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Content Based Image Retrieval System

Kajol Dahiya[1*], Gaurav Gautam[2]

[1,2] Department of C.S.E, International Institute of Technology and Management, DCRUST, Murthal, Haryana, India

Corresponding Author:kajoldahiya1994@gmail.com

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***Abstract*—** This paper proposes a new classifier named Extreme Learning Machine (ELM) on a hybrid framework for developing a Content Base Image Retrieval (CBIR) system to improve the accuracy problems faced with the earlier image retrieval system. This system mainly aims towards the accuracy with less consumption of time. In this system, Wang database is used with Local Binary Pattern (LBP), color moment, canny edge and region props for the extraction of texture, color, edge and shape feature respectively. After extracting all the features from the image, distance matrix will be determined to use it for further implementation. And then ELM classifier is used in this proposed CBIR to categorize all the images. Score Level Fusion is used as similarity measure for finding similar images. The obtained results proved that the accuracy and efficiency of CBIR system increased at a very high rate after using ELM classifier in terms of precision, recall, f-measure and retrieval time than just using similarity measure of the extraction features. The elapsed time and the average precision value is 0.277391 and 97.2500 respectively which is much accurate than the state-of-the-art techniques.

***Keywords*—**CBIR, color moment, canny edge detection, Local Binary Pattern(LBP), Extreme Learning Machine (ELM), Score Level Fusion.

I. INTRODUCTION

Content-based image retrieval system (CBIRS), also known as image content query (QBIC), is the application of visual computer techniques for recovering image problems like the searching of digital query image from the huge databases. Researching on recovery of images is of great significance as it can be applicable in different fields such as crime prevention, bio-medical, face recognition, remote sensing, digital library and astronomy. All the recovery of image is done on the basis of content of the multi-media. Here content word carries the description of color, shape, texture or other various information of an image. As there is a continuous increase in the computer power, the presence of the images in the database also increases at the highly exponential rate, decreasing storage costs and increasing internet access. Advancing automated image learning techniques is essential in order to efficiently handle image data. Earlier the written description of the images present in the file of the web pages are used for recovering the images from the database named the method as text-based image retrieval. As a conclusion, the output of these kinds of system completely varies according to the descriptors given to the images of the database. The image whose description is not assigned cannot be able to search. One more method used for retrieving an image is completely dependent on the information regarding the content of the image. The effective and efficient search of the image content is done with the help of descriptors as they have the very good amount of knowledge regarding the object and events present in the image or other multi-media. The visual content descriptors are further divided into local and global feature descriptor. The local-level descriptors of an image can either be extracted using a portion or region whereas the visual contents are used by global feature of the overall image. Main aim of these systems is to achieve more similar images from the database to the query image asked by the user to the system. The search of an image in CBIR system mainly depends upon the content present in the image which can be color, shape, texture, edge or another kind of information of the image as a scenario of retrieving the relevant images present in the given database. Then these recovered images are stored as per the proposition of the similarity between the query and the similar images retrieved from the database. These extracted features are used to calculate feature vector for the query image, CBIR represents every image in the database with a vector, after inputting the QI. CBIRS computes its feature vector then compares it with the vectors stored for every image in the database. These are the two processes used for solving the query in CBIR: first, the feature information, and second, the measure of similarity to calculate the similarity between the two image feature values. Most of the CBIR system use these descriptors of the image for searching from the database either using the single

descriptor or with the combination of two or more descriptor. As a result the accuracy varies according to the selection of the descriptor of the image for solving the query. After selecting the descriptors and extracting the features of the images of both query image and the images present in the database, the feature images are stored in the feature database.

In recent years, hybridization of so many descriptors of the image is the highly preferable topic selected by the researchers. But the performance of the system varies from one system to another with the combination of the descriptors of the images. Performance of the system completely depends upon the selection of the descriptors of the image used the selection of the descriptors of the image used for retrieval of image from the database. The main contributions of this work in the CBIR field are as follows:
1) Preparing a system for retrieval of image with the hybridization of four different descriptors of image in specific proportion for higher accuracy. 2) Reduction of the search space for the system by utilizing the ELM classifier which classifies the complete database into different categories leads to the consumption of less time with higher accuracy and combines the features with score level fusion. 3) Then the generated image retrieval system is further extensively tested with various test cases over the standard database.

