Analytical Study of CBIR Techniques

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ABSTRACT
Content based Image retrieval (CBIR) means search the contents of the image instead of information and capture images from database as per the user requirement. Content refers to as color, shapes, textures or any other information.The image retrieval is interesting and fastest developing methodology in all fields. It iseffective and well-organized approach for retrieving the image from large scale database. CBIR is a technique to take input as query object and gives output from an image database. To build up content based image retrieval system, to improve various processes implicated in retrieval like feature extraction, Image retrieval and similarity matching techniques. In this paper surveys has been conducted on some features such as color, texture and shape retrieval of images from the database and also study to compared content based image retrieval features like Color, texture and shape for efficient and accurate image retrieval. After going through exhaustive analysis of these CBIR techniques there isvarious parameters to review the paper, some of them it is found that each technique have its own strengths and limitations.So this paper gives summarization of the different features of images with their functionality for content based image retrieval systems.

General Terms
Image Retrieval, Image database

Keywords
CBIR,feature extraction, Color, Shape and Textures

1. INTRODUCTION
CBIR originated in 1992 used by T. Kato based on color and shapes. The approach of content based image retrieval (CBIR) system is to search image and retrieve relevant images from image database using visual content of an image.CBIR is a method which uses graphical contents known asfeatures. To search images from large scale image database according to user's request in the form of a query image. In today's era, CBIR receives input as a query object and as an output it receives similar objects from an image database. Generally for image retrieval CBIR used as visual features like color, texture, shapes or any combination of them. Image can be analyzed and retrieval automatically by automatic description which depends on their objective features. In large databases content based image retrieval (CBIR) is searching the problem of digital images. Most of the content based image retrievals (CBIR) use image features as color, shape & texture.

Early 1990 CBIR was become a very active research area. Most image retrieval system have been used like Random browsing, Search by example, search by sketch, search by text and navigation with customized image categories [4]. Today, CBIR features such as Color, Shape and textures using these content we retrieve images from database. Content-based image retrieval area takes a fabulous potential for investigation and exploitation for researchers and people in business due to its promising results.CBIR has two features Low level feature and High Level feature. Low level features including color, shape, texture, spatial information etc. and High level features including human face, text descriptor, keywords. Each of one having different methods to retrieve image from large scale image database which shows in fig 1.

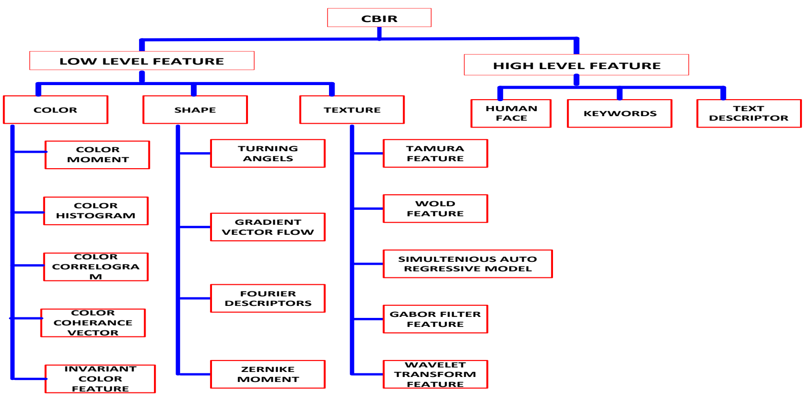

Fig 1: Hierarchy of CBIR

2. FEATURE EXTRACTION TECHNIQUE
Feature Extraction Techniques may consist of both text based features and visual features.-In the visual features can be categorized as low level and high level features. The assortment of the structures to characterize an image is one of the solutions of a CBIR system. Multiple methods have been presented for each one of these pictorialstructures and each one of them describes the feature from a different view [29]. The main low level features are three such as Color, Texture and Shape.

2.1 Color
Color is the basic features for the content of images. By way of the color feature human can recognizes and differentiate between object and images. Colors feature used in image

retrieval for the reason that they are dominant descriptors and also provide dominant information about images. To extract the color features from the content of an image, we need to select a color space for extraction. Colors are defined in three dimensional color spaces as of RGB color space is the most prevalent. The main problem of the RGB color space is that it is perceptually non-uniform and device dependent system. The HSV color space is anative system, which defines a specific color by its hue, saturation, and brightness values [7].The choice of color features depends on the segmentation results. If the segmentation provides objects which do not have homogeneous color, then at that time color is not a good choice [29].For the explanation of color feature many techniques can be used. They are Color Histogram, Color Moment, Color Correlogram, Color Coherence Vector, Invariant Color Feature etc.

