An Exhaustive Vision and Prospects of Content-Based Image Retrieval

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Abstract

Nowadays, work on digital images are gaining much popularity in the multimedia system, it becomes possible due to the rapid increase in the utilization of huge image database. Thus, the Content-Based Image Retrieval (CBIR) method has become the most valuable method for this purpose. This work mainly focuses on content-based image retrieval; which uses image features like color, shape, texture, etc. for searching the user query image from a large image database based on user request. CBIR is the most widely used technique as its searching capability is faster than the other traditional methods, and it works well in retrieving images automatically; it's also a big alternative for the traditional method based approach. The CBIR techniques are used in many applications like surveillance detection, crime avoidance, fingerprint identification, E-library, medical, historical monument and biodiversity information systems and many more.

Keywords

CBIR, Feature Extraction, Shape, Texture, Tamura, Wavelet Transform, Performance Measure

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Introduction

Content-based Image retrieval (CBIR) also known as Qquery by Image Content (QBIC) or Content-Based Visual Information Retrieval (CBVIR), is a method that uses computer vision techniques to image retrieval problems. Content-based image retrieval is conflicting with conventional knowledge of conceptual approaches.

Content-based is searching and analysis of different image features, it is a kind of metadata that takes the information of the image with the help of different keyword, tags, or descriptions of the image. The word content in CBIR refers to color, shape, texture, or some other information which is useful for the image description because searching is on metadata which depends on consequent choice and completeness. In other words, humans manually search a query image by entering keywords in a very large database which takes more time and also not able to analyze the right query information about an image. This assessment for retrieving the effective information from an image is not well defined. So the CBIR method is used which faces similar challenges effectively and efficiently.

The content-based image retrieval system has two basic challenges: first is the intention gap and the second is the semantic gap. In the intention gap, related difficulties of user suffering to express precisely the image content by a query, like an image or a sketch map. The semantic gap is related to originating the problem which is used to describe the tall height with the semantic concept of short height image features[1–3].

Content-based image retrieval introduces in 1992 by T. Kato, which explains the experimental method to retrieve an image features like color or shape feature from the huge image database automatically since the term used to describe the method of retrieving images from huge collection of image features database, various methods, tools, and algorithms are designed to develop the areas like statistical method, object detection, pattern recognition, and computer vision, etc.

In the early 20s, some new methods in CBIR are introduced. Especially, two types of research are in progress for retrieving the images from the large multimedia database. In the primary method, the local image feature of SIFT[4] is contented. SIFT is a feature detection algorithm to detect and describe local features in images. The second research is based on the ”Bag of Visual Words” (BOW) model[5]. Leveraged entropy retrieving, the BOW model makes a powerful summary of demonstration or illustration of images based on the quantization of the restricted local features and promptly modifies the characteristic of file indexing of an organization for image retrieval. According to supra research, end decennium has watcher issue of multitude work on multimedia content-based image retrieval[6–29].

It is used in the commercial field, The CBIR method was implemented by IBM, known as QBIC (Query-based Image Content). QBIC works on the networking and graphics-based approaches, it is a simple, easy, well understood and attractive substitute to traditional methods.

Commonly used content-based image retrieval framework is based on two types of modes namely offline mode and online mode, in which paper hubs on the word on these components, i.e., other query methods and image features, types of image feature advantage and disadvantage of features.

Related Works

Jun Yuea,b, Zhenbo Li This work focuses on low-level features of color and texture which is extracted form CBIR. These two types of features are based on a co-occurrence matrix to extract image features to form the feature vectors after it has been used in a global color histogram, local color histogram

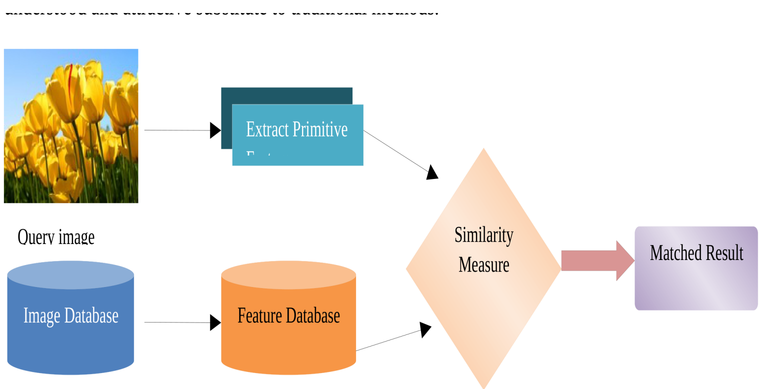

Figure 1. CBIR System Architecture

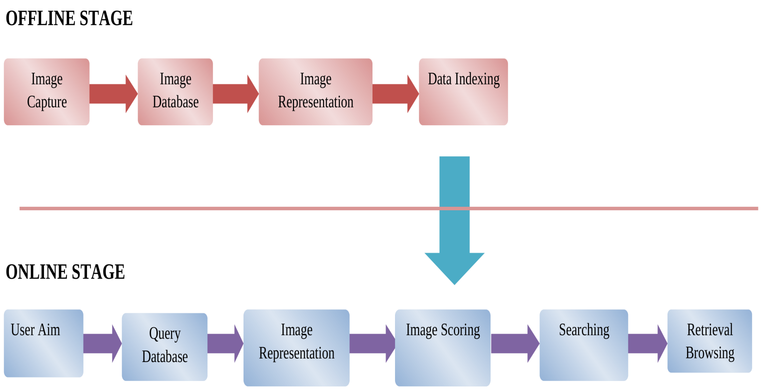

Figure 2. CBIR framework module

and texture features that are examined by CBIR. After feature extraction, it calculates the Euclidean distance measure to find the images. So, CBIR methods are designed by applying color and texture fused features with the help of constructs weights of feature vectors. The process of retrieving the experiments by showing the combination of features is retrieved which brings an enhanced illustration of the single feature, which proceeds to superior retrieve outcome. This whole work is done on Java Eclipse enlargement atmosphere and SQL server 2005 is used as the database system[30].

Nidhi Singh, Kanchan Singh, Ashok K. Sinha It solves the content-based image retrieval in energetic surroundings addressed the problem. It focuses on implementing a new structure that is capable of search, correct features to examine new query images that improve retrieval accuracy and to make it more effective. It works on the FCM approach, FCM means fuzzy C that is an algorithm that generalizes the hard c means algorithm. So, it is produced in a soft panel in a set database. In this paper, feature extraction method like Fast Fourier Transform is used for extracting the invariant array vector of images and after the segmentation of an image, that resultant array vector is used as a first feature vector that besides the HSI component of the color image, and then a second feature vector is used. It proposed an algorithm on 100 tested different real type images and gives better performance as compared to the traditional method of CBIR [31].

Mutasem K. Alsmadi, Mutasem K. Alsmadi this paper is based on a novel relationship between the evaluation of heuristic algorithm known as memetic algorithm (genetic algorithm with a great deluge) to achieve features of the target image and the train image. It comprises of GD algorithm with GA and also increases the quality of weights (solution) by increasing the fitness function (number), which helps in the process of searching. So, it tested on comparable images that are retrieved from a large image database and the calculated result works as average precision and recall rates performance measures. In the future, filtering techniques are used to get more accurate results in the CBIR [32].

A. Mohamed Uvaze Ahamed, C. Eswaran And R. Kannan focuses on accessible CBIR systems limitations like storage space, data security, and bandwidth requirement, to defeat these limitations, a new technique CBIR-PE which use to rectify errors instead of actual images for storage, transmission, and retrieval is presented. It proposes new techniques that are based on grouping like clustering technique called WBCT-FCM, WBCT and FCM, the performance of the proposed WBCT-FCM and CBIR-PE are evaluated using COREL-1k database. After testing, results are much better as compare to the traditional clustering technique and it retrieves better accuracy as compared to the existing methods [33].

Mostafa G. Saeed, Fahad Layth Malallah, Zaid Ahmed Aljawary proposed a new technique of edifice feature vector to represent images for clustering, it consists of 140 elements which take different feature like color histogram, color moments, Gabor filters, GLCM matrix, etc., it work implicitly on corle database which contains 1000 colored images [34].

Keyur D. Joshia, Sanket N. Bhavsar, Rajesh C. Sanghvi In the paper, results are obtained from binary and grayscale image retrieval, it is detected by descriptors for color IRS, while does not detect perfect query, because behind that it uses the KCOLavg descriptor, which eliminates the combination given by three colors and considers the average color contribution. Therefore, it does not give a better efficient descriptor in color images. So the study of intuitive descriptor gives a better output [35].

