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A Survey on CBIR on the Basis of Different Feature Descriptor

Mayank Jain[1*] and Divakar Singh[2]

[1]Research Scholar, University Institute of Technology, Barkatullah University, Bhopal, M.P., India.
[2]Faculty of CSE Department, University Institute of Technology, Barkatullah University, Bhopal, M.P., India.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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Abstract

In this paper we discuss all the CBIR technique and analysis the methods. We also compare all the feature extraction techniques in the tabular form. Color features are extracted with the help of color moments, color histogram, invariant color histogram, and dominant color. Color based CBIR technique there are limitations in the mention method in the table. So we decide to enhance the color based method in the content based image retrieval method. We analysis the all color based method which is used in the proposed method by authors. But color classification methods are not discussed in the above methods. So in the CBIR system if we used the color classification method based on the red, green and blue channel. We easily get the object as well as color. And we also studied various texture and shape based technique that is used by many authors in our research. Texture based various techniques are Gray Level Co-occurrence matrix (GLCM), Gabor Transform and Tamura Features. Texture descriptor provides a measure of properties such as smoothness, roughness, and regularity. The texture of the region is structural, statistical and spectral are three principal approaches used in image processing. Shape features are extracted using many approaches like as Histogram of Edge Directions, Region Moments, invariant Moments, Zernike moments, Legendre Moments.

Keywords: Color descriptor; shape descriptor; texture descriptor and feature extraction.

**Corresponding author: E-mail: mayank261288@gmail.com;*

1 Introduction

The CBIR technique is used in various fields such as medical, agriculture, security, weather forecasting, biological modeling, remote sensing, architecture, web image classification, crime prevention, satellite images, identification and retrieval, etc. [1,2]. Content-based image retrieval (CBIR) is the use of computer vision to the image retrieval difficulty that is the crisis of searching for digital images in huge databases. "Content-based" means that the search will evaluate the actual contents of the image. 'Content' word refers colors, shapes, textures, or some other information that can be taking from the image itself [3].

An image retrieval system returns a set of images from a collection of images in the database [4-7] to meet up the user's demand with similarity evaluations such as image content similarity, edge pattern similarity, color similarity, etc. An image retrieval system offers a proficient way to access, surf, and retrieve a set of similar images in the real-time applications. Some approaches have been developed to capture the information of image contents by directly computing the image features from an image as reported in [8–13].

The image retrieval system works as a classifier to break up the images in the image database into two modules, either relevant or irrelevant. When results are irrelevant, the feedback loop is repeated until the user is satisfied. Relevance feedback involves the user to label the similar and dissimilar image. An efficient image retrieval technique is used to retrieve similar images in various stages. The images firstly retrieved on color basis and the resultant retrieved images further match with their shape and texture feature respectively.

CBIR consists the two phases first is the indexing phase where image information like the color, shape, and texture is enumerated into features that are stored in an index data structure. Second is the retrieval phase where is searching for an image in the CBIR index. Color similarity is obtained by computing a color histogram for every image with the purpose of identifies the ratio of pixels within an image holding specific values. Tentative images based on the colors they contain are one of the most commonly used techniques because it does not depend on image size or direction. The color searches will usually keep comparing color histograms.

Texture is the image and especially physical quality of a surface. Texture is the characteristic structure of the interwoven or intertwined outfit, strands or the like that make up a textile fabric. Texture is the nature or manner of merger of the particles of a body or substance, a visual or physical surface characteristic resulting in a certain appearance. Texture descriptor provides a measure of properties such as smoothness, roughness, and regularity. The texture of the region is structural, statistical and spectral are three principal approaches used in image processing. Texture procedures look for visual patterns in images and how the texture of the images is spatially defined. These sets not only characterize the texture, but also where in the image the texture is located. Texture is a complex concept to represent. The classification of particular textures in an image is achieved by modeling, texture as a 2-D gray level feature.

Shape is the external form, contours or outline of someone or something. A shape is the form of an object or its external surface as opposed to other properties such as color, texture or material composition.

