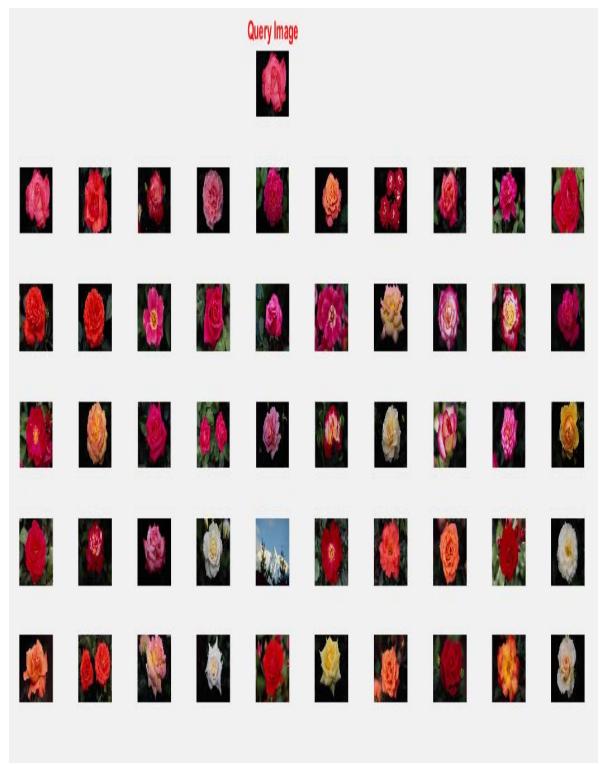


Fig. 7. Retrieval outcomes of Flower images based on query image using proposed method.

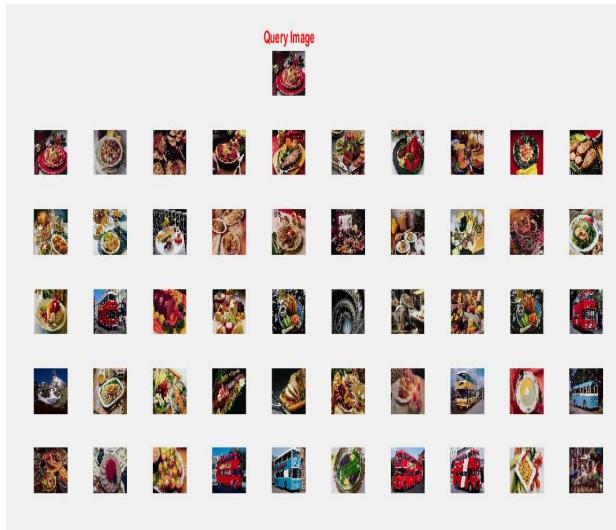


Fig. 8. Retrieval outcomes of Dish images based on query image using proposed method.

IX. CONCLUSION

In this proposed method we make a new feature vector dataset using texture and color features. LBP gives $1*256$, SFTA gives $1*21$ and HSV give $1*32$ feature vector for a single image and the last column gives image label information. So, the total features vector is $1*310$. From this combination, we achieve a higher precision rate as compare to another conventional method as shown above. Here, we retrieved 50 images from 1000 image database for each category results.

X. FUTURE WORK

CBIR is an interesting research area. There are lots of work have been done but still, we want accuracy with less overhead. For better result, we can use optimization algorithm for clustering so that it can create a good cluster and we can easily get the relevant images with a minimum overhead and of course it takes a minimum computational time.

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