Dr. Meenakshi Sharma & Anjali Batra focus on feature extraction and homogeneous attribute measures, Utilizing the pyramid is prepared on wavelet decay and energy levels are calculated. These energy levels are equivalent to the manipulative distance between the target image and training images. A substantially huge image database from the Brodatz album is applied for retrieval claims. The investigational report shows that the prep underrating of Canberra, Bray-Curtis, Square chord, and Square Chi-squared distances are more than the conservative Euclidean and Manhattan distance [36].

Yogita Mistry*, D.T. Ingole, M.D. Propose a hybrid feature system for competent CBIR, it is based on spatial, frequency, CEDD and BSIF feature descriptors. The proposed method uses the WANG database; it contains 1000 Corel images of 10 various types of .jpg image, of size 384 $\times$ 256 or 256 $\times$ 384, It combines 100 images in 10 various groups like animals, vehicles, objects, places, etc [37].

A. Khodaskar and S. A. Ladhake presented a paper on CBIR use in the color feature. This feature increases the probability of histograms for each color component. These histograms are separated into different numbers of major coordinates and for each coordinate, it calculates different statistical features like standard deviation, skewness, mean, variance, kurtosis, etc. The processing rate is slow, so the proposed technique experienced on average image databases and it achieved better results [38].

S. Pradeep and L. Malliga presented the CBIR technique use the big power of soft computing techniques like an artificial neural network, fuzzy logic, support vector machine, etc The traditional CBIR system retrieves images by using low-level image features, so it gets the semantic gap. It preposeds an advance structure for CBIR, based on the combination of basic soft computing techniques that extremely improves the accuracy of image retrieving, and also the proposed system work with relevance feedback based on SVM, it gives intelligent classification of images like based on relevant or irreverent query image, and after that, it calculates the performance measures like precision, recall, and accuracy [39].

Charmi Katira, Nikunj Vora, Krisha Wali, Abhinav Medhekar presented the technique of CBIR, which is used for coding ODBTC for a cohort of image descriptors. The encoding is done by using the ODBTC that combine the images block into quantizes and bitmap images, such as color CCF and BPF that is generated into straight for ODBTC encoded data streams without performing any decoding process. The experimental result shows that the planned scheme is greater than the block processing coding image retrieving systems [40].

Ekta Gupta and Rajendra Singh Kushwah proposed some primitive features of an image, which have been utilized in the current scenario system. Some features are selected based on similarity identification between the images. The proposed algorithms used for calculating the similarity between image features, and then describe it. MATLAB tool is used for image verification in a database [41].

Neelima Bagri1 and Punit Kumar Johari proposed the CBIR system for feature selection such as color and texture is called WBCHIR, shape and shade features are used for feature selection in the path of wavelet transformation and color histogram that makes these features energetic and adaptable. In this paper, the first time the segmentation and grid for feature extraction are used. [42].

Davar Giveki, Ali Soltanshahi, Fatemeh Shiri, Hadis Tarrah comparison is done between the combination of texture and shape features using texture Gray Level Co-occurrence Matrix and Hue moments and also the grouping of Tamura texture features and shape invariant Hue moments. For the performance measure of the system precision and recall, the method is used [43].

P. Selvi Rajendran, R. Sandya, T. Yogeswari, and G. Viveka, in this paper firstly experiment is done on the effectiveness of choosing color space performance using CBIR for Wavelet decomposition. So, increase the efficiency is the result of CBIR representation using wavelet transform in lab color space and color moments, [44].

S. Sasikala, R. Soniya Gandhi it proposes three algorithms to increase the performance (flicker, Photo bucket). In this paper, the HMok SimRank algorithm is used which derives the correspondence algorithm using IWSL to integrate data for query images in an image database. Ranking algorithm is used for finding the rank of the images, it increases in terms of both relevance and speed [45].

Sandeep Singh, Er. Rachna Rajput introduces CBIR problems and challenges, which uses an accurate image searching system. It is based on CBIR using Mpeg-7 descriptors, which work on low-level features and are extracted from the large database, it transforms between color spaces and quantization and uses color information for feature extraction. This proposed method achieves robustness and 92.4% accuracy [46].

T. Dharani and I. Laurence Aroquiaraj proposed a survey paper on the CBIR technique, it uses visual features of an image like color, shape, texture, etc. to search the user target image from the huge image database according to the user query. It is based on labeled and unlabelled images to analyze the efficiency of an image using the method like D-EM, SVM, RF, etc. [47].

A. W. M. Smeulders, M. Worring, S. Santini, A. Gupta, and R. Jain explain the running situation of content-based retrieval from, types of image format, the role of semantics, pattern and the sensory gap. For features, a certain retrieving method is used such as global features, salient points, object and shape, signs, and structural combinations, for similarity searching of image and objects in the image. For this purpose system engineering databases, system architecture, and evaluation are used [48].

A.W. M. Smeulders, M. Worring, S. Santini, A. Gupta, and R. Jain focuses on the number of digital images increasing from time to time and taking out it from huge databases which is flattering complex. Indexing image data is based on the text which is exhausted and blunder horizontally. The indexing uses low-level features of the image that may diminish the workload and make mining to become more rapid. The indexing technique index the digital images in the database by the peak color proportion. The images will be routinely confidential by its low-level feature like color. Execution of this technique will benefit image mining [49].

Tarulatha, N. Shroff and M. B. Chaudhary work on advance technology to increase accuracy using CBIR systems. So the research paper centers on the shifted design which is complicated for the low-level feature to extract algorithms that reduce the semantic gaps among image features and databases. In this paper, the author has done a literature survey on recent technologies to achieve an elevated level of semantic-based image retrieval.

Ying Liua, Dengsheng Zhanga, Guojun Lua focus on Gabor wavelet proof texture analysis for image retrieval method based on Gabor filter. The texture feature works on the mean and variance of statistical features for Gabor filtered image. In normalization, it is used by a spherical shift of the feature elements which override on points. The image indexing and retrieval are conducted on the image texture and usual images [51].

Image Retrieval Techniques

The image retrieval system is a structure for probing, finding and retrieving images from a huge image database. Traditionally, image retrieval uses some common methods for adding metadata like capturing, keyword or some other type of information that describes an image. An early researcher works on the following image retrieval techniques.

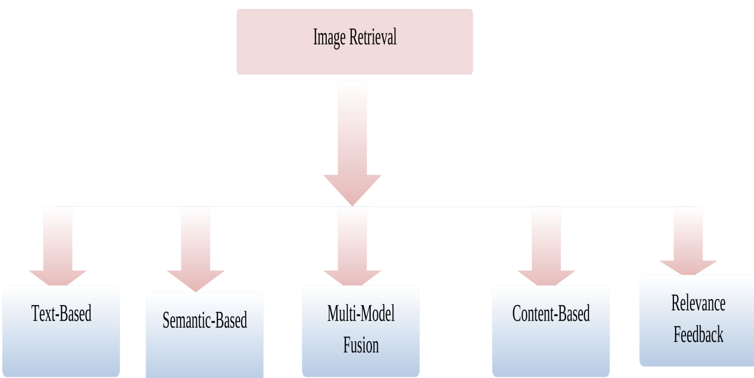

Figure 3. Image retrieval technique

I. Text-Based Image Retrieval

Text-based image retrieval method also known as description image-based system, used for retrieving XML documents that contain images, it is based on textual information for an exact multimedia query in the database. Therefore, it overcomes the limitation of the CBIR system. It allows the users to present information according to the needs of textual query and finding the significant images which match with the textual query and the database[52–56].

II. Multimodal Fusion Image Retrieval

Multimodal fusion image retrieval is required for data synthesis and a machine learning algorithm is called a combination of evidence. It is used for merging multiple sources of evidence, which is based on multiple modalities, like skimming effect, chorus effect and dark horse effect[57].

III. Semantic-Based Semantic-Based Image Retrieval

A semantic-based image retrieval system is used for current images. It is the method, that works to solve the semantic gap problem, which leads to two main approaches, first is Annotating images and second is image segment that uses automatic image explanation and adopting the semantic web initiatives[58,59].