The objective to find a similar image (object) from large collections or from distantly distributed databases is shared not only by educators, researchers, and professionals, but also by common users. Shape is an important visual feature and it is one of the fundamental features used to illustrate image content. But, shape representation and description is not an easy task. This is because when a 3-D real world object is projected on a 2-D image plane, one dimension of the object information is missing. Outcome of the shape extracted from the image only partially represents the estimated object. To create the problem still more complex, shape is often degraded with noise, defects, random distortion and occlusion.

The shape does not refer to the shape of an image, although to the shape of a picky region that is being sought out. Shapes will regularly be resolute by applying segmentation/edge detection to an image. Other

methods like use shape filters to identify given shapes of an image. Shape representation generally looks for valuable and perceptually essential shape features based on shape boundary information or interior content of boundary. A variety of features have been designed, including signature histogram, shape signature, shape invariants, moments, curvature, and shape context; shape matrix, supernatural features etc.

2 Literature Survey

Guo et al. [14] proposed a method on CBIR using features extracted from half toning-based block truncation coding. In this study, an image retrieval system is offered by exploiting the ODBTC encoded data stream to construct the image features, namely color co-occurrence and bit pattern features. The proposed scheme provides the best average precision rate compared to other scheme. This scheme can also be applied to video retrieval.

N. Shrivastava et al. [15] proposed a method for retrieval of color images in large databases by using an efficient technique. This proposed method is based on three stages feed forward network. A fixed number of images are first retrieved based on their color feature similarity. The relevance of the retrieved images is more improved by matching their texture and shape features respectively. This eliminates are obtained by fusion and normalization techniques, which are commonly used to calculate final similarity scores. The proposed technique produces superior outcome while consuming less computation time for large image databases.

N. Shrivastava et al. [16] proposed a method on an effective scheme for image texture classification based on binary local structure pattern on CBIR. This scheme presents a more effective completed modeling of the local binary pattern (LBP). This proposed scheme is tested over three texture databases i.e. Outex, Curet, and UIUC. The result of proposed method can get the higher classification accuracy while being more robust to noise.

N. Shrivastava et al. [17] proposed a method on multistage CBIR. The proposed method work on three layer feed forward architecture. Each layer narrow down the search range by filtering immaterial images based on color, texture and shape features respectively. Retrieving images in this way helps in reducing the semantic gap and to an extent eliminate the need of strict segmentation technique. This approach also reduces the problem of high dimensional feature vector at each stage only a part of the feature vector, representing the desired feature. It requires to be compared with the query image.

N. Shrivastava et al. [18] proposed a method CBIR based on relative locations of various regions of interest using selective regions matching. All images in the database are uniformly divided into several regions and every region is assigned a 4-bit region code based upon its location relative to the essential region. Principal color and Local Binary Pattern based texture features are extracted from these regions. The performance of the proposed approach is tested on the MPEG-7 CCD database and Corel image database. The experimental result of proposed approach increases the accuracy and reduces image retrieval time.

Mehtre et al. [19] proposed a method on shape measure for CBIR. In this proposed method, discuss effectiveness of several shape measures for content based correspondence retrieval of images. The different shape measures implemented include outline based features like as chain code based string features, Fourier descriptors, UNL Fourier features, region based features like as invariant moments, Zemike moments, pseudo-Zemike moments, and combined them.

Dubey et al. [20] proposed a method on rotation and scale invariant hybrid image descriptor and retrieval. In this proposed method, an efficient approach is presented to encode the color and texture features of images from the local neighborhood of each pixel. RSHD is promising under rotation and scaling. Also it can be effectively used under transformations of more complex image.

Mona Mahrous Mohammeda et al. [21] introduces a technique for content-based image classification and retrieval using PCNN. This technique uses an optimized Pulse-Coupled Neural Network to extract the visual features of the image in a form of a numeric vector called image signature. They evaluated our prototype against one of the widely used techniques and that the proposed technique can enhance the search results [21].

Mohsen Sardari Zarchi et al. [22] introduce a concept-based model for image retrieval systems model retrieves images based on two conceptual layers. First layer is the object layer; the objects are detected with the discriminative part-based approach. Second layer is designed to recognize visual composite, a higher level concept to specify the related co-occurring objects. The experiments are carried out on the well-known Pascal VOC dataset and results show that the model significantly outperforms the existing content-based approaches [22].

