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A Modified Features Selection Based Content-Based Image Retrieval With Enhanced Accuracy

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***Abstract*—In this paper presents different techniques in content-based image retrieval system. Content Based Image Retrieval (CBIR) system is a very important research area in the field of computer vision and image processing. CBIR is used to solve the problem of searching a particular digital image in a large collection of image databases. This paper deal with the brief overview of the CBIR with the various technique to retrieve the relevant images based on the similarity measure among the images in database and also enlighten with the various performance measure technique to evaluate the efficiency of the CBIR system. Evaluation of retrieval performance is a crucial problem in content-based image retrieval (CBIR). Many different methods for measuring the performance of a system have been created and used by researchers. This article discusses the advantages and shortcomings of the performance measures currently used. Problems such as defining a common image database for performance comparisons and a means of getting relevance judgments (or ground truth) for queries are explained.**

Keywords-CBIR, Feature Extraction, Color, Shape, Texture, Edge.

I. Introduction

Content-based image retrieval, also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR), is the application of computer vision techniques to the image retrieval problem, that is, the problem of searching for digital images in large databases. Content-based image retrieval is opposed to traditional concept-based approaches (see Concept-based image indexing).

"Content-based" means that the search analyzes the contents of the image rather than the metadata such as keywords, tags, or descriptions associated with the image. The term "content" in this context might refer to colors, shapes, textures, or any other information that can be derived from the image itself. CBIR is desirable because searches that rely purely on metadata are dependent on annotation quality and completeness. Having humans manually annotate images by entering keywords or metadata in a large database can be time consuming and may not capture the keywords desired to describe the image. The evaluation of the effectiveness of keyword image search is subjective and has not been well-defined. In the same regard, CBIR systems have similar challenges in defining success. "Keywords also limit the scope of queries to the set of predetermined criteria." and, "having been set up" are less reliable than using the content itself.

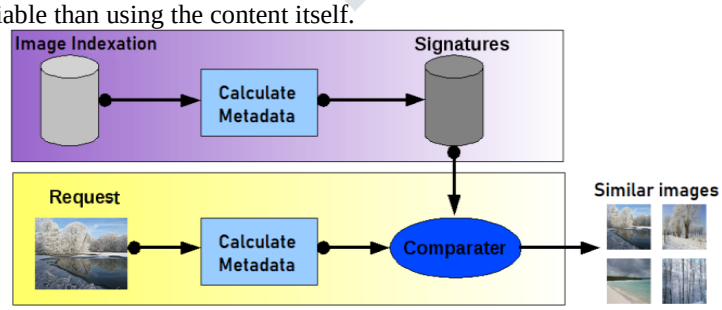

Fig 1 General scheme of content-based image retrieval

A. QBIC - Query By Image Content

The earliest commercial CBIR system was developed by IBM and was called QBIC (Query By Image Content). Recent network and graph based approaches have presented a simple and attractive alternative to existing methods.
While the storing of multiple images as part of a single entity preceded the term BLOB (Binary Large OBject), the ability to fully search by content, rather than by description had to await IBM's QBIC.

B. RGB Color Model

The RGB (Red, Green, Blue) model is used most frequently in image processing applications and computer graphics color images. Each color in this model can be broken down into its relative intensity in the three primaries corresponding to the three cones in human eye: red, green and blue.

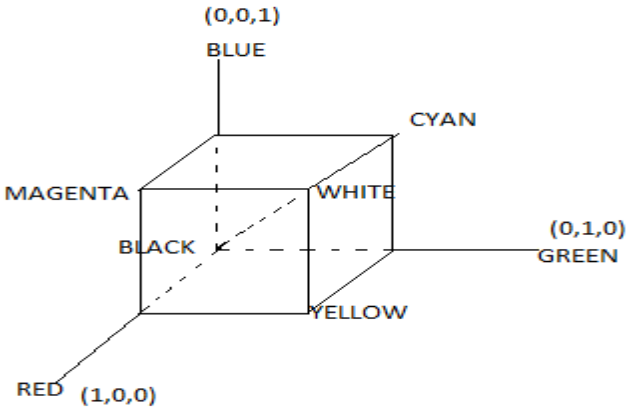

Fig: 2 RGB color model

II LITERATURE SURVEY

2.1 Introduction

In this section presented a different researcher works and their progress. the solution of this drawback has been introduced, for this a replacement technique is evolved named "Content based Image Retrieval (CBIR)".