The remaining section of this paper is framed as follows: Section II describes related works on the field of combined feature based CBIR system. The methodology features integration technique is explained in Section III. Section IV gives the experimental results and discussion. Conclusion and future scope of this work are discussed in Section V.

II. RELATED WORK

Pavithra In this paper, pertinent images are selected by the framework initially from the large database with the help of color moment. Afterward, two more feature detection methods were used which are Canny edge detection and Local Binary Pattern (LBP) for extracting edge and texture features from the image present in database and resulting images from this framework's initial stage. Then Bubble sort algorithm is used for sorting the resulted images selected after calculation of two features using Manhattan. Here three databases are uses i.e. wang's , carol-5k and carol-10k having precision value as 11.8% - 22.315%, 8.025% - 18.935% and 10.755% - 32.221% improved accuracy as compared to the state of the art techniques.[1]

A.D. Mahajan, S. Chaudhary believes that the utilization of low-level features is not sufficient enough for describing the high level precision of an image from the database by reducing the semantic gap. Author describes the advantages and disadvantages of various descriptors. Each technique are used and tested in the system of large dataset to determine the best out of them. The performance of FCH and GWT is evaluated in form of precision and recall value and compared with color moment and GWT. SVM classifier was also studied for getting better accuracy.[2]

Jasmine Samraj, R. Dhivya studies about the CBIR systems and the meaning of content in this system. Author also explains about the difference between the traditional retrieval system and the CBIR system. This paper mainly focuses on the techniques of the extraction of local and global features of the image. Extraction of global feature is done on the complete image whereas an individual region is considered of an image for the extraction of local level feature extraction.[3]

S. M. Chavda, M.M. Goyani studies about the CBIR system and the applications of CBIR system like E-commerce, medical field, art collection and satellite measure and many more. Feature Reduction, Similarity measure, Ranking, Feature Extraction, Feature Selection and Classification are the various processes on which the performance of CBIR system. Author mainly focuses on the techniques used for the extraction of the feature as this phase of the system is very important and most crucial.[4]

M. Nester Jeyakumar, Jasmine Samraj description of various classifiers is done in this paper as it improves the performance of the system by decreasing the search space. New descriptors were introduced which are Local Intensity Order Pattern (LIOP) and Scale Invariant Feature Transform (SIFT). Author compares three classifiers named Classification and Regression Trees (CART), Random Forest (RF) and Support Vector Machine (SVM) before and after the reduction of dimension of an image. Results are evaluated on the basis of accuracy, precision and recall.[5]

K.Kranthi Kumar This paper firstly describes about the primitive features of an image and then explains why do we need to use CBIRS instead of using traditional method of image retrieval giving the reason of insufficient, laborious and extremely time consuming. In this paper we came into conclusion that color feature is extracted using color histogram and compared into database using quadratics distance algorithm and texture feature is extracted using energy level algorithm and compared with Euclidean distance algorithm.[6]

Swati L. Dudhe This paper introduces two different concepts which are Content Based Image Retrieval (CBIR) and Attribute Base Image Retrieval (ABIR). For retrieving the semantically related images two different data mining techniques are connected by the fusion of image multimodel information (visual and textual) which are further associated with cluster rules mining algorithm. The concept of Bag of Feature (BOF) technique is used .As a conclusion this paper increases the speed of system and reduces the occlusion

problem as related to existing method. In future the fusion of ABIR and CBIR can be done.[7]

Muhsina Kaipravan In this paper, A CBIR system is introduced which is completely based on the features of integrating both color and texture. Due to some kind of limitations in the power of color histograms, a new feature extraction technique is used named color moment from the image which encode some special kind of information. Then some weights are assigned to each features and finally similarity measures are calculated using Manhatta distance measure. Result shows the accuracy of query/retrieval.[8]

