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Analysis of Various Content Based Image Retrieval Techniques

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Abstract - *Due to the growth in the field of digital media, it has become necessary to have an efficient images retrieval and management system. Traditionally, text-based image retrieval systems were used for this purpose but due to their limitations they are now absolute. Content based image retrieval techniques provide promising results for efficient images retrieval in real time. This paper provides a review on various content based image retrieval techniques present and compare their advantages and disadvantages. The paper also discusses the factors on which a good content based image retrieval technique depends on. Lastly, it is observed that the more types of features are extracted and combine, the more accurate results are retrieved in real time.*

***Key Words*: Content based image retrieval, Color, Shape, Texture Features.**

1. INTRODUCTION

Presently there are two types of methodologies that are used for image retrieval for extracting similar images from the large set of databases. The first one is the old text based image retrieval system called TBIR. Here, the assumption is that every images has some related information called 'tags' associated with it. The search is performed based on these tags. And the databases images which have the same tags are retrieved at the output. The drawback of this method is that the assigning of these tags is a manual task and hence it is error prone. The presence of tags leads to ambiguity for example, a tag "apple" may refer to a fruit as well as an electronic brand name.

In order to overcome these limitations and to make an efficient system, content based image retrieval (CBIR) module was designed. The CBIR system takes an query image as input and displays are similar images from the database provided. Here the CBIR system makes use of features matching in order to decide whether two images are similar are not. For this purpose various images features are extracted from the query and the database images. A distance metrics is used to calculate the similarity score between the extracted features of the two images, which are to be compared.

Various types of features can be extracted from an image like color, shape, texture and spatial information. A feature is nothing but the information about the semantic and content information present in an images. The features provide important information about the image and helps in efficient retrieval of the images from large databases. Various types of features that can be extracted from an image are as follows:

A. Color Features

Color features provide color information present in an images like RGB channels, color moments, color auto-correlogram, HSV histograms, etc

B. Shape Features

Shape features provide orientation related information of various objects present in an images. Various techniques such as wavelet transform are used for extracting shape features information from an image.

C. Texture Features

Texture features provide texture related information present in an image. A texture can be coarse, medium, fine, etc. Texture information is considered very important in some categories of geographical images to retrieve them from databases.

D. Spatial Features

Spatial features provide object and space relationship i.e. relative space between various objects present in an image.

2. CBIR MODEL

A generics content based image retrieval model is as shown below:

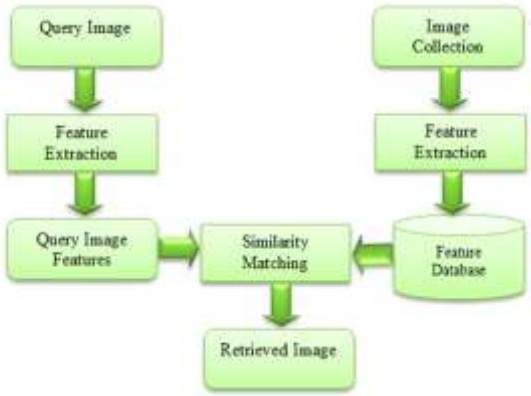

Fig 1 : Generic content based image retrieval model

3. INTRODUCTION

- Convolution, Approximation and Spatial Information Based Object and Color Signatures for Content Based Image Retrieval

Author : Khawaja Tehseen Ahmed, Syed Ali Haider Naqvi, Amjad Rehman and Tanzila Saba

Techniques used :

Paper [1] proposes a CBIR system which uses color and object features for similarity matching between input query image and database images. The spatial object information is obtained by suing the Mexican Hat Function Approximation (MHFA). Color information is extracted from the RGB channels. Principal component analysis is used to make the features set robust. Bags-of-words architecture is used to classify the the databases images as match or not match

Dataset used :

Caltech-101 and Corel-1000 challenging datasets are used for the experimentation. 15 challenging categories are selected our 101 image semantic groups from Caltech-101. In Corel-1000 all ten categories are used for experimentation.

Results:

Tab 1 : Precision and recall in [1]

Category	Precision	Recall
Africa	0.76	0.13
Beach	0.65	0.15
Building	0.66	0.15
Bus	0.60	0.17
Dinosaur	1.00	1.00
Elephant	0.68	0.15
Flowers	0.95	0.11
Horse	1.00	0.10
Mountain	0.60	0.17
Food	0.75	0.13

Limitations :

a. The existing model fails to identify the texture information from the image which leads to ambiguity in image retrieval in some categories of images.

b. The existing model has high precision values only for some categories of images like Dinosaur, Flowers and Horses.

- A New Approach for Content Based Image Retrieval Using Statistical Metrics

Author : Intedhar Shakir Nasir

Techniques used :

In [2], a CBIR method is proposed which uses color features by calculating gray histograms of the images. Here, Bhattacharyya Distance is used to measure the similarity between the query image and database images. The proposed system shows fine refinement in the accuracy compared to the traditional CBIR systems.