2.2 Related Work

Monowar, et.al, (2021). The research work an image retrieval system, AutoRet, which can establish image relationships based on image content. The model is constructed with a spatial pooling based DCNN architecture, extracting high-quality embeddings from multiple portions of an image. Further, a recurrent neural network relates the embeddings and outputs prominent content information of a given image. The local feature extraction based on the spatial architecture is trained in a self-supervised manner, which can also utilize labeled data. We evaluate the model in three different datasets and determine that the presented AutoRet performs competently in self-supervised training. Moreover, mixing a small portion of labeled data also improves the robustness of the model. Benchmarks evaluate that, AutoRet is competitive in performance on self-supervised learning in all of the datasets. Further, the performance of AutoRet is also prominent concerning the small increase in the number of labeled classes during the self-supervised training process. We strongly believe that this Sensors work would motivate researchers to invest endeavor in robust self-supervised based image retrieval systems, focusing on labeled data as well. ***Alrahhal, M., & Supreethi, K. P. (2019, February)*** - In the proposed work we focused on two areas. Firstly, we proposed the LNP method for image retrieval which yields a better result when compared with LBP, LDP and LTrP methods in terms of average recall. Next, we focused on CBIR with machine learning techniques to improve the performance of the system. In the future, we can extend the work to develop the LNP method in video retrieval. Deep learning techniques can be used in CBIR to acquire more accuracy and minimize training time for the machine. Also, we can combine CBIR with Hadoop techniques to process huge images database and working in a distributed environment.[01]**Fadaei, S., Rashno, A., & Rashno, E. (2019, December)** - This paper presented a fast and efficient method to speed up CBIR system. The proposed method was based on an interval extracted from Zernike moments which excluded all images out of this interval before retrieval process. Experiments on Corel-1k database showed that the proposed scheme decreases retrieval time significantly with the same retrieval accuracy in comparison with existing CBIR systems. Future efforts will be directed towards proposing speed up methods with efficient intervals extracted from texture and color features which are good descriptors for images with irregular objects. Finally, an optimize combination of intervals from different features can be proposed as another future work.[02] **Alsmadi, M. K. (2018)** -This study recommended the effective CBIR system employing MA for the retrieval of imagesfrom databases. Once a query image is entered, the proposed CBIR performs the extraction on the image features such as color signature, shape and texture color from the image. Meanwhile, the MA based similarity measure is used to efficiently retrieve images relevant to the query image. The experiments were conducted according to the Corel image database. As shown, the proposed MA algorithm possesses strong capacity in distinguishing color, shape and colortexture features. The addition of the ILS algorithm with the GA has raised the quality of solution (weight) via the increase in the fitness number. This has assisted in the improvement of the exploitation process during the process of searching. The CBIR system proposed in this study was assessed via different images query. As demonstrated by the execution results, the method is successful in retrieving the similar images from the images database. It also supersedes other proposed CBIR systems with respect to average precision and recall rates. This can be evidenced from the precision and recall values that were computed from the results of retrieval. In particular, the average precision and recall rates were 0.8883 and 0.7125 correspondingly. For the forthcoming work, the techniques of filtering will be utilized in order to attain results that are more accurate in the content based image retrieval system.[03] **Ali, A., & Sharma, S. (2017, June)-** In this research paper, the problem of image retrieval will be solved using combination of SIFT, BFOA and DNN. Firstly feature extraction will be done using SIFT. Then, at first, the neural network is trained based on the features of images in the database. In BFOA algorithm used to optimize the feature set. This algorithm is an initialize the set of size i.e., called population. Problem Solutions from individual population are used and reserved to new population. This is hope, that the novel population would be better than previous one. Results which are particular to form novel solution i.e. data stream bits are selected with the help of best cost function, the suitable phases they have to regenerate.[04] **Lu, X., Zheng, X., & Li, X. (2016)** - In this paper, we propose a latent semantic minimal hashing algorithm, which is able to generate the most appropriate semantic-preserving binary codes with respect to query images. The proposed method uses matrix factorization to learn the latent semantic feature, while minimizing the binary

quantization loss with an orthogonal transformation simultaneously. As a result, the proposed method can generate hashing codes with more semantic property. Empirical studies on different public datasets validate that the proposed method works very well at a large margin in terms of mean average precision compared with the competing methods, and achieves very promising hashing performance.[05] **Anil Balaji Gonde [8] et al** proposed and enforced the use of text on co-occurrence matrix for this task of image retrieval, i.e. content based image retrieval, here a combination of a trust wavelet transforms (AWT) and Julesz's text on elements are used to generate the text along the picture. Further, text on the co-occurrence matrix is obtained from text onan imagewhich is employed for feature extraction and retrieval of the images from natural image database. AWT is employed to decompose the image further, completely different text on components are wont to observe the spatial correlation among the transform pixels in horizontal, vertical, diagonal and minor diagonal directions. Taxation co-occurrence matrix offers second order statistics associated with text on the image. The instructed methodology is examined on a Corel image database and therefore the retrieval results have shown substantial improvement in average exactitude, average recall rate, further as feature extraction and recovery time compared to optimal quantized wavelet correlogram (OQWC) and Gabor wavelet correlogram (GWC).