VI. Relevance Feedback Image Retrieval

It is used for finding the difference between the user information and the image representation, which defines the limit of retrieval accuracy of an image by nuclear retrieval systems. It is basically due to the essential semantic gap. It is used to reduce these gaps. The basic idea behind the relevance feedback is to integrate the person' s perception regarding the query and involve the user to calculate the retrieval results[76], user interaction is necessary for achieving better results[60–63].

Content Based Image Retrieval Techniques

CBIR systems are projected on many technique, but some problems for image retrieving system on the basis of pixel content left over fluid[64–75].

I. Query techniques or Query-based technique

Query by example is based on a query technique, which works based on a searching algorithm. The searching algorithm is based on the functionality of the resulting image and shares common image information which is known as Reverse searching image.

Some common examples of an image searching system are as follows:

- An existing image can supply by users and choose the random set.
- The user draws a rough calculation of an image.

II. Semantic retrieval

Semantic retrieval is used to start a user quest, for example, ”find pictures of Abraham Lincoln”. It is a sort of open-ended task, which is extremely complicated for computer operations. Lincoln can' t face the cameras and the same poses. CBIR systems use a low-level feature such as texture, color, and shape features, these features are used in grouping and interfacing, so it is easy to input the databases which are qualified to match features (like face, fingerprint, or shape). Generally, image retrieval requires a human identification of the higher-level concept.

III. Relevance feedback (human interaction)

The Combine CBIR system is a searching technique for the identification of the large variety of probable user's image and the target can be a strong task. A CBIR system relies totally on the aptitude of understanding of user queries.

IV. Iterative or machine learning

Machine learning and application is an iterative technique for the fitting of extra culpability in CBIR.

V. Other query methods

This method is based on searching and browsing, for example, navigation of modified and hierarchical categories such as query by image type, query by a various instance of images, query by visual outline, query by the straight requirement of image features and multimodal queries (e.g. combining touch, voice, etc.)

CBIR Methods

CBIR is the most popular method for comparing two images, it is used as a distance measure. The distance measure is based on comparing the similarity between the two images based on color, texture, and shape.

I. Color

The color feature is one of the most significant features in a content-based image retrieval system, it is helpful in image recognition. Color features are a pixel property and these properties work on the reflection of light. Color tells about the variation between object, position and time of day. There are many types of color model that describes the color information of an image, it makes image information about inequity potential to the single point gray level values.

Color space is a method that represents pixel coordinates in 3D color space, in which the popular RGB method is used for image retrieval. RGB method is consists of three colors which are red, green and blue, and known as additive primaries, which is developed by combining all the three colors. In contrast method, CMY is used for printing, which contains three colors that are cyan, magenta and yellow, and it is called subtractive primaries. It is developed for brightness inclusion. Both the color models RGB and CMY are mechanism-based or perceptually non-uniform.

The CIE (L*u*v*) space device freelance and measured to be perceptually standardized. CIE is made for subtractive color mixtures, while CIE is designed for the arrangement of stabilizer rinse variety.[47].

HSV space model is commonly used in computer graphics and expanded as hue, saturation, and value. The invariant moment is used to change the light and camera direction, hence it is an appropriate method for image retrieval. The invariant moment is represented by calculating the wavelength of light, it expresses the pure spectrum color model, which ranges from 0° to 360°. RGB coordinates are easier to translate into HSV (HLS or HSB) coordinate and are represented by using a simple formula,

$$H = \cos^{-1}\frac{1}{2}\frac{[(R-G)+(R-B)]}{\sqrt{[(R-G)^2+(R-B)(G-B)]}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$S = 1 - \frac{3[\min(R,G,B)]}{R+G+B} \ldots\ldots\ldots\ldots\ldots \quad (2)$$

$$v = \frac{R+G+B}{3} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

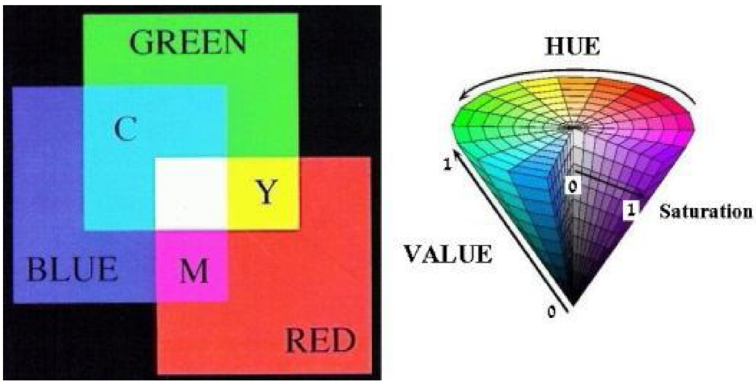

Figure 4. RGB space color model to HSV space image[80].

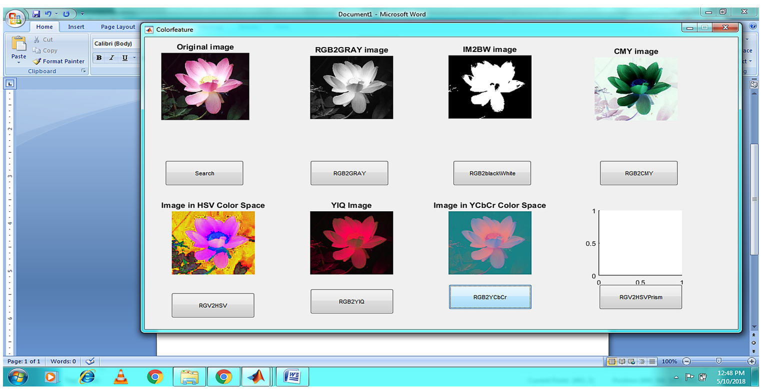

Figure 5. (a) Color conversion to different color model

Some common techniques used in color feature are as follows:

a) Color Moment

The most popular color feature used for CBIR is the color moment. The color moment is a statistical measure that differentiates image using the feature extraction method and that image is recognized by

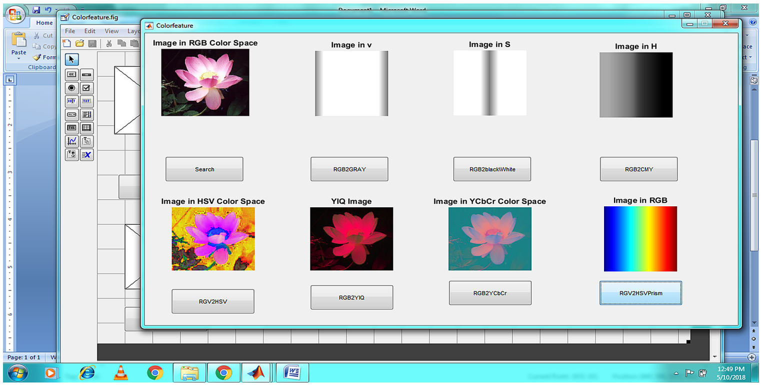

Figure 5. (b) Color conversion to the different color model

the distribution of color moment (statistical measure) or features. There are some common statistical measures namely mean, variance and skewness. The color moment proves the efficiency and effectiveness of color statistical distribution of images.

$$\mu_{i=}\frac{1}{N}\sum_{j=1}^{N} f_{ij} \;\ldots\ldots\ldots\ldots\; (1)$$

$$\sigma_i = \left(\frac{1}{N}\sum_{j=1}^{N} \left(f_{ij} - \mu_i\right)^2\right)^{\frac{1}{2}} \;\ldots\ldots\ldots\ldots\; (2)$$

$$s_i = \left(\frac{1}{N}\sum_{j=1}^{N} \left(f_{ij\_}\mu_i\right)^3\right)^{\frac{1}{3}} \;\ldots\ldots\ldots\ldots\ldots\; (3)$$

where f_{ij} is value image, i^{th} is color element image pixel, j and *N is* no. of the pixel image.