Kamlesh Kumar In this paper, the complete focus is done over the extraction of basic-level visual features like edge, shape, color, texture and spatial layout. Here, LBP extracts the texture analysis and RGB color image descriptor. To determine the similarity among the retrieved image and feature extracted images from database an algorithm named Euclidean Distance is assigned. This system results in higher accuracy and efficiency on the basis of overall precision, f-measure, recall and retrieval time instead of the systems having single or individual extraction features.[9]

Savita The discovery of various techniques of representing the features of shape and texture is done in CBIR. Various features that can be used for extraction on wang database are Gobar, local, wavelet, Histogram and texture and further these 5 methods are classified using SVM (Support Vector Machine). Here combination of four different kind of feature sets are used. Feature extraction method performed is accuracy and correct classification is 97.5311% and 91.58% is for texture feature set. [10]

Jitesh Pardhan This paper introduces the hierarchical CBIR system which leads to the decrease in the search space the extraction of one of the three feature at each level of hierarchy. A three level hierarchy helps in reducing the size of image database by removing the irrelevant image from the database at the very first step/level of extraction of feature, then in the second level more analogous images are extracted from the reduced feature database. At the third level, most similar images are achieved. This process of extraction of features at every level of hierarchy is not rigid as the selection of the order of the feature extraction is very difficult which helps in upgrading the working of system. Comparatively the output of the system is high rather than earlier methods. [11]

Ceyhun Celik Here, a new term is described named semantic gap which is generated between the low-level feature and high level semantic information which is the main problem in CBIR these days. After the experimental result it is declared that the efficiency of the system is increased by Local Feature Descriptors and Sparse Representations (SR) is used to extract high level semantics. To get the conclusion the system is compared and tested with three different algorithms named Locality- constrained Linear Coding (LLC), Online Dictionary Learning (ODL) and Feature-based Sparse Reps(FBSR). As a result most successful approach is LLC for Coil20 dataset and FBSR for corel1000.s[12]

SK Mazharul Islam In proposed method the selection of features of an image is done by using several sophisticated fuzzy-rough method and then these results of various methods are combined to regain an image representation of prominent feature subset from a particular query. It boost the performance due to efficient feature subsets selection and fuzzy-indiscrenibility relation based fuzzy-rough framework for upper-approximation computation which leads to increase in the number of relevant images based on boundary region with similar images.[13]

Deole, Pragati Ashok, and R. U. S. H. I. Longadge For classification, the K- nearest Neighbor Algorithm (KNN) is used by the author along with the color extraction for the recovery of feature of image. The improvement of the system according to the performance is completely based upon the classification of KNN algorithm and the utilization of corresponding standard deviation.[14]

Katare, A., S. K. Mitra, and A. Banerjee author works on retrieving of image using multi-objects of an image in CBIR system. For extracting the shape feature from multi-object scenario a method named GVF active contour is used. The author mainly works on an additional feature of GVF active contour. This method is very encouraging after getting the experimental results.[15]