. As per his finding, two textures are discriminated on the basis of first and secondorder statistics. The first order statistics are nothing but the histogram of pixel intensity in the image and co-occurrence matrix gives the second order statistics. Julesz gave some axioms of taxation theory where he stated that human vision operates in two distant modes i.e. protective mode and attentive mode. Preventive mode is basically a preconscious system that knows where the text on gradient occurs, but is unaware of what these textons are. This answer is given in the attentive vision mode. Preventive vision first determines the scale from an aggregate of similar texture elements and then computes the text on gradients at the boundary of textures. He also mentioned that the texture elements must fall within a critical distance in order for the protective system to count the number of textons in the corresponding critical area and this determines the text on gradients. Here it used the seven textons with grid of size 2 x 2 as shown in fig. 1 to cover adjacency in horizontal, vertical,diagonal and minor diagonal direction.

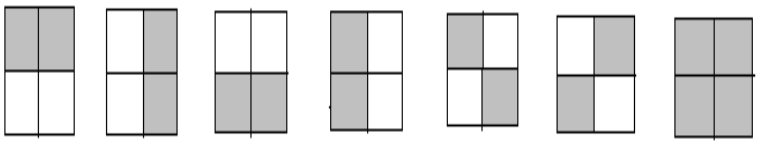

Fig 3. Text on elements, T1, T2, T3, T4, T5, T6, T7.

III. ALGORITHMIC DESCRIPTION

Wavelet Transform

Wavelet Transform is a mathematical function that is used to divide a given function into different scale components. Usually a frequency range is assigned to each component. Wavelet Transform is a representation of function by wavelets. Wavelets are signals which are confined in time and scale and are of irregular shape.

A Wavelet Transform $\psi(t)$has two main properties,

$$\int_{-\infty}^{0} \psi(t)\, dt = 0 \quad (1)$$

This equation says, the function is oscillatory or it has wavy appearance.

$$\int_{-\infty}^{0} |\psi(t)|^2\, dt < \infty \quad (2)$$

Discrete Wavelet Transform

The discrete wavelet transform (DWT) is a linear transformation. It operates on the data vector whose length is an integer power of two, It is a method that separates data into different frequency components and then take each component to match with its resolution scale. DWT has a better energy compaction property and therefore it is used to improve picture quality at high compression ratios.

Fundamentals of CBIR (CBVIR) Preludes:

Visual Information Retrieval (VIR) is a relatively youthful region of examination in Computer Science and Engineering. As in formal data recovery, the determination of a VIR framework is to recuperate all the symbols (or picture arrangements) that are significant to a client question while recovering as few non-applicable pictures as could reasonably be expected.

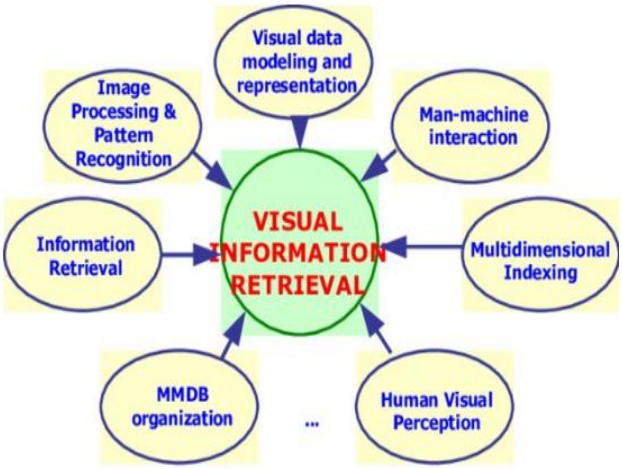

Fig 4. Visual Information Retrieval blends together many research disciplines.

Feature Extraction and Representation

CBVIR frameworks ought to have the capacity to consequently extricate visual gimmicks that are used to recognize the substance of and picture or feature cut. Instances of such qualities incorporate shade, surface, size, structure, and movement data. In particular settings the procedure of gimmick human confronts or items.

Dimension Reduction and Multidimensional Indexing

The concentrated gimmicks are assembled into some suitable information structure or scientific develop (e.g., A standardized gimmick vector), and suitable measurements (e.g., Euclidean separation) are utilized to quantify the likeness between a picture and whatever other picture.