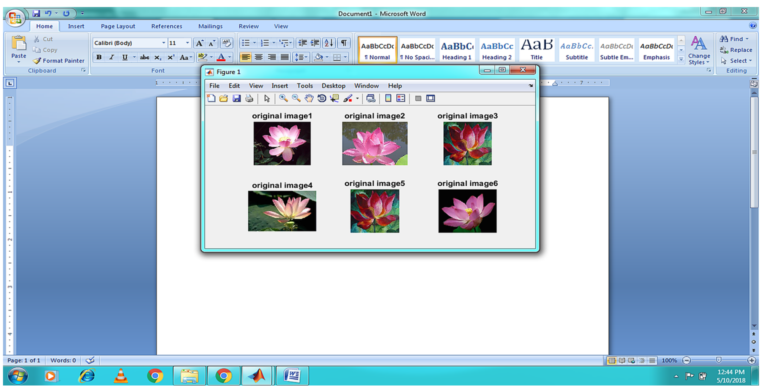

Figure 6. Database

Table1. The experiment result of color Moment

S.no	ColorMo1	ColorMo2	ColorMo3	ColorMo4	ColorMo5	ColorMo6
Image1	98.5513	150.7495	101.2073	85.5941	101.1767	77.3031
Image2	95.9414	64.8982	58.3551	83.2036	57.7118	87.1210
Image3	69.7427	111.2991	73.9050	84.5222	73.8894	48.2561
Image4	77.0045	33.9630	50.8406	67.5750	50.2813	53.6986
Image5	82.2800	125.5592	67.4838	67.3654	67.6743	60.8554
Image6	84.2418	50.5414	43.1666	61.5602	42.4683	70.5261

b) Color Histogram

A color histogram is an interpretation and identification of RGB image intensity. Color histogram defines color vector, which is a set of pixels of all images, coordinates which are denoted by the chance of the pixels and the image working individually as an RGB image. It is a way of viewing translation and rotation, by changing an image slowly with the help of scalar transformations, stoppage and viewing angle.

H is a color histogram vector for image defined as

$H = \{H[1], H[2], H[3], \ldots\ldots H[i], \ldots..H[N]\} \ldots\ldots\ldots\ldots\ldots\ldots$.. (1)

where i is a color histogram, H[i] is no. of pixels color, i is an image, and N is no. of the coordinate for a color histogram.

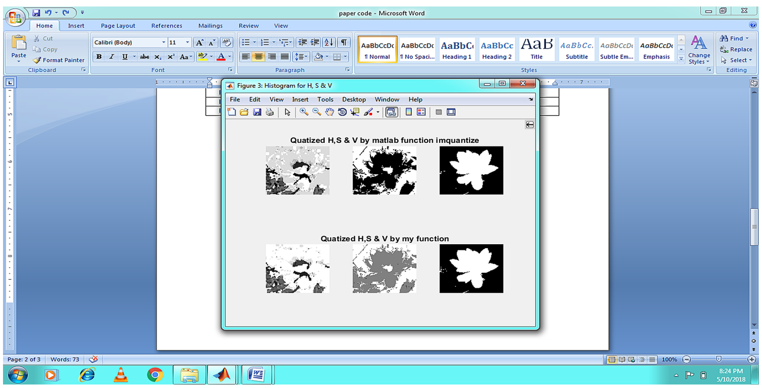

Figure 7. HSV Histogram for Color Model

c) Color Correlogram

The color correlogram is a table indexing feature using color pairs, where the k^{th} entry for (i, j) specifies the possibility of indexing of coordinates of color j at a distance of k from a pixel of color I in the image[5].

Mathematical representation of color correlogram is shown in eq (1)

$\gamma_{(i,j)^{(k)}} = \Pr_{p1\epsilon c(I), p2\epsilon I}[P2\epsilon I_{c(j)} | P1 - P2| = K] \ldots\ldots\ldots\ldots\ldots\ldots$.. (1)

where i, j $\in \{1, 2, \ldots, N\}$, k$\in \{1, 2, \ldots, d\}$, and | p1 – p2 | is the distance between pixels p1 and p2.

d) Color coherence vectors

The color coherence vector is divided into two categories namely coherent histogram and non-coherent pixel. Pixels are measured to be coherent if they are part of a continuous equally colored area and the size of this area exceeds some threshold, it means frequently definite as 1% of the large area of the image.

Table. 2 Advantages and Disadvantage of Color Models

Models	Advantages	Disadvantages
RGB (Red, Green, Blue)	The transformation method is not used for displaying information, as it is measured as the bases of color space for the different methods, it uses video display because of its stabilizer properties.	It does not use as object identification and recognition of colors.
CMY(K)	It is normally used for production printer color.	It is a subtractive model so inks are not given output as color.
HSV	HSV color model can be simply identified by individual observation as compare to CMY or RGB.	Hue coordinates are receptive to derivations because of its sharp nature features.

II. Texture

The texture is the most important or popular feature of an image, which is a set of the matrix which calculates spatial collection of color intensities of an image and selects the region of an image. It can be synthetically created or identifies natural scenes that are captured in an image. The texture feature is used in segmentation, classification, pattern recognition, and computer vision.

Some common techniques used are Coarseness, Contrast, Directionality, Line-likeness, Regularity, and Roughness.

These are divided into three approaches: structural, statistical and spectral.

1. **The structural approach** is an image texture set of primitive texture elements (pixel or texels) in morphological operators and adjacency graph. It is based on a regular subpattern.
2. **Statistical approach** is a quantitative measure, like Fourier power spectra, co-occurrence matrices, shift-invariant principal component analysis (SPCA), Tamura feature, etc.
3. **Spectral techniques** are a property used for the Fourier spectrum, which explains the global periodicity of a gray level image by the identification of high energy coordinates in Fourier spectrums.

The commonly used technique in the statistical method are_

A. Gray Level co-occurrence Matrix
B. Tamura Texture
C. Wavelet Transform

A. Gray Level co-occurrence matrix is developed by R.M. Haralick, and it is the most important and popular method for representing image textures. It is the second-order statistical methods in which 14 statistical measures are used for feature extraction.

Table: 3 GLCM Feature

S. no	Feature	Formula	Remark
1	Contrast	$\sum_{n=0}^{Nn-1} n^2\{\sum_{i=1}^{Ng}\sum_{j=1}^{Ng} P(i,j)\}, \lvert i-j\rvert = n$	Have discriminating ability. Rotationally variant
2	Entropy	-$\sum i \sum j P(i,j) \log(P(i,j))$	Have strong discriminating ability. Almost rotational invariant.
3	Correlation	$\frac{\sum i \sum j P(i,j) - \mu_x \mu_y}{\sigma_x \sigma_y}$	Have a strong discriminating ability. Rotational dependent feature.
4	Sum average	$\sum_{i=2}^{2N} i p_{z+y}(i)$	Characteristics are similar to variance. Rotation is invariant.
5	Sum of squares: Variance	$\sum i \sum j \,(i-\mu)^2 P(i,j)$	Computationally expensive Rotation variant.
6	Info. The measure of Correlation 1	$\frac{HXY-HXY}{\max\{HX,\,HY\}}$	Similar to the Correlation
7	Info. The measure of Correlation 2	$(1-\exp[-2(HXY2-HXY)])^{\frac{1}{2}}$	Similar to the Correlation
8	Inverse Different Moment	$\sum i \sum j \frac{1}{1+(i-j)^2} P(i,j)$	Similar to the angular second moment.
9	Sum Variance	$\sum_{i=2}^{2N} (i-f_s)^2 P_{(x+Y)}(i)$	Similar to variance
10	Sum Entropy	-$\sum_{i=2}^{2N} P_{(x+y)}(i) \log\{P_{(x+y)}(i)\} = f_s$	Similar to entropy
11	Angular second moment / Energy	$\sum i \sum j P(i,j)^2$	No distinguishing ability
12	Difference variance	$\sum_{i=0}^{N-1} i^2 P_{(x-y)}(\mathrm{i})$	Similar to Variance
13	Difference Entropy	-$\sum_{i=0}^{N-1} P_{(x-y)} \log\{P_{(x-y)}(\mathrm{i})\}$	Similar to Entropy
14	Max. Correlation coeff./ Mean	$Q(i,j) = \sum k \frac{P(i,j)P(j,k)}{p_x(i)p_y(k)}$	The square root of the second-largest Eigenvalue

