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Recent Content Based Image Retrieval Techniques – A Brief Study

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***Abstract*— Traditional retrieval techniques are becoming deteriorated, as the network and development of multimedia technologies are becoming more popular. This scenario has triggered the demand for efficient and effective tools for retrieval of query images from database. By providing exact and fast retrieval for query images from database, Content Based Image Retrieval (CBIR) is becoming a source of retrieval technique. It enables a user to extract an image from a large amount of images based on a query. From past few years remarkable progress has been made in both theoretical research and system development. In this paper we are providing set of information on techniques implemented in improvement of content based image retrieval.**

***Keywords*— Content based image retrieval, image extraction, and multimedia.**

I. INTRODUCTION

In today's morden age, digitization has become a trend as all spheres of human life are using images for efficient services such as in commerce, crime prevention, surveillance, engineering, architecture and bio-metrics etc. This increasing application of digital images has actuated the development of image retrieval techniques. Many general purpose image retrieval systems have been developed from years. Text based and content based retrieval is traditional retrieval techniques. The text based approach was originated at 1970s. In this approach images are retrieved by text descriptors that are images were first manually annotated to text and then searched using text based approach from traditional database. However, since manual annotation of images into text for a wide spectrum of images is not feasible, the efficient management of the rapidly expanding visual information became an urgent problem. This drawback attracted developers to build retrieval based on content. Content-based image retrieval (CBIR) was developed in 1990s; this is a process which finds images from database similar in visual content to a given query. The performance of content-based image retrieval is based on a comparison of low level features, such as colour, texture and shape features, extracted from the images themselves. Feature Extraction can be done from region or the entire image. Rather of whole image users are concerned with retrieval of particular region within the image, in general, CBIR algorithms are region specific.

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II. Low Level Features In CBIR

The traditional retrieval approach text retrieval used text features to retrieve the query image, this retrieval of images using text feature is called high level feature of text retrieval. Color, texture, shape and edge features are used to retrieve the query image from database in content based image retrieval these features are called as low level features of CBIR. The following subsections address the color, texture, shape and edge features used in CBIR.

Color Features

Color is the quality of an object or substance with respect to light reflected by the object, color is determined visually by measurement of hue, saturation and brightness of the reflected light. In day to day life color helps us to distinguish between different objects, places, and the time of day. Hence color is the most significant feature of an image that makes possible the reorganization of images by humans. Color is the most widely used visual features for image retrieval. Its three-dimensional values make its discrimination potentiality superior to the single dimensional gray values of images. Color features are extracted using color moments, color histogram, color correlogram and dominant color.

Color space

Each pixel of the image can be represented as a point in a 3D color space. Commonly used color space for image retrieval are RGB, Munsell, CIE L*a*b*, CIE L*u*v*, HSV (or HSL, HSB), and opponent color space. The appropriate color space characteristics of a retrieval image are its uniformity. Uniformity states that the measured proximity among the colors must be directly related to the psychological similarity among them.

Color moments

When the image contains just the object Color moments have been successfully used. Parameters used to represent color moments are the first order (mean), the second (variance) and the third order (skewness) which have been proved to be efficient and effective in representing color distributions of images

Histogram

In image retrieval a histogram is employed to represent the distribution of color in image. The color quantization is determined by the number of bins of histogram. Thus, the histogram shows the number of pixels whose grey level fails within the range indicated by corresponding bin. Some metric are utilized which determines the distance or similarity between the two histograms to evaluate between query image and image in database. A color histogram for a given image is represented by a vector:
Where ‘i’ is the color bin in the color histogram, and H[i] represents the number of pixels of color i in the image, and n is the total number of bins used in color histogram.

Color correlogram

Color correlogram was proposed to characterize not only the color distributions of pixels, but also the spatial correlation of pairs of colors. The first and the second dimension of the three-dimensional histogram are the colors of any pixel pair and the third dimension is their spatial distance. A color correlogram is a table indexed by color pairs, where the k-th entry for (i, j) specifies the probability of finding a pixel of color j at a distance k from a pixel of color i in the image.