Extraction of Image Semantics

The human perceptual experience of visual contents is strongly linked with high-level, semantic information about the picture. Current Computer Vision techniques work at a lower tier (as low as individual picture elements).

QBIC

QBIC (Query By Image Content) were produced by IBM Almaden Research Center. Its schema and strategies have impacted a lot of people later frameworks. QBIC backings inquiries focused around case pictures, client developed outlines, and chose shades and grain plans. In its latest variation, it permits content based magic word inquiry to be consolidated with substance based closeness seek.

Photo book

Photobook (Pentland, Picard, and Sclaroff, 1996) is a situated of intuitive devices for skimming and Searching pictures created at MIT Media Lab. Photo book comprises of three sub-books, from which shape, surface, and face gimmicks are concentrated individually. Clients can question the framework focused around peculiarities from each of the three sub-shapes.

Four Eyes

Four Eyes (Minka, 1996) are an enhanced variant of Photo book that incorporates the client pertinence criticism. Passed a ton of positive and negative cases, it chooses which models or blends of models to utilize and realizes which mixes work best for fathoming specific sorts of inconveniences. At the point when confronted with another issue like one it has illuminated some time recently, Four Eyes can understand it more rapidly than it could the first run through.

Netra

Netra is a model CBVIR framework created in the UCSB Alexandria Digital Library (ADL) venture (Deng and Manjunath, 1998).

MARS

Defaces (Multimedia Investigation and Retrieval Organization) were initially delivered at the University of Illinois at Urbana-Champaign. The essential center of MARS is not pretty much getting a solitary "best" offer representation, yet rather on the most proficient method to organize the different visual gimmicks into a serious recovery building design, which can alertly adjust to distinctive applications and diverse clients.

Pic To Seek

Pictoseek (Gevers and Smeulders, 1999) is a picture web index created at the University of Amsterdam. Pleasant uses independent Web crawlers to gather pictures on the Web.

Visual Seek

Visualseek (Smith and Chang, 1996; Smith and Chang, 1997) are a piece of a group of CBVIR frameworks created at Columbia University

IV. PROPOSED ALGORITHM & IMPLEMENTATION

The idea behind content-based retrieval is to retrieve, image from an info that are relevant to a given query image. Many steps are required for this. First, the options of the image things are extracted and their values and indices are saved within the database. Then the index structure is ideally used to filtrate all orthogonal things by checking attributes with the user's query. Finally, attributes of the relevant image are} compared in line with some similarity measure to the attributes of the query and retrieved image are stratified so as of similarity.