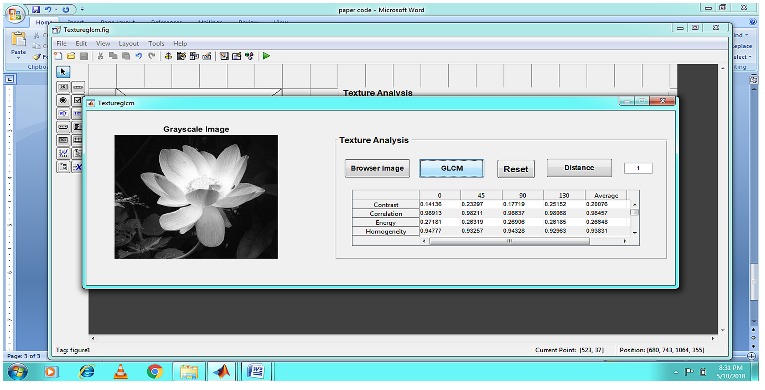

Figure 8. Texture Analysis for 1-pixel distance

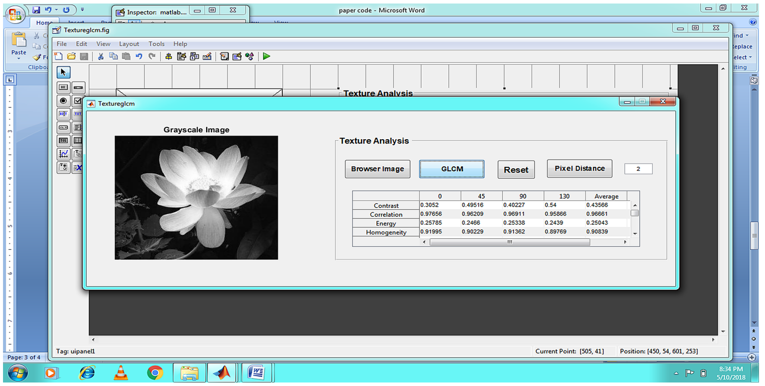

Figure 9. Texture Analysis for 2-pixel distance

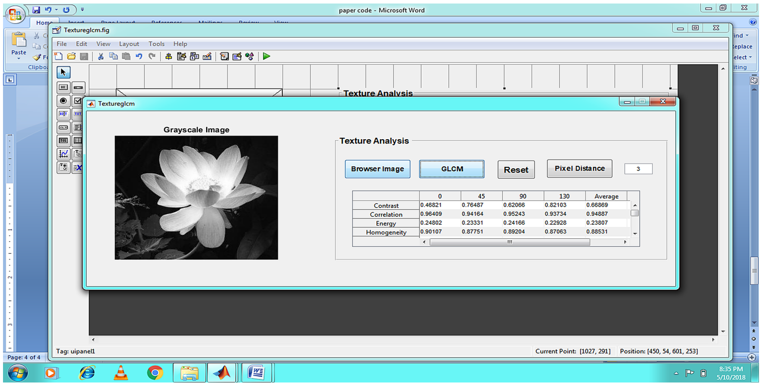

Figure 10. Texture Analysis for 3 pixel distance

Table 4. Texture feature of GLCM

S.no	Feature	Image1	Image2	Image3	Image4	Image5	Image6
1	Autocorrelation 1	15.6346	15.6346	15.6346	15.6346	15.6346	15.6346
2	Autocorrelation 2	15.6675	15.6675	15.6675	15.6675	15.6675	15.6675
3	correlation 1	0.9691	0.9691	0.9691	0.9691	0.9691	0.9691
4	correlation 2	0.9765	0.9765	0.9765	0.9765	0.9765	0.9765
5	Cluster Prominence 1	1303.913	1303.913	1303.913	1303.913	1303.913	1303.913
6	Cluster Prominence 2	1311.307	1311.307	1311.307	1311.307	1311.307	1311.307
7	Cluster Shade 1	100.7474	100.7474	100.7474	100.7474	100.7474	100.7474
8	Cluster Shade 2	101.3129	101.3129	101.3129	101.3129	101.3129	101.3129
9	Dissimilarity 1	0.2155	0.2155	0.2155	0.2155	0.2155	0.2155
10	Dissimilarity 2	0.1883	0.1883	0.1883	0.1883	0.1883	0.1883
11	Max Probability 1	0.4785	0.4785	0.4785	0.4785	0.4785	0.4785

S.no	Feature	Image1	Image2	Image3	Image4	Image5	Image6
12	Max Probability 2	0.4827	0.4827	0.4827	0.4827	0.4827	0.4827
13	Sum of Square 1	15.7321	15.7321	15.7321	15.7321	15.7321	15.7321
14	Sum of Square 2	15.7321	15.7321	15.7321	15.7321	15.7321	15.7321
15	Sum of Average 1	6.10709	6.10709	6.10709	6.10709	6.10709	6.10709
16	Sum of Average 2	6.10288	6.10288	6.10288	6.10288	6.10288	6.10288
17	Sum of Variance 1	42.8879	42.8879	42.8879	42.8879	42.8879	42.8879
18	Sum of Variance 2	43.0304	43.0304	43.0304	43.0304	43.0304	43.0304
19	Sum of Entropy 1	1.9545	1.9545	1.9545	1.9545	1.9545	1.9545
20	Sum of Entropy 2	1.9435	1.9435	1.9435	1.9435	1.9435	1.9435
21	Diff of Variance 1	0.4022	0.4022	0.4022	0.4022	0.4022	0.4022
22	Diff of Vari2nce 1	0.3051	0.3051	0.3051	0.3051	0.3051	0.3051
23	Diff of Entropy 1	0.5566	0.5566	0.5566	0.5566	0.5566	0.5566
24	Diff of Entropy 2	0.5135	0.5135	0.5135	0.5135	0.5135	0.5135

B. Tamura: Tamura feature is designed by studying the human perceptual experience of texture features. There are some perceive textures feature types which are as follows:

a) Courses
b) Contrast
c) Directionality
d) Linelikeness
e) Regularity
f) Roughness

a) **Courses:** Coarseness is a distance measure related to the spatial variation of a gray level image, so it easy to find the size of the primitive element (pixels or texels) form the texture feature. Coarseness is the quantitative measure of a scalar image that fixed the window size. So the smaller value of the texture element is known as coarser.
b) **Contrast:** It is measured to check that the image is black or white on the bases of distribution.
c) **Directionality:** It contains information of edge strength and directional angle. It uses the pixel-wise differential for computing an image.
d) **Linelikeness:** It describes the average conjunction of edge directions, so it defines the isolated pixels by using distanced and down with the direction α.
e) **Regularity**: It defines the course, contrast, direction, and loneliness, it is denoted by *r*uses as a normalization factor and σ defines the standard deviation of the texture features of each sub-image.

C. Wavelet Transform

Wavelet transforms offers the multiresolution method that describes texture analysis and classification. It explains the basic function of a superposition in the family called wavelets. It computes the 2 D image. It is based on a multi-resolution approach, so it applies the recursive filtering and sub-sampling due to which the image divided into sub-levels, every level is decomposed into sub-bands of four frequencies which are, LL, LH, HL, and HH.

where L represents low frequency and H denotes the high frequency. Some common types of wavelets are Haar, Coiflet, Morlet, Mexican Hat, Haar, and Daubechies.

Haar wavelets are the most popular and simplest wavelets, while Daubechies is fractal structures and path current of wavelet application.

III. Shape

The shape is the most popular and important feature. It is used to extract the information from an image, but because of the noise, occlusion, arbitrary distortion, object recognition problem became more difficult. Shape representation is focused on the shape features so it is boundary-based or region based. An efficient shape feature needs some properties like identifiability, translation, affine invariance, noise resistance, occultation invariance, statistically independent and reliable to make it more efficient.

A. Boundary based: It mainly focuses on the outer boundaries of an image that defines the important region by using the external characteristic of an image, in each pixel (or coordinate) along with the image boundary. There are following types of the region:

a) Polygonal Models, or Boundary partitioning
b) Fourier Descriptors
c) Spines, higher-order constructs
d) Curvature Models

B. Region-based shape: Region-based shape feature, focuses on the shape region of the whole image by using a complete image internal description. There are some kinds of method representation which are as follows:

a) Super quadrics
b) Fourier Descriptors
c) Implicit Polynomials
d) Blum' s skeletons

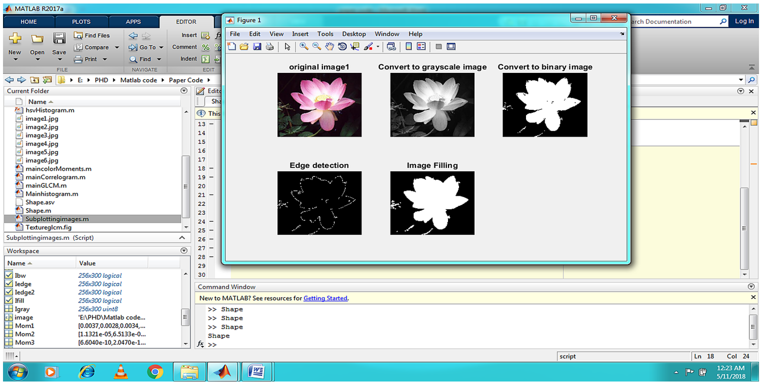

Figure 11. Edge detection

C. Fourier Descriptor: Fourier descriptor describe the shape feature of an object in an image, in which it uses Fourier transform for boundaries and consider the shape (contour) of a two-dimensional image.