Dataset used : Corel-1000 and Flicker 27

Result:

Tab 2 : Precision and recall in [2]

Corel-1000				
	Precision	Recall	F-measure	Accuracy
Elephant	1.00	1.00	1.00	100%
Rose	0.83	0.85	0.82	84%
Bus	0.90	0.94	0.92	91%
X-ray	1.00	1.00	1.00	100%
Dinosaur	0.84	0.86	0.82	86%
Sport	0.92	0.94	0.90	92%
Trees	1.00	1.00	1.00	100%
Mountain	0.80	0.84	0.82	82%

- A New Architecture for Image Retrieval Optimization with HARP Algorithm

Author : S.Selvam and S.Thabasu Kannan

Techniques used :

S. Selvam (2017) et. Al proposed a more generic CBIR system using color, shape and texture features. Color moments were used as a color similarity measurement between images. Gabor filters were used for extracting texture features. Edge histogram features were used as shape descriptors. Above three descriptors were combined and optimized using genetic algorithm and HARP clustering algorithm was used for classification of images. Proposed system showed that the precision and recall parameters increased with the number of features increased (best result was obtained with color, texture, shape features together)[3].

Dataset used : Corel-1000

Results:

Tab 3 : Precision and recall in [3]

Parameter	Value
Average Precision	89.1%
Average Recall	69.8%
Reduction in time	6.18 seconds

Limitation :

Designed system worked efficiently for various categories of images except Elephant class.

- A Novel Approach of Color-Texture based CBIR Using Fuzzy Logic

Author : Nikhil Chaturvedi, Saurabh Agarwal and Punit Kumar Johar

Nikhil Chaturvedi (2014) et. Al proposed method which combines the concept of Texture based Image Retrieval system and clustering based on color component. Fuzzy clustering algorithm was used to represent color clusters of image. Each R,G,B colors had respective five subclusters namely very low, low, medium, high and very high to represent the degree of appearance for each color. Texture features namely energy, entropy and contrast were used in this method of retrieval. This system showed higher efficiency than the Texture Based CBIR and Color Based CBIR alone[4].

Result :

Tab 4 : Precision and recall in [4]

Parameter	Precision	Recall
Value	0.60	0.80

- Satellite Image Mining using Content Based Image Retrieval

Author : Shubha .G. Sanu, Pushpa .S. Tamase

Shubha .G. (2017) et. Al proposed a CBIR system for classifying satellite images with a similar query image. Initially the images are segmented into several parts using J-seg algorithm and then a region based representation is built for each image. Texture features are extracted by Gray Level Co-occurrence Matrix and used for comparison. At the end, Bayesian classifier which classifies images using a probabilistic approach is used for retrieving end results.[18].

- Content Based Retinal Image Retrieval Using shifting Wavelet Transform for Classification of Retinal Fundus Images

Author : S. S. Tadasare, Prof. S. S. Pawar

S. S. Tadasare (2018) et. Al proposed a system which uses a hybrid feature along with various distance measures for content-based image retrieval. Color correlogram, color moments and color histograms are extracted as color features. Stationary wavelength transform, Binarized Statistical Image Features and Gabor wavelength transform are extracted as texture features. Color and Edge Directivity Descriptor which uses color and texture information into single histogram bin are used for reducing the feature sets. This experimentation was carried out with Euclidean distance, City Block Distance, Minkowski Distance, Mahalanobis Distance and Chebyshev Distance among which Euclidean Distance showed higher precision result [13].

- Content Based Image Retrieval (CBIR)

Author : S. Rubini, R. Divya, G. Divyalakshmi and Mr T. M. Senthil Ganesan

Rubini (2018) et. Al proposed a CBIR system depicting color features using color descriptors to obtain better retrieval efficiency from large databases. Initially the RGB query image is

converted into grayscale image and then four morphological gradients of edge maps are generated. Seven moments of each

edge map are calculated i.e. total 28 features are stored. Based on the minimum distance metrics top ten images are retrieved. Canberra Distance is used for similarity matching. [19].

Tab 4 : Comparison of CBIR techniques

Sr. No.	CBIR System Comparison		
	Paper Title	***Features Extracted***	***Performance Result***
1	Convolution, Approximation and Spatial Information Based Object and Color Signatures for Content Based Image Retrieval	Color and object signatures	Precision = 0.76 Recall = 0.22
2	A New Approach for Content Based Image Retrieval Using Statistical Metrics	Color and texture features	Precision = 0.72 Recall = 0.74 F-measure = 0.72 Accuracy = 73 %
3	A Novel Approach of Color-Texture based CBIR Using Fuzzy Logic	Color and texture features	Precision = 0.60 Recall = 0.80
4	Content based image retrieval system by fusion of color, texture and edge features with svm classifier and relevance feedback	Color, texture and edge information	Precision = 0.80 Recall = 0.08 F-measure = 0.1454
5	A New Architecture for Image Retrieval Optimization with HARP Algorithm	Color and shape features	For only 3 Image classes (Elephant, Horse and Dinosaur) Precision = 0.89 Recall = 0.69

4. CONCLUSIONS

Content based image retrieval systems has become an important area for research in the field of computer science and engineering. As a result of various images searches that are performed everyday. The image retrieval was done initially using the text based approach which had significant shortcomings. Due to this CBIR systems were invented which overcame these drawbacks. The paper [9] provides best result in terms of precision parameter as 0.80 of a content based images retrieval system. The paper [3] yields best performance with precision as 0.89 % for three classes of images namely elephant, horse and dinosaur. We conclude from the above review of various content based image retrieval papers that as more types of features like color, shape, texture are extracted and combined for similarity score matching, the accuracy and the performance of the system increase significantly.

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