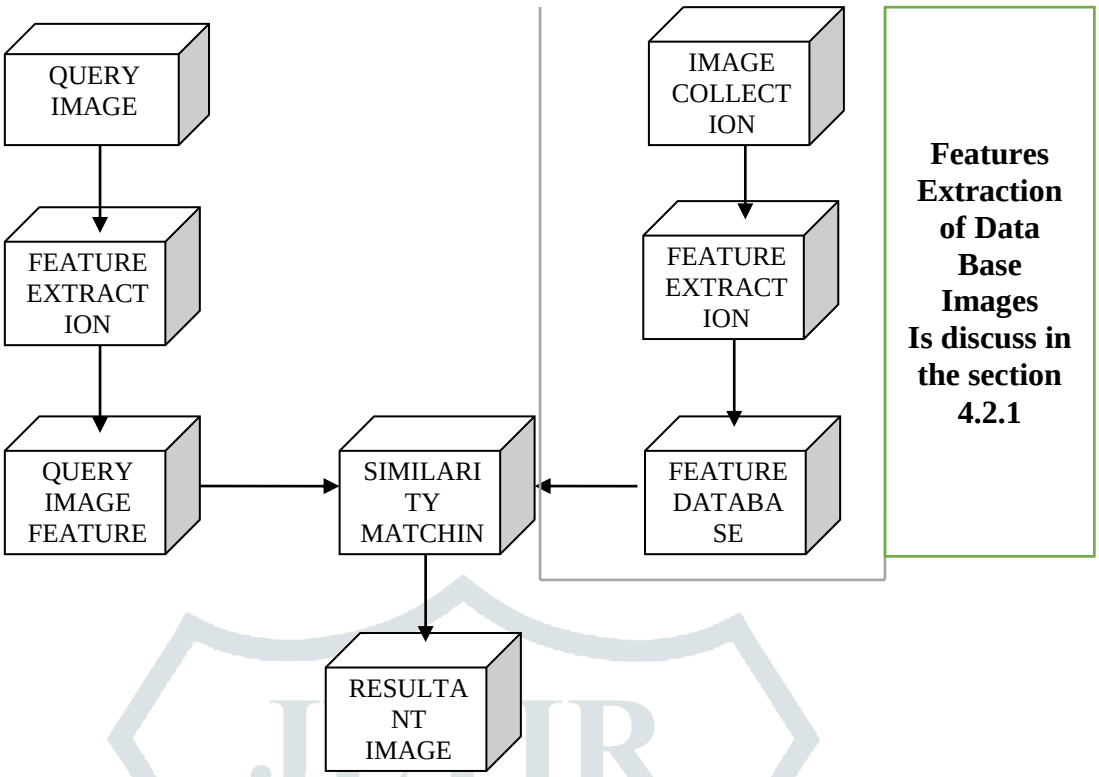

Fig. 5 Data flow diagram of CBIR process

Feature extraction is a means of extracting compact but semantically valuable information from images. This information is used as a signature for the image. Similar images should have similar signatures. If we look at the sky can be described by its blue color. Furthermore, we can take the size of the objects in the image into account. Just like the person's name.

In other word feature extraction is only that we can retrieve the unique property of the image which can be easily identified our desired query image. Process of feature extraction is explained in fig. 4.3

4.2.3 Feature matching

The similarity between two images (represented by their feature values) is defined by a similarity measure. Selection of similarity metrics has a direct impact on the performance of content-based image retrieval. The kind of feature vectors, selected determines the kind of measurement that will be used to compare their similarity [26]. If the features extracted from the images are presented as multi-dimensional points, the distances between corresponding multi-dimensional points can be calculated.

These features are combined effectively so that the retrieval accuracy and recall rate is enhanced. The classification techniques such as Support Vector Machine (SVM) are used to classify the features of a query image by splitting the group such as color, shape and texture. Finally, the relevant images are retrieved from the database. Accuracy and error rate are found to be precise. This method gives much better performance than the traditional method of image retrieval. The proposed work employs the use of HSV histograms, color moments and color auto-correlogram in extracting the color feature, wavelet transformation in extracting shape features and Gabor wavelets in extracting texture features of images. The application performs a simple feature-based search in an image database for an input query image, using extracted feature vectors. It then compares the HSV histograms of different images using the Quadratic Distance Equation. Further enhancing the search, the application performs a texture-based search in the color results, using wavelet decomposition and energy level calculation. It then compares the texture features obtained using the Euclidean Distance Equation. A detailed step would further enhance these texture results, using a shape-based search. To improve the accuracy, employing the use of SVM classification algorithm a confusion matrix isgenerated which actually classifies the relevant and non- relevant images.