Contour representations are divided into three types

A. Curvature
B. Centroid distance
C. Complex coordinate function

A. Curvature: Curvature $K(s)$ is a method which changes the rate of the tangent direction of the curve, it is represented as *s,* s is the point of the curve. It can be represented as,

$K(s) = \frac{d}{ds}\theta(s)$.................. (1)

Where $\theta(s)$ *represent* the turning function of the curve.

B. Centroid distance: Centroid distance is a method that calculates the distance function between boundary pixel and the centroid (*xc, yc*) of an image object, It' s defined as:

$R(s) = \sqrt{(x_s - x_c)^2 + (y_s - y_c)^2}$................ (2)

C. Complex Coordinate: Complex coordinates describe the coordinates of boundary pixels and complex number, it's defined as:

$Z(s) = (x_s - x_c) + j(y_s - y_c)$.................. (3)

D. **Fourier transforms** contour representation can be divided into three ways, it is used to generate the complex coefficients representation of the shape of an object frequency domain. The first one is **Lower frequency coefficients** that express the general shape property, second is **higher frequency coefficients** used to reproduce the shape information and third **is complex coefficient**s which achieve the rotation invariant, scalar invariance, amplitude coefficients separated by the amplitude of DC component and non zero coefficients. The transformation invariance is based on the contour illustration.

E. **Moment Invariant:** Moment Invariant is based on conventional shape representation; it is a set of moment invariants. The main reason to propose the moment invariant is to calculate region-based moment; if the object R is represented as the binary image, then the center moment order of p+q for the shape of object R is defined as:

$\mu_{p,q} = \sum_{(x,y)\varepsilon R} (x - x_c)^p \, (y - y_c)^q$......................... (4)

Where (x_c, y_c) represents the center of the image.

Invariants are independent of position, size, and orientation. Moment invariant is bases of these moments are translation; rotation and scale can be derived as:

$\varnothing_1 = \mu_{2,0} + \mu_{0,2}$....... (1)

$\varnothing_2 = (\mu_{2,0} - \mu_{0,2})^2 + 4(\mu^2)_{1,1}$...... (2)

$\varnothing_3 = (\mu_{3,0} - \mu_{1,2})^2 + (3(\mu_{2,1}) - \mu_{0,3})^2$......... (3)

$\varnothing_4 = (\mu_{3,0} + \mu_{1,2})^2 + (\mu_{2,1} + \mu_{0,3})^2$............(4)

$\varnothing_5 = (\mu_{3,0} - 3\mu_{1,2}) \left(\mu_{3,0+\mu_{1,2}}\right) \left[(\mu_{3,0} + \mu_{1,2})^2 - 3\left(\mu_{2,1} + \mu_{0,3}\right)^2\right] + (3\mu_{2,1} - \mu_{0,3})(\mu_{2,1} + \mu_{0,3})[3(\mu_{3,0} + \mu_{1,2})^2 - (\mu_{2,1+\mu_{0,3}})^2]$............ (5)

$\varnothing_6 = (\mu_{2,0} - \mu_{1,2}) \left[(\mu_{3,0} + \mu_{1,2})^2 - (\mu_{2,1} + \mu_{0,3})^2 + 4\mu_{1,1} \left(\mu_{3,0} + \mu_{1,2}\right) \left(\mu_{2,1} + \mu_{0,3}\right)\right]$...... (6)

Table5. Hue Moment

S.no	Hue Moment	Image1	Image2	Image3	Image4	Image5	Image6
1	Moment 1	0.0037	0.0028	0.0034	0.0045	0.00343	0.0051
2	Moment 2	1.1320	6.5133	7.9582	1.8011	7.9544	2.2833
3	Moment 3	6.6040	2.0469	1.6069	2.3019	1.5979	2.8695
4	Moment 4	6.0669	2.0748	1.7688	2.3844	1.7525	2.8935
5	Moment 5	3.8165	4.2588	2.9822	5.5861	2.9328	8.3352
6	Moment 6	2.0412	5.2940	4.9287	1.0061	4.8795	1.3779
7	Moment 7	-4.2586	3.8194	1.6999	-2.2187	1.5708	-2.0836

F. Turing Angles: In this, contour works on 2D images, the close sequence representation leads to successive boundaries of pixel (*xs, ys*), where $0 \leq s \leq N$-1 and N define the total number of element on the boundaries, turning function is represented as $\theta(s)$, which finds the angle of the counter, it uses clockwise tangent for the functions of the curve length *s which is* according to the situation point on the image (curve), it defines as

$$\theta(s) = \tan^{-1}\left(\frac{y'_s}{x'_s}\right) \quad \ldots\ldots\ldots\ldots (1)$$

$$y'_s = \frac{dy_s}{ds} \ldots\ldots\ldots\ldots (2)$$

$$x'_s = \frac{dx_s}{ds} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Table 6. Various feature techniques[77]

Types of feature	Methods	Characteristics
Color Features	Conventional color Histogram(CCH), Fuzzy Color histogram (FCH), [20,21] ColorCorrelogram	Simple to calculate. It cannot instruct the spatial info. It cannot instruct by color coordinates seminaries. It considers the degree of color relationship between the coordinates. It is strong to quantize fault. Here, the robustness changes the brightness intensity.
Texture Features	Steerable pyramid, Contourlet transform, Complex directional filter bank (CDFB)	In this, we use basic filters for translation and rotation. These filters are the linear combination of basic functions. Only the rotation invariants are the use of texture retrieval. Combining the Laplacian pyramid function with a directional filter requires less computation and difficulty. Optimally, it achieves the joint resolution of space and spatial frequency which is computationally intensive. So, it gives the highest result of texture retrieval. It compares the retrieval outcome with the Gabor wavelet output and it is Shift Invariant.
Shape Features	Fourier Descriptor, Moment Invariants, Directional Histograms	The shape feature is a phase of understanding and implementing the shapes.

Distance Performance Measures

In CBIR, searching is between the target image and training images. So, the image retrieval method shows results according to the list' s image list. Many distance measures are developed for the CBIR feature in recent years.

Distance measures used to locate the connection of feature vectors like Euclidean, Standard Euclidean distance and Manhattan, etc. In the CBIR system it is used to compare to the relationship between the images.

Euclidean distance: It is the distance between the two coordinates of the image is called Euclidean distance know as L $_2$ distance, in which X (x1, x2) is a two-point and Y (y1, y2) is two-dimensional Euclidean coordinates. The line segment is used with the endpoints of the X and Y form the hypotenuse of a right angle. The distance between two corrdinates X and Y is defined as the square root sum of the square, that differences between the corresponding coordinates of the points, is define as

$D(p,q) = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$.......................... (1)

Where, N is dimensions points, such as X=(x_1,x_2,x_3,.........,x_n) and Y=(y_1,y_2,y_3,.........y_n).

1. Standard Euclidean distance: In which Euclidean distance is calculated by standardized data, it can be defined as

Standardized Data= (original mean value)/Standard deviation

$d = \sqrt{\sum (\frac{1}{{s_i}^2})(x_i - y_i)^2}$.......... (2)

2. Manhattan distance: It calculates the distance between two points, where lattice is stringently based on horizontal or vertical path, which is opposite to the diagonal . The Manhattan distance is based on the sum of the horizontal and vertical components whereas the distance of the diagonal is calculated by using Pythagorous Theorem. Mathematically, it is defined as

$Mh(p,q) = (x_1 - x_2) + (y_1 - y_2)$............. (3)

3. Minkowski distance: It is widely used metric of the image retrieval, in which each image element feature vector is independent of each other and all features are equally important. Basically, Minkowski distances are used to calculate the distance between two images. Mathematically, it can be defined as

$D(p,q) = (\sum_i (f_i(x) - f_i(y))^p)$................. (4)

4. Mahalanobis Distance: In this measure the distance metric is applied to each and every dimension of the image feature, which are vector independent of each other and are significance. It can be defined as

$D(p,q) = \sqrt{(F_p - F_q)^T C^{-1} (F_p - F_q)}$............ (5)

Where, C is representing the covariance matrix of image feature vector.