III. METHODOLOGY

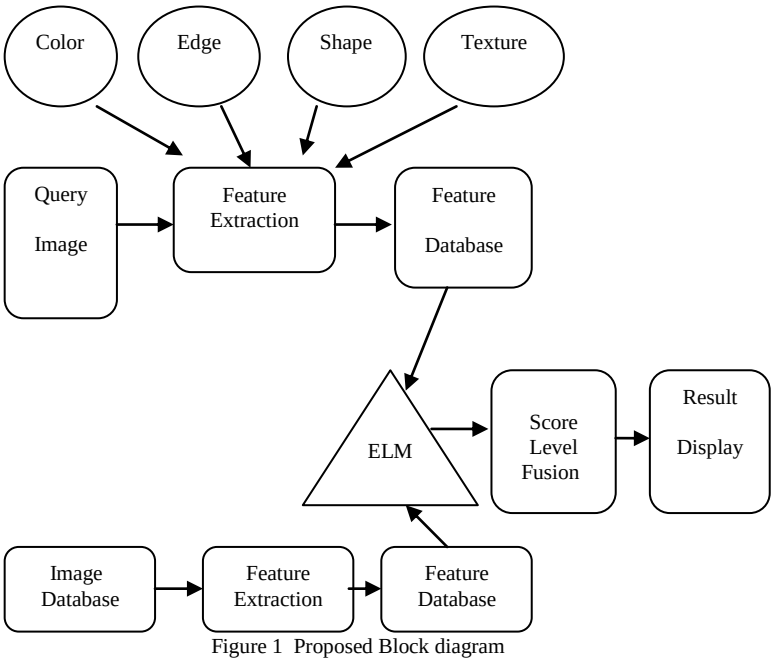

Figure 1 Proposed Block diagram

Proposed a hybrid image retrieval system block diagram using ELM Classifier and a score level fusion is shown in Figure 1. In the proposed work, the query image is taken as an input by the system and the low level features like color, shape, texture, edge are extracted from the image using various extracting techniques like color moment, canny edge, LBP, regionprop etc. Simultaneously, feature database is constructed from the image database which includes the extracted images according to their features. Color descriptor is the extremely commonly used descriptor for extracting the features from the database. Color feature can be extracted by using the color moment algorithm with the following sequence: 1) Individual Red, Green and Blue matrices which are generated from color planes of RGB values. 2) Color Histogram is then calculated from each color matrix. 3) Then variance and median are calculated from color histogram. 4) Further summation is calculated from row variance and medians. 5) The vector of features is generated by collection of all the matrices (R, G and B). 6) Then the database named feature database stores this feature vector.

For extraction of texture feature, the colored image is transformed into an image of gray scale in the extraction of the texture feature. From converting gray scale transformation to RBG is performed on these images as the step of pre-processing before exploring LBP on the images. A 3*3 matrix formed by pixel is represented by LBP as a comparison between the centre pixel and pixels of its surrounding changing into binary numbers. The ration supposes that if the value of the surrounding pixel is higher than the value of the main pixel than 1 otherwise will be 0. After having received 8 binary numbers in each pixel, the outcome will be substituted by the decimal form.

For the extraction of the edge feature, all the useful structural data from various different vision objects of the original image is extracted. For this canny edge detector is used because this extraction technique is very useful for the data to be processed in reducing the amount by extracting the useful structural data from various different vision objects of the original image.

The extraction of the shape function primarily seeks at capturing the shape characteristics of the image. Most important semantic information is carried out by the shape feature of an image. Image's region or part mainly describes the feature of shape. Initially in the training phase using color moment, canny edge, LBP and region prop features are extracted from the images present in the database and given to the ELM for training. ELM is then trained on the basis of the classes already described in the database. ELM system is a ranking algorithm that ranks pictures according to the query's significance. ELM is not only able to complete the same job at speeds roughly thousands of times quicker than traditional neural networks but also to perform better than other classifier instead of using other classifier. ELM algorithm can train much faster than SVM because for the same tasks, single-hidden layer feed forward neural networks need few hidden nodes. Then the similarity measure is done by match score between the query image extracted feature and the database extracted feature image. Here, transformation- based score level fusion using sum-rule fusion is used in the proposed work. Four different features of an image is extracted, so our equation may have four weights, the equation is-

$$F_s = a*dm1 + b*dm2 + c*dm3 + d*dm4 \qquad (3.1)$$

Where a=0.4; b=0.3; c=0.2; d=0.1;

And dm1, dm2, dm3 and dm4 are distance matrix of color, edge, texture and shape respectively. This score level fusion is used further for testing the accuracy of the system is correct or not.