Texture Features

Texture is another important property of images. “Texture is an ascribe representing the spatial arrangement of the grey levels of the pixels in a region or image”. Information on structural arrangement of surfaces and objects on the image is given by texture feature. Gray Level Co-occurrence matrix (GLCM) is used to extract the texture feature. Various texture representations have been investigated in pattern recognition and computer vision. Basically, texture representation methods can be classified into two categories: structural and statistical.
Structural methods, including morphological operator and adjacency graph, describe texture by identifying structural primitives and their placement rules. Statistical methods, including Fourier power spectra, co-occurrence matrices, shift-invariant principal component analysis (SPCA), Tamura feature, Wold decomposition, Markov random field, fractal model, and multi-resolution filtering techniques such as Gabor and wavelet transform, characterize texture by the statistical distribution of the image intensity.

Shape Features

One more important feature of content based image retrieval is shape feature. Shape features are chosen depending upon the situation and nature of the image to get best results. Compared with color and texture features, shape features are usually described after images have been segmented into regions or objects.
Shape representation can be distributed into two categories:

a) Boundary based which uses only the outer boundary of the shape. This includes rectilinear shapes, polygonal approximation, finite element models, and Fourier-based shape descriptors.
b) Region-based which uses the entire shape regions

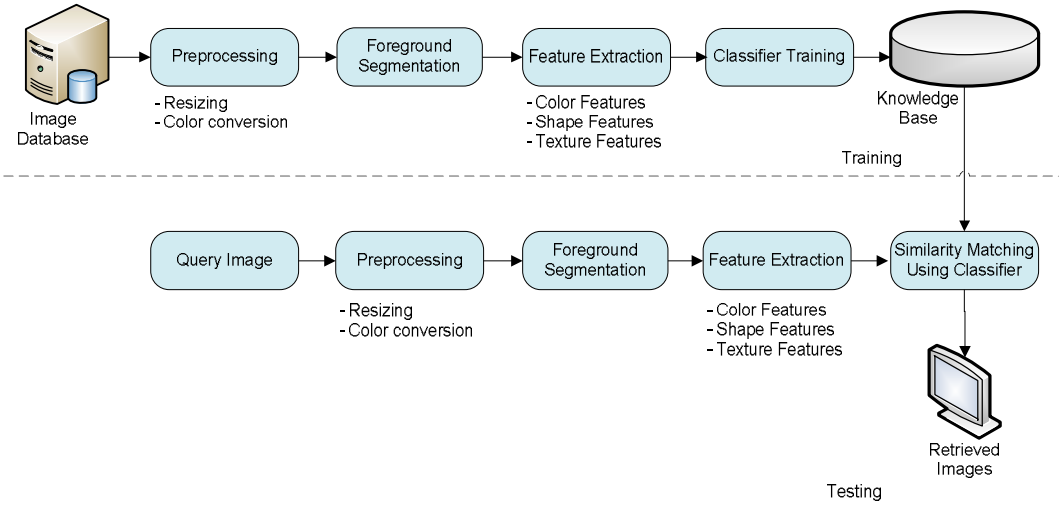

Figure 1. Top - level Block Diagram of Content Based Image Retrieval System

Above Figure 1 depicts the block diagram for content based image retrieval. Followed steps for this proposed method is as follow

- Database is created initially from different available sources for the image to be retrieved from. Pre-processing is done for available images in the database and query image. Pre-processing includes resizing and color conversion. Resizing fixes the size of all the images in the database and query image to one fixed size which helps for the further process of the model. Color conversion in needed to convert three plane images into two plane images to reduce the complexity. It includes gray conversion, binary conversion. Over all pre-processing deteriorates the distortion and enhances the features of image.
- After the pre-processing Next step is to extract images foreground for further processing. Foreground extractions includes detection of object in an image which is of a interest.
- Once the foreground extraction is done feature extraction of an image is performed. In this proposed method color, texture, and shape feature extraction are done. This extracted feature helps in further steps for image matching.
- To compare the feature of query image with features of images into the database in order to match the query image in the database some classifiers are used. These classifiers are trained with available set of features to check the best match for query image in the database.
- Once the classifiers are trained well, similarity matching is performed using these classifiers and conclusion is done with best matching for a query image from database.

Different sets of algorithms are available to make use of, for the accomplishment of this method. Algorithm efficiency can be enhanced by accumulating more than one technique in the process.

III. SURVEY

In [01] Suchismita Das proposed a work on CBIR system which used four different methods on image feature for its fast retrieval. Two methods include color feature extraction which used a fuzzy partition of the HSV color space and wavelet transformation of the fuzzified new image and other two methods include color

and texture feature extraction using curvelet transform. In this paper author concluded that curvelet transform gave better performance than wavelet as it captures edge information more accurately than wavelet.