2.1.1 Color Histogram

The color histogram is easy to work out and effective in describing both the global and local dissemination of colors. It's also robust to translate and rotate the image and only change with the scale. A color histogram [31] signifies the dissemination of colors in an image, each histogram bin relates in the color space. Color histograms are a fixed of containers where every container characterizes a specific color of the color space is used. The number of bins be determined by the number of colors in the image. A color histogram for an image is defined as,H={H[1],H[2],H[3],H[4],…….H[i],……H[n]}

Where *i*denotes the color container in the color histogram and *H[i]* denotes the sum of pixels of color, and *n* is the entiresum of containersused in the color histogram.

If two images have accurately the similar color fractionbut then again the colors are scattered inversely, then we can't retrieve that image correctly and this is the main drawback of color histogram.

2.1.2 Color Moment

To overcome the quantization problem of color histogram, color moments are used as feature vectors for image retrieval.The image is divided into three equal regions from each of the three regions we extract each color distribution. The efficient and effective representing color distributions of images color moments can be used with three regions are as follows:

i. Mean
ii. Standard deviation and
iii. Skew-ness

2.1.3 Color Coherence Vector

A color coherence vector is a histogram which dividers pixels permitting to their altitudinal coherence [30].According to image pixel, each one pixel inside the image is separated into two kinds, i.e., coherent or incoherent. In the feature vector including some spatial information histograms can be manufactured for equally coherent and incoherent pixels. [30]. Due to spatial information, it has been exposed that CCV offerssuperior retrieval effects than the color histogram.

2.1.4 Color Correlogram

The color correlogram[6] was projected to describe not only for the colordistributions of pixels, but then againsimilarly the spatial correlation of two of a kind of colors. From the three dimensional histogram the first and another are the colors of every pixel twosome and third is for spatial distance. If we consider all the probable groupings of color pairs the extent of the color correlogram will be actualhuge, for that reason a simplified form of theFeature called the color auto-correlogramis used. The color Auto-correlogram only captures identical colors of the spatial correlation and hence reduces the dimensions.As compared to the color histogram and Color Coherent Vector, the color auto-correlogram provides the greatest retrieval results, but there is effect of the high level of computational expensive due to its high dimensionality.

2.1.5 Invariant Color Feature

Color not only redirects the material of surface, but also differs significantly with the change of radiance, the direction of the surface, and the observing geometry of the camera. But, invariance to these factors is not reflected in most of the color features which are familiarized above.In recent times invariant color feature has been presented to content-based image retrieval. Once applied to image retrieval these invariant color feature mightproduceIllumination, scene geometry and viewing geometry independent representation of image but also some loss in discrimination power in the middle of images.

2.2 Texture

Texture can be responsible for the measure of properties such as, coarseness, regularity and smoothness. Texture can be stated as repeated patterns of pixels in excess of a spatial domain. If the texture has visible with some noise, the patterns and their repetition can be random and unstructured. Many different methods are recommended for computing texture but in the middle of those methods, no one method works best with all types of texture. Some common methods are used for texture feature extraction such as Wavelet Transform, Gabor Wavelet Transform, Fourier Transform, Gabor Filter Feature, Wold Feature, Tamura Feature etc.

2.2.1 Tamura Feature

The Tamura features [21], including coarseness, contrast, directionality, linelikeness, regularity, and roughness, are considered in agreement with emotional studies on the human awareness of texture. Coarseness is an amount of the granularity of the texture. Using histogram-based coarseness illustration can impressively increase the retrieval performance. Thisvariation creates the feature capable of distributing with an image which has multiple texture properties, and therefore is more useful to image retrieval from large scale database. The first three constituents of Tamura features have been used in some early well-known image retrieval systems, such as QBIC [18, 22].

2.2.2 Wold Feature

Wold feature [34] provides another method to describing textures in terms of perceptual properties. The three Woldcomponents harmonic, evanescent, and in deterministic, correspond to periodicity, directionality, and randomness of texture respectively. Periodic textures have a strong harmonic component;vastly directional textures have a strong component, and less structured textures. In spatial domain wold feature involves reducing a cost function, and resolving a set of linear equations and in theFrequency domain, Wold components can be acquired by global thresholding of Fourier of the image. This method is considered to accept a variety of inhomogeneities in natural texturedesigns.