IV. RESULTS AND DISCUSSION.

The suggested CBIR scheme has been tested with Query Images and similar images from the Wang database have been retrieved. In order to achieve this system, various different features are extracted from the query images as well as the images in the database including color feature, edge feature, a texture feature and shape feature. Testing of the proposed work can be done in two different ways i.e. with GUI and without GUI. In GUI, the users just have to enter the number assigned to the image in the database as the query image. And further, CBIR system will extract the feature and find more similar images which are present in the database. In non-GUI interface, the tester have to change the query image in the test code itself and then check the output of that query image in the numerical way showing the precision value and the recall value of the QI. To check the precision value and the accuracy of the proposed system we are going to retrieve 25 similar image of the query image and check whether the proposed system is accurate or not according to the value of the precision. The query image of the proposed system is shown in figure 1 and the corresponding output is described in figure 2.

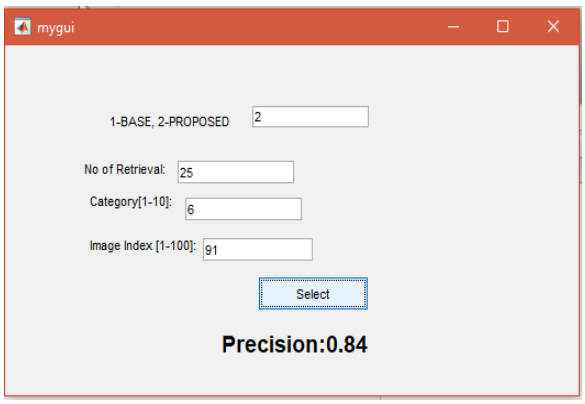

Figure 1Query image for retrieving 25 similar images

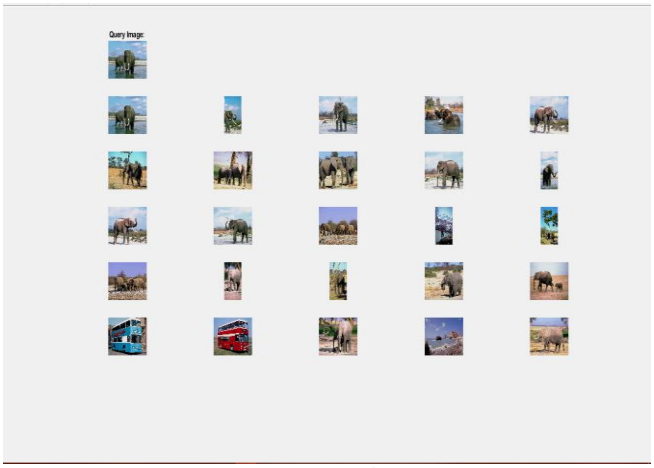

Figure 2 Required output of the query image

For the detection of the performance of the system, we will randomly take one image from each class created in the database by the user. Then the average precision and recall value of N number of retrieval of images. The evaluation of the algorithm of the system is done by the N number of retrieved images which can be 20, 40 and 80 retrieved images. The results of these retrieved images are shown in table2.

Table 1 **Analysis of average precision value and time of 2 CBIR system**

	Average Precision Value N Values			Elapsed Time		
	20	**40**	**80**	**20**	**40**	**80**
Hybrid features + Euclidean Distance Measure	95.00	85.50	71.50	0.450	0.424	0.375
Hybrid features + ELM + Score Level Fusion	100	97.75	89.37	0.196	0.214	0.273

The above table clearly shows that the average precision value of the proposed system is much higher than the system having hybrid feature extraction using Euclidean Distance Measure algorithm. The time consumed to retrieve the required similar image is also less as compared to earlier system.

Table 2: Result Analysis of precision (P) and recall(R) values

Categories	N = 20		N = 40		N = 80	
	P	R	P	R	P	R
African Tribes	100.00	20	100.00	40	91.25	73
Sea	100.00	20	97.50	39	87.50	70
Building	100.00	20	97.50	39	87.50	70
Bus	100.00	20	100.00	40	96.25	77
Dinosaurs	100.00	20	100.00	40	86.25	69
Elephants	100.00	20	100.00	40	90.00	72
Flowers	100.00	20	100.00	40	96.25	77
Horse	100.00	20	97.50	39	88.75	71
Mountain	100.00	20	90.00	36	86.75	69
Food	100.00	20	95.00	38	83.75	67

The above table gives the precision value and recall value on different number of retrieval images from the database. It can be seen that the system shows 100% accuracy for the retrieval of 20 similar images from the database. But the precision value decreases slightly by increasing the number of retrieving images.