Kommineni Jenni et.al. did reverse engineering in their proposed method [02]. In this method database is classified to get efficient conclusion instead of query image. Used technique in this method is support vector machine classifier. Using colour string coding and string comparison feature extraction of an image is done. The proposed method includes three main steps i.e database classification using support vector machine, feature extraction and similarity measure. This database classification method has triggered the developers to bring out new techniques for CBIR.

This proposed method [03] used affine image moment invariants as descriptors of local image areas in an image retrieval framework. E. G. Karakasis et.al. Proceeded with this work using SURF detector to extract image moment invariants which acts as a descriptors. To use this new descriptor Bag of Visual Words concept is introduced here. By feeding the produced moments into Bag-Of-Visual-Words. Detailed feature vectors are formulated. This process consists of three design steps. In first step, one color affine moment invariants are calculated. In the second step, the used invariants are calculated over the chromaticity of the original image, and in the third one, a normalization scheme takes place in order to widen the invariants' range of values. Producing small sized compact feature vectors with minimum information redundancy is one of the advantages of moment invariants.

Author Anu Bala, and Tajinder Kaur [04] developed a new descriptor Local texton XOR patterns for content based image retrieval. This method used three modules namely HSV histograms, Texton XOR patterns, and Local Texton XOR Pattern. Flow of this model is: firstly RGB is converted to HSV. Texton image is calculated for V color space then LTXXORPs are calculated for each pixel of texton image. For this LTXXORPs and H, S, V color space histograms are calculated. These calculated histograms are concatenated to construct feature which help retrieval of query image from database.

In[05] Rehan Ashraf et.al. Proposed a method for content based image retrieval using Embedded Neural Networks with Bandletized Regions. Bandletized transform highlights information about the major objects found in an image i.e it returns the geometric representation of the texture of object region. To approximate images having some geometric regularity Alpert transform was applied to compute the bandelet bases. Back propagation neural network is used in this method, which make it certain that the texture estimation parameters to apply Gabor filter should be approximated with maximum accuracy.

Murat Birinci, Esin Guldogan, and Moncef Gabbouj worked with relevance feedback system for content based image retrieval in 2011 [06]. They worked for a system to give fast retrieval of dynamic images. To full fill this job the system was built where users have to give feedback in terms of positive and negative images to give an idea to a system to analyze the required images for that particular user. To update the retrieval results instantly dynamic querying techniques were used. If user gives feedback as positive image then it means that user is in search of resulted images and if it is the other way case then system will discard those images with its relevant images and uploads new images from lower ranks.

In 2012 Stefanos Vrochidis, Anastasia Moumtzidou, Ioannis Kompatsiaris presented retrieval of patent images [07]. Basically this project has included both text and content based image retrieval. To give best results for patent images this method used Adaptive Hierarchical Density Histograms (ADHD), Support Vector Machines (SVMS), and Textual feature retrieval which gave accuracy around 94% and hybrid retrieval gave accuracy about 96%.

Smarajit Bose et.al. combined the segmentation based approach with conventional approach which addressed new hybrid approach for CBIR [08]. In this method Relevance Feedback (RF) mechanism is used to fill the semantic gap between low level features and high level feature perceived by humans. By varying the weights of features dynamically via feature reweighting efficiency of retrieval is improved by RF mechanism. The author used unrestricted segmentation method in this method.

In [09] author Anuja khodaskar and Siddarth Ladhake has introduced a retrieval process with inverted indexing and core semantic multiple ontology data structure. This method accomplishes reduced semantic gap in the extracted features of image and maps ontology by proposed ontology. The procedure followed by this method is, query image is taken via ontology language. From core semantic multiple ontology and multilevel indexing inverted index is generated which stores the frequency and the occurrences of the term in image DB and its weight to evade computing it in the retrieval phase. By comparing the query image features with image contents retrieval of images is done in this method.

Based on similarity refinement new Short Term Learning (STL) method is processed by author Saeid Saryazdi et.al. [10]. By a proposed rule set, weight correction of feature's components was done using mean

and standard deviation of positive and negative images to mitigate limitation of the existing similarity refinement methods. Combined with similarity measure or distance function short term learning method improved the outcome of retrieval techniques.