2.2.3 Wavelet Transform

Like Gabor filtering, the wavelet transform [33] provides a multi-resolution approach to texture analysis and classification. The computation of the wavelet transforms consist of recursive filtering and sub-sampling. At every level, the signal is decomposed into four frequencies. LL, LH, HL and HH,where 'L'indicates low frequency and 'H'indicates high frequency. For texture analysis wavelet transform has been divided into two major types pyramid-structured wavelet transform (PWT) and the tree-structured wavelet transform (TWT). Mostly important information appears in the middle frequency channel of texture feature, to overcome this problem; the Tree Structure Transform decomposes other bands like LH, HL or HH when required.

2.2.4 Fourier Transform

Fourier Transform has been the best significant part of signal transform. It converts a signal from the time area into the occurrencefield to measure the frequency components of the signal. In CBIR Fourier Transform was used to mine texture features from high-frequency constituents of the image. Inappropriately, Fourier Transform unsuccessful to capture the information about objects locations in an image and could not provide local image features [32]. The Fourier Transform is a significant image processing tools which is used to spoil an image into its sine and cosine mechanisms.

2.2.5 Gabor Filter

For the extraction of Texture Features mostly used statistical method is the Gabor filter. This is most functional method for the Texture. Through Gabor filter many methods planned to characterize textures of images. In most of the CBIR systems constructed in Gabor wavelet, the mean and standard deviation of the distribution of the wavelet transform coefficients are used to build the feature vector.

2.3 Shape

Another important visual feature is Shape. Shape is the basic features used to describe image content. Shape's representation and description is a difficult task because one dimension of object information is lost when a 3-D object is proposed onto a 2-D image. The purpose for selecting shape feature for concerning an object is because of its essential properties such as identifiability, invariance, and reliability, accordingly shape has verified to be a favorable feature based on which retrieval of image can be performed [7]. There are some shapes Descriptor methods like Zernike Moments, Fourier Descriptor, Gradient Vector Flow, Geometric Moments etc.

2.3.1 Fourier Descriptor

Fourier descriptors define the shape of an object with the Fourier transform of itsboundary.The co-efficient of Fourier transform are called Fourier descriptor. For applying Fourier transform standardized the boundary points of all the shape in database. Robustness is pleasant properties Fourier descriptor. It is capable to capture some perceptual structures of the shape and easy to originate [29]. Through Fourier descriptors, coarse shape features or global shape features and the finer shape features are takenthroughminordirectionconstants and higher order coefficients correspondingly.

2.3.2 Zernike Moments

Zernike moments are as same as to the Fourier transform, to develop a signal into series of orthogonal basis. To recover the image from moment based on the theory of orthogonal polynomials has proposed by Teague and also has introduced Zernike moments [7]. Zernike polynomials [7] are derived from the complex Zernike moments. Zernike moments descriptors do not need to know boundary information, creating it proper for more complex shape representation. In of geometric moment's higher order moments are difficult to construct, to overcome that problem Zernike moment's descriptors are created by arbitrary order.

3. RESULT DISCUSSION

To extensive study and analysis of the CBIRtechniques for image retrieval database; it is concluded that each technique has some relative strengths and limitation. A detailed comparison of image retrieving techniques studied is shown in following table.

Table 1show the comparison between color methods which are used by many researchers in their research. Here, all methods have its own strengths and limitations.

In Color Moment technique researcher used L*u*v & L*a*b color spaces hence increase retrieval performance but due to compactness it may lower discrimination power. In Color histogram it is robust to translation and rotation, easy to compute effective characterizing and also increase the memory and computational time but it not take the spatial information since different images can have similar color distributions. Color coherence vector, color correlogram and Invariant color features have also some strengths and limitations.