5. Chebyshev distance: It calculates the distance between the two points p and q. Chebyshev distance represents the standard coordinates p_i and qi and it is a metric of uniform norm. It can be represented as

$D_{chess}(p,q) = \max(p_i - q_i)$............. (6)

where, p and q are two points, Cartesian coordinates are (x_1, y1) and (x_2, y_2).

6. Quadratic for Distance (QF): The Minkowski distance covers all the coordinates, extract the feature histogram which is totally independent and does not describe the information of the certain coordinate pairs which are corresponding to the features and is similar to the other pairs, it defined as

$D(i,j) = \sqrt{(F_i - F_j)^T A(F_i - F_j)}$.................... (7)

Where, A [a_{ij}] define the similar matrix, a_{ij} denotes the coordinates between i and j of similar matrix. F_i and F_j are vector list.

Performance Evaluation

Performance measures are used to calculate the results and uses image retrieval mesures such as precision and recall, which works on feature extraction and gives positive stability outcome. These features extract information without any interpretation problems.

It can be categorized as Precision, Recall and F score.

Precision

Precision is the performance measure that retrieves the related images to the query image from the total retrieved database images.

$$Precision = \frac{No.\ of\ relevant\ \ retrieved\ image}{Total\ No.of\ \ retrieved\ image} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Recall

Recall performance measure is the measurement of the retrieval of the relevant images to the image database.

$$Recall = \frac{No.of\ relevant\ retrieved}{Total\ No.\ relevant\ in\ the\ database} \ldots\ldots\ldots\ldots\ldots (2)$$

F Score

In precision and recall measure, accuracy of an image retrieval of the relevance query image is calculated from the database image, in which the calculated values shows the success of image retrieval. Some time these two measurements are not able to optimize correct accuracy of the capable image retrieval. Hence they combined as single value that value describes the accuracy of an image retrieval. This arrangement is known as F-Score or F-measure. Precision and Recall measure are the combination of the computing the score it is known as weighted average or harmonic.

$$F = 2 * \frac{(Precision*Recall)}{(Precision+Recall)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Table 7. Comparison of features extraction methods[79]

S. No	Feature Extraction Method	Performance Evaluation Parameter	Advantage	Disadvantage
1	Color Histogram, Standard Wavelet	Retrieving Accuracy	It improves the retrieval accuracy.	Insufficient feature set
2	Color Moment, Gabor Filter GVF	Retrieving Efficiency	It creates vigorous feature set.	elevated semantic gap
3	Color Moment, Gabor Filter, Co-occurrence Matrix	Precision	It reduce the semantic gaps via the RF and SVM	It is time overriding to the label negative.

S. No	Feature Extraction Method	Performance Evaluation Parameter	Advantage	Disadvantage
4	Color Histogram, Tamura, Zenike Moment & Edge	Precision and Recall	Reduce dataset. All similar images of correlated features are retrieved.	Similarity measurement and image retrieval perform two times so it increases calculation.
5	Daubechies Wavelet	Precision, Classification accuracy	Narrow down search space. Handle large image database.	Feature set not sufficient

Conclusion

In this paper, comprehensively study of various methods is done. The discussion of the general framework of CBIR system is done It further summarizes the important points of extraction from encompassing survey. The survey shows that CBIR is still a very interesting area for research. Different work is undergoing in this field to develop or modernize CBIR system. It lessen the gaps between the low level and high level features. Most of the work can also be used to optimize retrieval performance. Also some recent work on CBIR system is done by cobining two or more areas simultaneously to achieve better results in terms of performance.

Comparative Analysis of Some Recent Techniques

Table 8: Literature Review of CBIR Techniques[78]

S. No.	Author and Year	Technique used for feature extraction/ indexing/ matching / relevance feedback/ database used	Comment
1	M.A.Z. Chahooki, N.M. Charkari 2012[25]	Shape based indexing : contour-based and region based method. Manifold learning is used for dimension reduction the MPEG-7 are the part B and fish shape dataset	Retrieval accuracy is increased due to the combination of four different characteristics of shape feature. Isomap manifold learning method increase the retrieval precision
2	Eleftherios Tiakas, Dimitrios Rafailidis,Anastasios Dimou, andPetros Daras, 2013[36]	Multi sort indexing (MSINX) is high dimensional image descriptor Image Clef Wikipedia Retrieval 2010, Flickr 1 M, IRISA datasets	System give the more accurate retrieval result in less time. Mean average precision is calculated. It can handle energetic operations of insertion and deletion in real time.
3	Michal Batko,Jan Botorek, Petra Budikova, Pavel Zezula, 2013[12]	Automatic image annotation and classification(semantic search). Precision and response time of Proof media photo bank and proof media search log Annotation is calculated	Focused on web annotation Combines image and text processing techniques Annotation quality can be significantly improve due to various expansion and reduction techniques .

S. No.	Author and Year	Technique used for feature extraction/ indexing/ matching / relevance feedback/ database used	Comment
4	Romain Raveaux,Jean-Christophe Burie, Jean-Marc Ogier, 2013 [16]	Image is segmented into regions. Graph based image representation (region adjacency graph) is calculated to show spatial relationship From each region color (color histogram), texture (co-occurrence matrices) and shape (Zernike Moments) features are computed K-means clustering is used for cluster regions Coil-100 dataset is used.	This approach gives good results as compare to tree based approach.
5	Lingyang Chu, Shuqiang Jiang, Shuhui Wang, Yanyan Zhang, Qingming Huang, 2013 [31]	Partial Duplicate Image Retrieval (PDIR) using SIFT features. Combined orientation position (COP) consistency Graph model for similarity matching, it calculate the mean average precision and Average Retrieval Time. It Use Holodays/1000k, Sub-Dupimage/1000k, Dupimage1000k, IPDID/1000k and mobile data set	It enables to accurately match visual Words. It is between two partial duplicate images. As PDIR is system factor, it improves the strength of dealing with different data, as it based on SIFT feature extraction. Method is proved as effective in retrieving near duplicate images.
6	SibenduSamanta, R. P. Maheshwari, ManojTripathy, 2013 [30]	Image indexing and retrieval using Line Edge Binary Pattern (LEBP) Brodatz image dataset Performance is measured using Average Retrieval Rate (ARR)	DLEBP extract line edge information as well as eight directional line edge values Image retrieval performance significantly improves known as Average retrieval rate (ARR)
7	Suraya Abu Bakar,Muhammad Suzuri Hitam, Wan Nural JawahirHj Wan Yussof, 2013 [22]	Scale invariant feature transform is based on the feature extraction method. Experimentation done on MPEG-7 dataset	Mostly suited and provide outstanding retrieval results for images with many good alternative to traditional CBIR system as it is invariant to scale, rotation and translation
8	Jaehyun An, Sang Hwa Lee, and Nam Ik Cho, 2014 [6]	Descriptor works on color feature and finds salient objects. Binary map (spatial distribution of dominant color) roughly describes object shape and relative location. Testing is done on corel 1k and corel 10k dataset.	It provides the better retrieval performance according to conventional color based methods. Binary map of dominant color matches the shapes well, Therefore, it is most suitable for object-based color image retrieval
9	Zhiyong Cheng, Jialie Shen, Haiyan Miao, 2014 [13]	Color (color histogram, color correlogram) and texture (Gabor, Tamura and Edge histogram) visual features textual information (social-tag based) retrieval method relevance feedback NUS-WIDE and MIRFLICKR dataset	Retrieval system using textual feature can achieve much better performance than only visual features
10	Hanwang Zhang, Zheng-Jun Zha, Yang Yang, Shuicheng Yan, Yue Gao, 2014 [14]	Tries to reduce Semantic gap used Hybrid, feedback mechanism to refine search result	Method can be used to distinguish semantic gap, resemblance with image accuracy. user search images quickly.