In [11] Daniele Cerra and Mihai Datcu proposed a method on similarity measure using the fast compression distance which is a compression dictionary. This method is applicable on diverse data types. The extraction of offline dictionary is by FCD for each object which has previously been encoded into a string. This method provides lossless compression as it follows string encoding which stores some textural information within each pixel. A new semantic feature extracted from dominant colors is proposed by Ahmed Talib et.al. in [12]. Advantage of this method is while image matching decision, where much more focus is received by color objects, this proposed method reduces the effect of image background. Accordance with DC pertaining to the object or to the background, weight is assigned to each DC in the image; this is the mechanism of the proposed method. To further increase the accuracy of the method modification in terms of similarity measure is done for this process.

This Table 1 below refers to couple of papers published in the year 2014 and 2015 which carried out work on Content Based Image Retrieval.

Table I. Survey On Various CBIR Techniques

Paper	Method	Year	Performance analysis	Advantage	Improvement
A New Content Based Image Retrieval System by HOG of Wavelet Sub Bands[13]	Discrete wavelet Transformation (DWT), and Histogram of Oriented Gradient (HOG) with relevance feedback.	2015	Accuracy = 87%	With good accuracy this method has best image retrieval in large amount of images.	
A Hybrid Approach for Improved Content-based Image Retrieval using Segmentation[08]	Relevance feedback Mechanism based on feature reweighting with an instance-based distance is employed with unrestricted segmentation	2015		Improved effectiveness for large database with reduced number of iteration .	
An Efficient Content Based Image Retrieval using Advanced Filter Approaches[14]	Anisotropic morphological filters, hierarchical kaman filter and particle filter, mahalanobis distance, color Feature extraction, gray-level extraction.	2015		Advanced filter approached used in this method gives better result as compared to GLCM filter and also has effective recall rate.	To get more accurate results in this method, soft computing techniques for filtering techniques can be applied
Content Based Image Retrieval Using Colour Strings Comparison [02]	Support vector machine, colour string coding; strings comparison;	2015	Precision = 87%	This method reduces the unnecessary comparisons And reduced computational complexity	Precision and recall rate can be increased by computing some newly developed techniques
A Content-based Image Retrieval System Based On Convex Hull Geometry [16]	Image Retrieval; Shape Signature; Image Segmentation; Edge detection; Convex hull; Area ratio	2015	Precision = 97%	As only the convex hull points are used in the matching process, retrieval is quite fast	By preserving rotation invariance this method can further is improved. Feature set can also be extended to include inner shape features and texture dimensions by grouping the edge sets based on their color and texture properties.

Content Based Image Retrieval Using Embedded Neural Networks with Bandletized Regions [05]	Bandelet transform; Gabor filter; artificial neural Network; geometric extraction	2015	Precision= 82%	Suitable for the image represented by the core image objects instead of considering every image patch. Best average precision and recall rate.	Filters used in this method restricts the performance of the system occasionally
New-Fangled Alignment of Ontologies for Content Based Semantic Image Retrieval [09]	Content based image retrieval; domain ontology; metadata ontology;multiple ontology; semantic gap;	2015	Precision= 90%	Improvement in retrieval result as compared to single ontology based retrieval. Proposed core semantic ontology for content based image retrieval system improve semantic Image retrieval with high accuracy, precision, recall and efficiency.	
An Experimental Study on Content Based Image Retrieval Based On Number of Clusters Using Hierarchical Clustering Algorithm[15]	Hierarchical agglomerative clustering algorithm (HAC).	2014	Accuracy = 98%		Not suitable for large database. Poor choice of number of clusters will increase execution time.
An Efficient Content Based Image Retrieval using EI Classification and Color Features [17]	Color Distances, Edge Pixels, Feature Extraction, Image Clustering, Inner Pixels.	2014	Precision = 80%	Strong descriptor for Image matching is obtained.	Method can be enhanced by utilizing some new feature against traditional features used in this method

IV. Conclusion

In this paper number of methodologies are explained which helps to enhance the performance of the content based image retrieval. With in reference to some traditional papers new methods built in for content based image retrieval are included in this survey. Content based image retrieval system used color, texture and shape features traditionally, as this system has lots of its application developers built their interest into it and introduced many more new advantageous techniques which are giving the best results for image retrieval into the database. Still lots of techniques are been built for CBIR which yields even more effective and efficient system for future.

In this paper general block diagram of CBIR is explained with its sub blocks which gives an brief idea about the CBIR. Traditional feature extractions methods i.e color, texture and shape feature extraction are also explained with related data. Recent technology developed in this field is studied by referring recent published papers n chart is built according the information provided in those papers. Introduced methodologies for CBIR are explained in brief in survey.

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