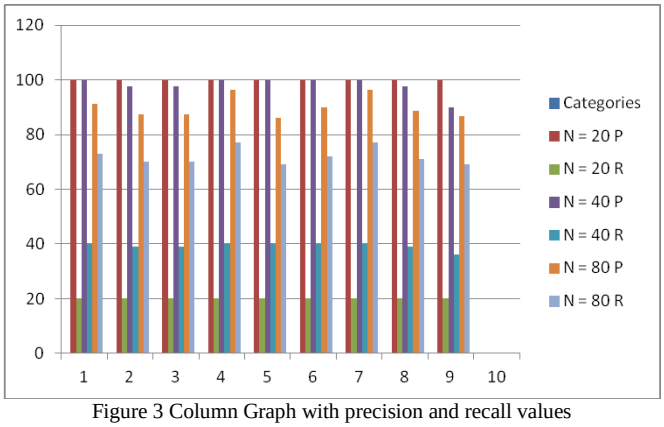

Figure 3 Column Graph with precision and recall values

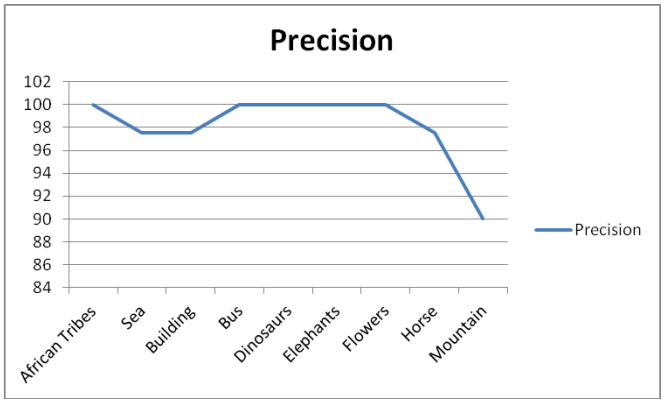

Figure 4 Precision Graph

The above column chart shows the precision value and recall value for 20, 40 and 80 retrieved images from the database. In this chart most of the bar is reaching to the final point with value 100 which means that the accuracy of this system is very much higher. The precision graph describes the behaviour of the proposed system. From this we can say that the performance of CBIR system increases after using the EML classifier and score level fusion instead of using simple Euclidean Distance Measure for detecting the similarity between the images present in the database and the query image.

V. CONCLUSION AND FUTURE SCOPE

This paper proposed a new hybrid framework of retrieving the similar images from the database efficiently by using descriptors which are texture, shape, color and edge using LBP, region prop, color moment and canny edge algorithms respectively. The search space and the process of selection of images changes completely by introducing ELM classifier

which gets trained by the values of extracted low-level features. Further the distance matrix of each feature is combined to check the similarity between the images by score level fusion. All the experiments of proposed work are done on the Wang's database. The evaluated result shows that the performance and the accuracy of the proposed are much better than the system without the classifier. And the consumption of time for the execution of the query in the system also decreases as compared to other CBIR system. This system can be able to perform on multiple databases also. We can also increase the efficiency of measuring the similarity matrix of the features of the images by using some other algorithm. Some other vision factor can be selected for feature database.

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Authors Profile

Kajol Dahiya pursued Bachelor of Computer Science and Technology in 2016 and pursuing Masters of Computer Science and Technology from International Institute of Technology affiliated from Deenbandhu Chhotu Ram University of Science and Technology in year 2019. She is currently working in International Institute of Technology and Management, Murthal, Sonipat as Lecturar from the last one year.

Gaurav Gautam is working as an Associate Profssor, Head of Department, Department of Computer Science at International Institute of Technology and Management, Murthal, Sonipat. He has 15 years of experience and working in IITM,Murthal from the last 7 years.