S. No.	Author and Year	Technique used for feature extraction/ indexing/ matching / relevance feedback/ database used	Comment
11	Daniel Carlos, Guimarães Pedronette, Jurandy Almeida, Ricardo da S. Torres, 2014 [33]	Image re-ranking using BP-tree etc., Result (MAP) evaluated with different feature includes: ACC, BIC,CCV,GCH and LCH, ALOI dataset with 72000 images and 1000 classes of objects	Rank list is produced by efficient indexing structure. It is scalable and well suited to large dataset
12	Nishant Shrivastava, Vipin Tyagi, 2014 [27]	Region based on segmentation of overriding color and local binary pattern features extraction of each region MPEG7 CCD and Corel image dataset. Average Normalized Modified the Retrieval Rank of employed calculate the performance	ROI also used to specify spatial location of regions It improves efficiency through feature set containing a dominant color and LBP. It also consumes less computation time
13	Emir Sokic, Samim Konjicija, 2014 [17]	Fourier descriptor based feature extraction MPEG-7 CE-1 set B, Swedish leaf dataset is used.	Method outperforms both the effectiveness and efficiency, Not suitable for region based approaches. This descriptor is essentially a contour based
14	K. Seetharaman, M. Kamarasan, 2014 [28]	Multi-resolution based features extraction Vistex texture DB and Brodatz texture image dataset is used. Average precision and recall rate is calculated.	System is theoretically easy and memory efficient It reduces the computational complexity. Desirable for large size image database
15	Zhongmiao Xiao, Xiaojun Qi, 2014 [37]	Relevance feedback Combines is high level semantic and low level visual features. Datasets used are: COREL images, Flickr Images, NUS-WIDE images	Features Datasets used are: COREL images, Flickr Images, NUS-WIDE images
16	Ahmad Alzu'bi, Abbes Amira, Naeem Ramzan, 2015 [4]	Sematic image retrieval to reduce semantic gap is discussed. Various relevance feedback schemes are explained.	Affect the performance of system in terms of accuracy, speed is discussed.
17	Cong Bai, Jinglin Zhang, Zhi Liu, Wan-Lei Zhao, 2015 [18]	Multiresolution feature vector are created using Color and texture features K-means histogram are used for classification of number of histograms. Widely used texture databases are selected: VisTex, A LOT and Stex	Easy implementation Improves retrieval performance compare to state-of –art techniques.
18	A. Laxmi, Malay Nema and Subrata Rakshit, 2015 [38]	Relevance feedback by axis re-weighting scheme is proposed Caltech and corel dataset is used for testing	An approach leads to better convergence reduces the digit of iterations to reach superior retrieval accuracy.
19	Alex Papushoy, Adrian G. Bors, 2015 [15]	Defining salient regions at local and global level Earth movers distance is used for similarity comparison Benchmark. Dataset used are Simplicity and Corel 1K	It can be produce similar outcome to relevance feedback based retrieval, and system provides stable outcome for large variety of image categories
20	Izem Hamouchenel, Saliha Aouat, 2015 [8]	Texture segmentation using neighbors based binary pattern method Brodatz dataset is used.	Research textures have been well recognized, Produces better segmentation results compare to classical decomposition method Improve accuracy of segmentation.
21	M. Barrena, A. Caro, M. L.Durán, P. G.Rodríguez, J. P. AriasNicolás, T Alonso, 2015 [5]	Color, texture and shapes feature extraction Classification using automated learning is used, Indexing and relevance feedback is used to increase the retrieval performance	Three spaces in combination improve results for recall and precision Relevance feedback enhances the quality of retrieval process. Query finding are listed and sorted

S. No.	Author and Year	Technique used for feature extraction/ indexing/ matching / relevance feedback/ database used	Comment
22	Shaoyan Sun, WengangZhou, Qi Tian, and Houqiang Li, 2015 [9]	Region identification with generic object detection Fusion of CNN and VLAD features Benchmark dataset: Holidays and UK Bench dataset	Promising accuracy is achieved. System developed is scalable. Image demonstration of competent to the memory visual projection of retrieval process gives the time efficiency.
23	Anu Bala , Tajinder Kaur, 2015 [19]	Local text on XOR patterns feature descriptor Corel dataset is used in experimentation.	Feature vector are constructed on LTxXORPs and HSV histogram Shows significant improvement in terms of Recall and Precision
24	Yusuke Matsui, Kiyoharu Aizawa, Yushi Jing, 2015 [23]	Fine multi-scale edge orientation histogram based feature extraction is proposed. Magna dataset is used for comparision	Proposed good solution to sketch based image retrieval Could retrieves images from MANGA database (not for other sketches)
25	Anuja Khodaskar , Siddart Ladhake, 2015 [26]	CBIR system using Ontology, Tries to reduce Semantic Gap using shared vocabulary(semantic features)	Bridges the semantic gap between the low and high level features Improves semantic image retrieval with high accuracy, precision and recall
26	Mostafa Rahimi , Mohsen Ebrahimi Moghaddam, 2015 [29]	Color ton distribution descriptors based on color co-occurrence matrices Classification using self-organizing map Corel and VisTex dataset	It chooses and extracts appropriate visual features with rich contents. Low convolution of feature extraction method is used in SOM classifier. It can be used as structural and signal processing feature description system which fails to supply satisfactory result in an image with strong color distribution.
27	Malay Kumar Kundu, Manish Chowdhury, Samuel Rota Bulo,2015 [39]	Feature extraction using Multi-scale geometric analysis (MGA) of non-sub sampled contour- let transform (NSTC) Graph based relevance feedback for ranking simplicity dataset, OLIVA dataset and Caltech dataset is used for testing purpose.	Reduces dimensionality of features User representation can process retrieval loop to reduce the semantic gap. Ranking mechanism effectively exploits user's feedback to improve quality of retrieval process
28	Aun Irtaza, M. Arfan Jaffar, Mannan Saeed Muhammad, 2015 [40]	CBIR using Genetic Algorithm and SVM. Assures effective retrieval by taking user considerations into an account (i.e. Relevance feedback) Corel set A, corel set B dataset are used.	Genetically optimized SVM overcomes the limitations of regular SVM like classifier instability, hyper plane biasness. Image retrieval results shows superiority in terms of recall and precision
29	Bin Xu, Jiajun Bu, Chun Chen, Can Wang, Deng Cai, Xiaofei He,, 2015 [32]	Feature extraction use Grid color moment, edge histogram, Gabor wavelets, local binary pattern and GIST features. Graph based ranking is used as experimentation on Corel and MNIST dataset	Supports scalable grap reconstruction Significantly reduces the computational time
30	Kommineni Jenni, Satria Mandala, Mohd Shahrizal Sunar, 2015 [10]	Color string coding and string comparison based feature extraction uses SVM as classifier, Corel photo collection is used.	Decreases computational complexity Significantly increases accuracy in image retrieval

S. No.	Author and Year	Technique used for feature extraction/ indexing/ matching / relevance feedback/ database used	Comment
31	Jun Yu, Dacheng Tao, Meng Wang, Yong Rui,2015 [34]	Visual features (color, shape and texture) are extracted from the users feedback Dataset is collected from Microsoft Bing image search engine.	More accurate and robust ranking model is designed Noises in clicked features can be removed by visual contents
32	Gholam Ali Montazer, Davar Giveki,2015 [24]	Scale invariant feature transform (SIFT) is based on K-means clustering algorithm and its classification is Tested on Caltech 101 dataset	Using k-means clustering two main drawbacks of SIFT i.e. memory usage and matching time are overcome which shows high performance in searching images with objects
33	Jing-Ming Guo, Heri Prasetyo, and Jen-Ho Chen,2015 [20]	Feature extraction based on Error Diffusion Block Truncation Coding (EDBTC). Feature vectors are calculated using color histogram feature (CHF) and bit pattern histogram features (BHF) Vector quantization is used to compute image feature descriptor APR is calculated for corel 1000 and corel 10000 dataset	Method is superior than former BTC methods . Due to added indexing scheme it achieves higher retrieval accuracy Feature vector are computed by incorporating vector quantization
34	Min Huang, Huazhong Shu, Yaqiong Ma, Qiuping Gong, 2015 [21]	Color moment (color), Zernik moments(Shape) and co-occurrence matrix (texture) based feature extraction on Corel image dataset	Combination of three features solves the shortcoming (i.e. partly express and description of image) of method as single feature Retrieval result is better than Contrary retrieval because it take more time
35	Menglin Liu, Li Yang, Yanmei Liang, 2015 [11]	Feature extraction based on (Chroma) color (gray color co-occurrence matrices, tamura and wavelet) texture features	Gives better performance with traditional luminance texture images
36	Ko-Jen Hsiao, Jeff Calder, Alfred O. Hero, 2015 [35]	Pareto front method with (efficient manifold ranking) EMR Able to handle multiple query with the queries belongs to different image semantics.	Linear combination of ranking results are suitable for real-world datasets

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