Table 1. Comparison of CBIR using Color feature

Sr. No.	Author	Technique	Strength	Limitation
1	W. Niblack [13]	Color Moments	As uses L*u*v & L*a*b color spaces hence increase retrieval performance.	Due to Compactness it may lower discrimination power.
2	Y.Gong,H.J.Zhang&T.C.Chua [14]	Color Histogram	i) Robust to translation & Rotation. ii) Increase the memory & Computational time. iii) Easy to compute effective in characterizing.	Does not take the spatial information, thus different images can have similar color distributions

3	G.Pass&R.Zabith [10]	Color Coherence Vector	Using additional spatial Information it provides better retrieval result.	Each histogram bin partitioned into 2 types, Coherent & Incoherent. Hence, large uniformly colored regions are used.
4	J. Huang [6]	Color Correlogram	i) It captures the spatial correlation between colors & reduces dimensions. ii) It Characterize the color distribution of pixels.	It is most computational expensive due to its high dimensionality.
5	G.D.Finlayson[19] T.Gevers&A.W.M.Smeulders [12][13]	Invariant Color Feature	Scene geometry, Viewing geometry & independent representation of color contents of images	Loss in Discrimination power among images.

Table 2 shows the comparison between Texture Feature with all techniques have its own strengths and limitations.

The Tamura Feature used histogram based coarseness hence significantly increases the retrieval performance. But the limitation of Tamura features is that there was no work at multiple resolutions to account for scale. Wold feature is also precious by image distortions such as scale and orientation variations due to perception [29]. All the sameworking well on Brodatz textures, these features are proved to be less effective and also Image represented by a multiresolution Gaussian pyramid with low pass filtering.

Table 2. Comparison of CBIR using Texture feature

Sr. No.	Author	Technique	Strength	Limitation
1	Ying Liua, DengshengZhanga et. Al [29]	Tamura Features	Using histogram based coarseness greatly increase the retrieval performance.	No work at multiple resolution to account for scale.
2	Ying Liua, DengshengZhanga et. Al [29]	Wold Feature	i) Minimizing cost function. ii) Solving a set of linear equation.	Affected by image distortions such as scale and orientation variations due to perspective distortion.
3	B.S.Manjunath[20] &R.W.Picard,T. Kabir , F.Liu[23]	Simultaneous Auto-Regressive Model	Better performance using Brodatz texture database	Image represented by a multiresolution Gaussian pyramid with low pass filtering.
4	A.K.Jain&F.Farroknia [24]	Gabor Filter Feature	Used Scale tunable edge & line detector	i) Computationally intensive. ii)Achieves highest retrieval result
5	T.Chang, C.C.J.Kuo[2] & A. Laine,J.Fan [25]	Wavelet Transform Feature	i)Involves recursive Filtering ii) Signal decomposes in four frequency bands.	Important information appears in middle frequency channels.

Table 3 shows the comparison between Shape Feature with different techniques each of one having its own strengths and limitations.

Image retrieve using Shape feature including various methods such as turning angels, Gradient Vector flow, Fourier descriptors, Zernike moments etc. Using turning angels minimum distance can be calculated but variant to the rotation of object. Gradient vector flow has limited utility and also poor convergence to boundary concavities. Robustness is pleasant properties of Fourier descriptor butat very high frequencies noise are truncated out.Zernike moments do not need to know boundary information and they are constructed to arbitrary order.

Table 3. Comparison of CBIR using Shape feature

Sr. No.	Author	Technique	Strength	Limitation
1	T.Gevers[21]	Turning Angels	Minimum distance to be calculated	Variant to the rotation of object & Choice of the reference point
2	P.S.Hiremath, JagadeeshPujari[3]	Gradient Vector Flow	Supports the edge pixels with opposite pair of forces	i)Limited utility ii) Have static extend force. iii) Poor convergence to boundary concavities.
3	ChintanK.Panchal , Risha A. Tiwari[7]	Fourier Descriptors	i)Robustness ii) Capture some perceptual Characteristics of the shape.	At very high frequencies noise are truncated out.
4	ChintanK.Panchal ,RishaA. Tiwari[7]	Zernike Moments	i) Allow Independent moment invariants to develop an arbitrarily high order. ii)Teague has proposed use of orthogonal moments	Do not need to know boundary information for complete shape representation

4. CONCLUSION

In this paper different types of methods are pronounce. All these methods given in paper are best.There are some combinations are available like color and texture, color and shape etc. for retrieved image from large image scale database. Also combinations of the three features are available. After going through exhaustive analysis of CBIR techniques against the various parameters such as strength, limitation and significance of the effects, it is established that standingprocedures have some limitations and strengths. So this paper gives summarization of the different features of images with their functionality for content based image retrieval systems.

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