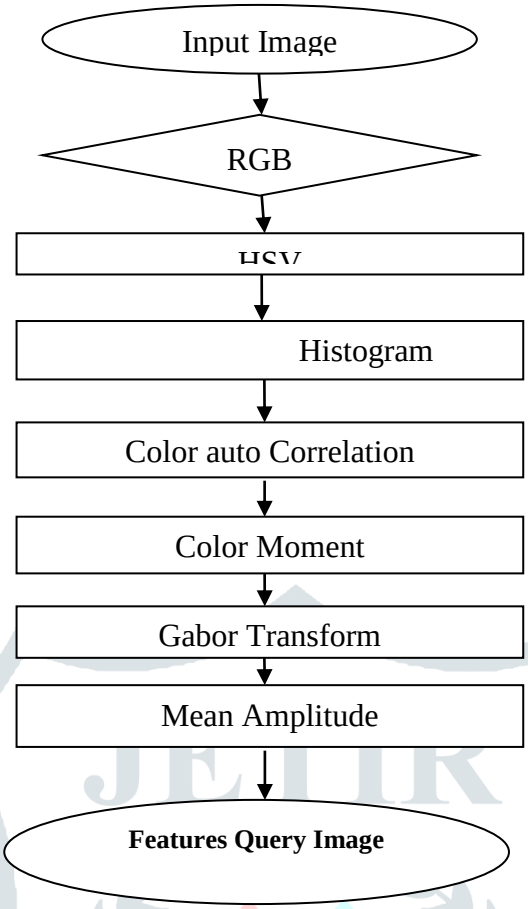

Fig 6 Feature Extraction of Query image

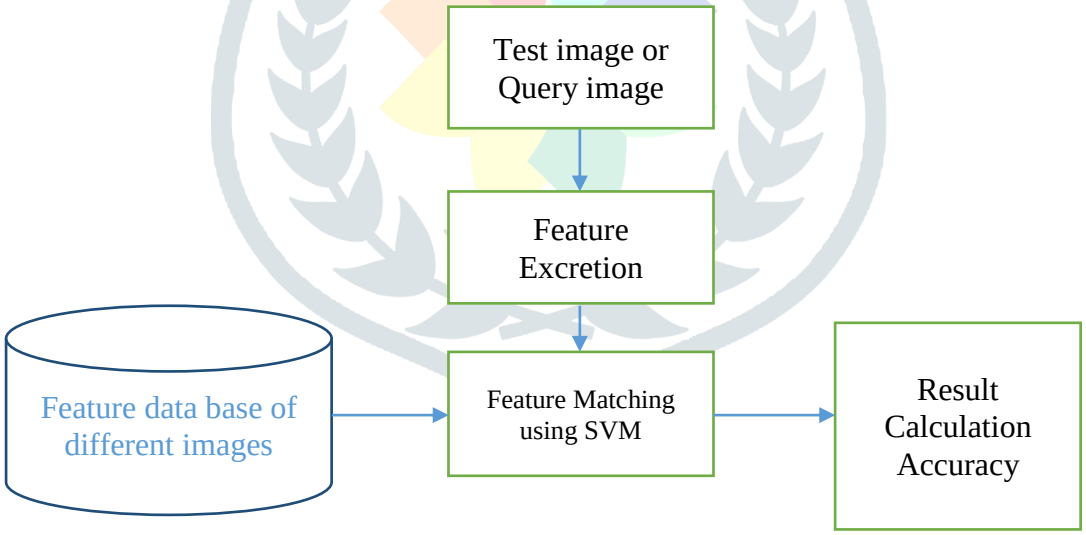

Fig 7 Features Matching using SVM

V.SIMULATION AND RESULT ANALYSIS

We use MATlab software 8.0.0 and some reputed image used for experimental task. For the performance evaluation of feature reduction classifier technique used MATlab software package [27]. MATlab is a software package for high performance numerical computation and visualization. It provides an interactive environment with hundreds of built-in functions for technical computation, graphics and animation. Best of all, it also provides easy extensibility with its own high-level programming language. MATlab stands for matrix laboratory. There are also several optional "toolbox" available from the developers of MATlab.

Fig 8 Applications of Matlab

Retrieval Results with Precision and Recall

To test the effectiveness of our algorithm, we randomly select 1 image from different classes or categories, namely Africans, Beaches, Monuments, Buses and Dinosaurs. Each query returns the top 6 images from the database. The result of all five categories in five different query retrievals is shown in Table 5.1. As can be seen from Figure 5.1 to 5.5 our CBIR system using has very good retrieving results over the randomly selected images as queries.

The following figures show the results for retrieval images.

For the DWT to be applied to the system the fitness function has to be calculated as per the user's interaction as,

$$F(q,C) = w1 \cdot sim(q,C) + w2 \cdot \delta \quad (3)$$

Table. I Precision and Recall values of five categories

S.NO	CATEGORY	PRECISION %	RECALL %
		WITH DWT	
1	AFRICAN	61	12
2	BEACH	93	18
3	MONUMENTS	85	17
4	BUSES	71	14
5	DINOSAURS	100	20
	AVERAGE	**82**	**16.2**

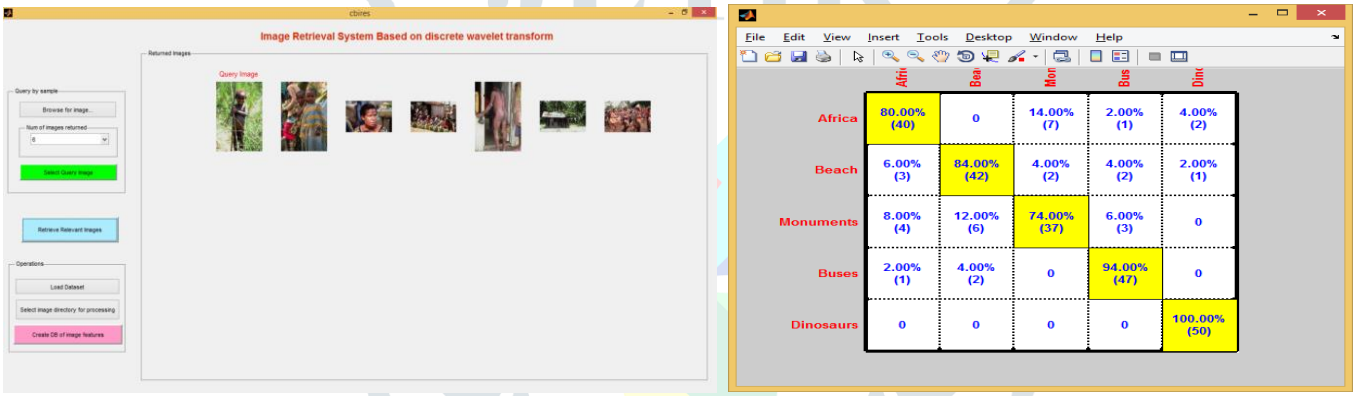

Fig.9 Query and Retrieved images of Africans

Accuracy = 86.80%

Confusion Matrix:

46	0	2	0	2
4	41	5	0	0
9	2	39	0	0
1	3	2	44	0
0	0	3	0	47

Predicted Query Image Belongs to Class = 1

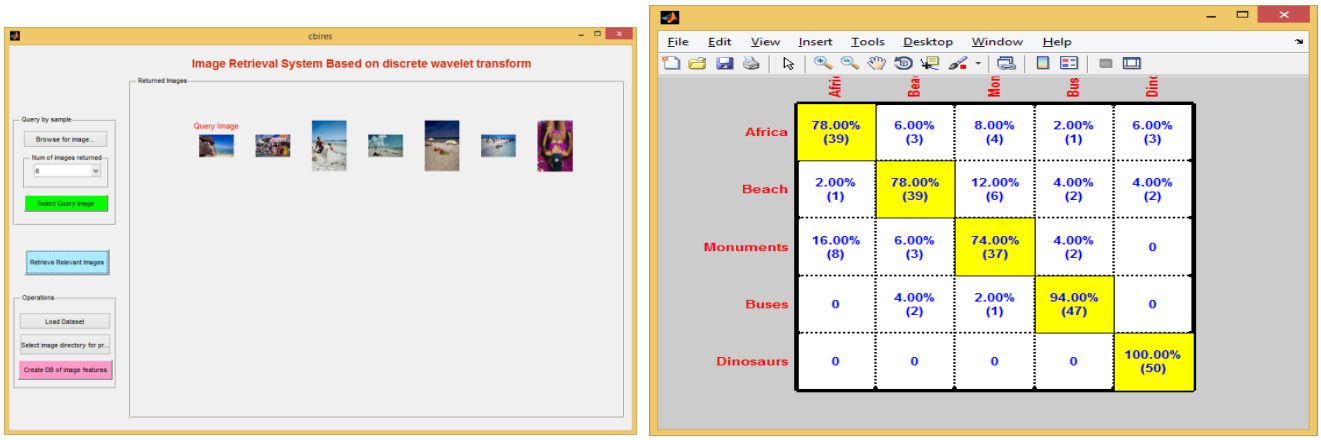

Fig.10 Query and Retrieved images of Beaches

Accuracy = 84.80%
Confusion Matrix:

39	3	4	1	3
1	39	6	2	2
8	3	37	2	0
0	2	1	47	0
0	0	0	0	50

Predicted Query Image Belongs to Class = 2

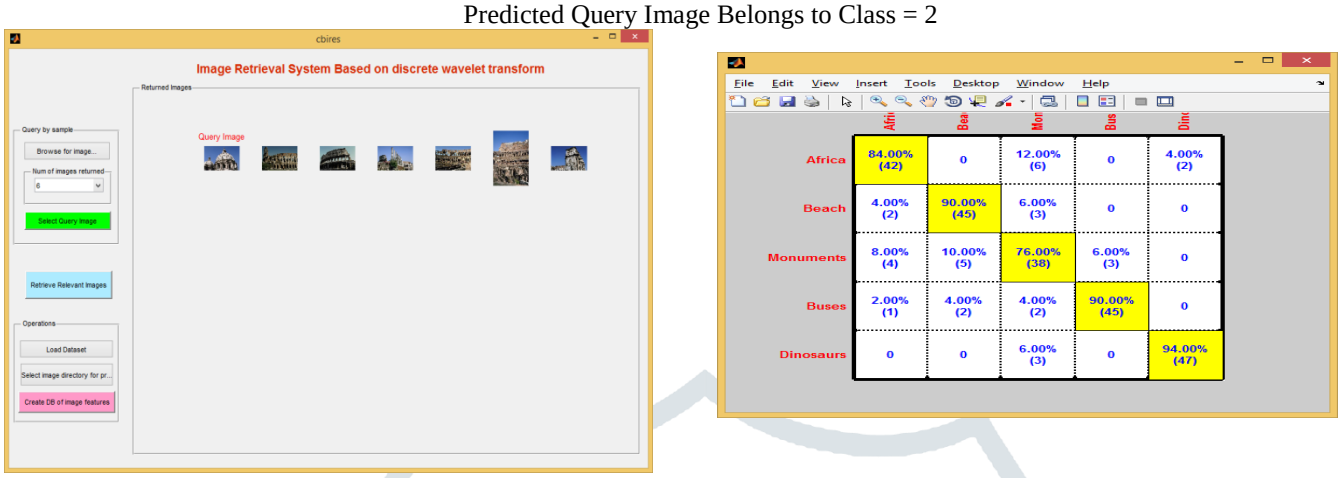

Fig.11 Query and Retrieved images of Dinosaur

Accuracy = 85.20%
Confusion Matrix:

40	2	8	0	0
3	38	8	1	0
3	2	39	6	0
1	0	2	47	0
0	0	1	0	49

Pedicted Query Image Belongs to Class = 5

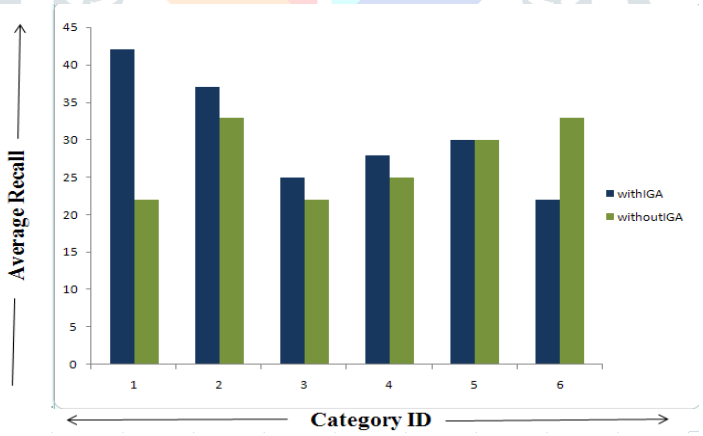

Fig. 12 Comparison of Recall values for five different categories with and without IGA.

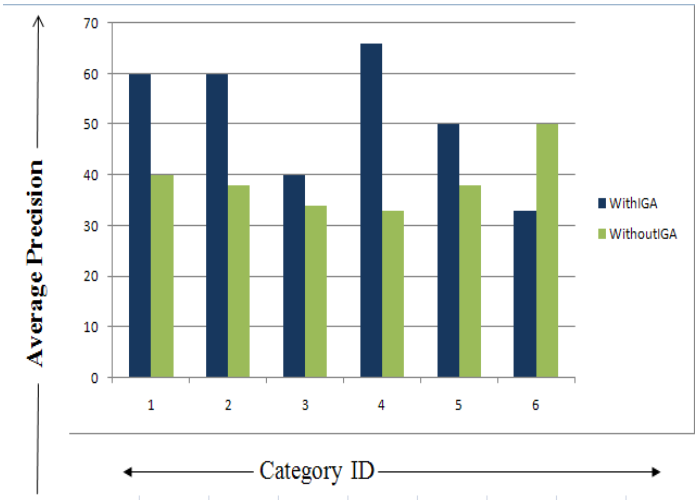

Fig. 13 Comparison of Precision values for six different categories with and without IGA.

Table II. Result Comparison of Proposed Method With Different Previous Method

S. No.	Year / Ref	Journal	Method	Result
01	2022/	Proposed	Hybrid Features based	98%
02	2021/[2]	Journal of Signal Processing Systems/ Springer	Color and Shape Features	89%
03	2019/[3]	IEEE	Zernike moments based CBIR	91%

V.CONCLUSION

Content based mostly image retrieval may be a difficult technique of capturing relevant pictures from a large space for storing. though this space has been explored for many years, no technique has achieved the accuracy of human visual perception in distinguishing pictures. Regardless of the size and content of the image database is, a human being will simply acknowledge pictures of the same class. From the terribly starting of CBIR analysis, similarity computation between pictures used either region based or world based options. World options extracted from a picture are helpful in presenting unsmooth pictures that haven't any certain specific region of interest with relevancy the user. In this we proposed and implemented the method of CBIR using the DWT, on following the steps of color and texture descriptors, which provides the features for the same, then the DWT will make the most efficient and precise retrieval of images from the database. This method gives the effective and reliable option for CBIR. In future try to improve these parameters shown in below .

- Content Based Image Retrieval using DWT improves the results for retrieval, but there is a dependency on the unlimited image database set, this has to be considered for the future work.
- To further improve the performance of the retrieval system, the study of taking shape features into account during the similarity distance computation can be considered.
- To implement the system for medical image retrieval also.
- To develop the system for video related search, using DWT.

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