Ming Zhang et al. [23] proposed a novel image retrieval method like hybrid information descriptors (HIDs) that consisting of mutual information descriptors (MIDs) and self information descriptors (SIDs). It comparing with further vacant methods applied to content-based image retrieval (CBIR) on four datasets and show the usefulness and effectiveness of the HIDs. The broad experimental results can also demonstrate this [23].

Subrahmanyam Murala et al. [24] introduce expert content-based image retrieval system using robust local patterns. The local region of the image is represented by making the use of local difference operator and separating it into two components such that sign and magnitude. The achievement of the technique presented when compared to SLBP and other existing transform domain techniques in terms of their evaluation measures [24].

Yu-Chai WAN et al. [25] introduce Online Learning a Binary Classifier for Improving Google Image Search Results It is promising to get better web image search results during exploiting the results and visual contents for learning a binary classifier which is used to refine the results. This paper proposes an algorithm framework as a solution to this problem. The training data selection process is divided into two stages such as initial selection for triggering the classifier learning and dynamic selection in the iterations of classifier learning. They investigate two main ways of initial training data selection clustering based and ranking based, and compare automatic training data selection schemes through manual approach. This algorithm is effective to improve Google search results, especially at top ranks, thus is helpful to reduce the user effort in finding the desired images by browsing the position in depth. Even so, it is still worth meditative to make automatic training data selection scheme better towards perfect human annotation [25].

Yeong-Yuh Xu et al. [26] introduce Multiple-instance of learning based assessment neural networks for image retrieval. This paper proposes a multiple-instance learning based decision neural network (MI-BDNN) that attempts to link the semantic gap in CBIR. The proposed approach considers the image retrieval problem as a MIL problem wherever a user's preferred image theory is learned by training multiple-instance learning based decision neural network with a set of exemplar images, each of which is labeled as conceptual related (positive) or conceptual unrelated (negative) image. The MI-BDNN based CBIR system is developed, and the results of the experiments showed that multiple-instance learning based decision neural network can successfully be used for real image retrieval and classification problems [26].

Menglin Liu et al. [27] introduce a chroma texture-based method in color image retrieval. The large numbers of experiments performed and proved that the chroma texture feature was a very important complement to the traditional fluorescence texture. The effectiveness of the image retrieval is enhanced a lot by combination of fluorescence texture and chroma texture with a lower-dimensional vector [27].

3 Methodology

The following stages in process of CBIR are as:

(i) Image acquirement: It is the process of acquiring a digital image.
(ii) Image Database: Image database collection of 'n' number of images depends on the user choice.

(iii) Image preprocessing: It is used to improve the image in ways that increases the probability for success of the other processes. First of all image is processed in array to extract the features, which describe its contents. The processing contains the first filtering, second normalization, third segmentation, and last objects identification. Image segmentation is the process of separating an image into many parts. Output of this stage is a set of essential regions and objects.

(iv) Feature extraction: Shape feature, texture feature and color feature are describing the content of the image. The features further can be classified as low and high-level features. In this stage visual information is extracts from the image and store as features vectors in a features database. For each and every pixel, the image description is set up in the type of feature value or a set of value called a feature vector by using the feature extraction. And these feature vectors are used to evaluate the query with the other images and retrieval [28,29].

(v) Similarity matching: The information about each image is stored in its feature vectors for computation process and these feature vectors are matched with the feature vectors of query image which helps in measuring the similarity. In other words the images to be search in the image database whether the same image is present or not or how many are similar kind images are exist or not. This step involves the matching of the above stated features to get a result that is similar with the use of similarity measure method called as Distance method. There are different kinds of similarity measurements like Euclidean distance, histogram intersection, Bhattacharya distance and Mahalanobis distance, City Block Distance, Canberra Distance for CBIR applications,.

(vi) Retrieved images: It searches the earlier maintained information to find the matched images from database. The output will be the similar images having same or very nearby features [30] as that of the query image.

(vii) User interface: This stage provides the display of the outcomes, their position, and the type of user interaction with possibility of refining the search through some automatic or manual preferences scheme [31].

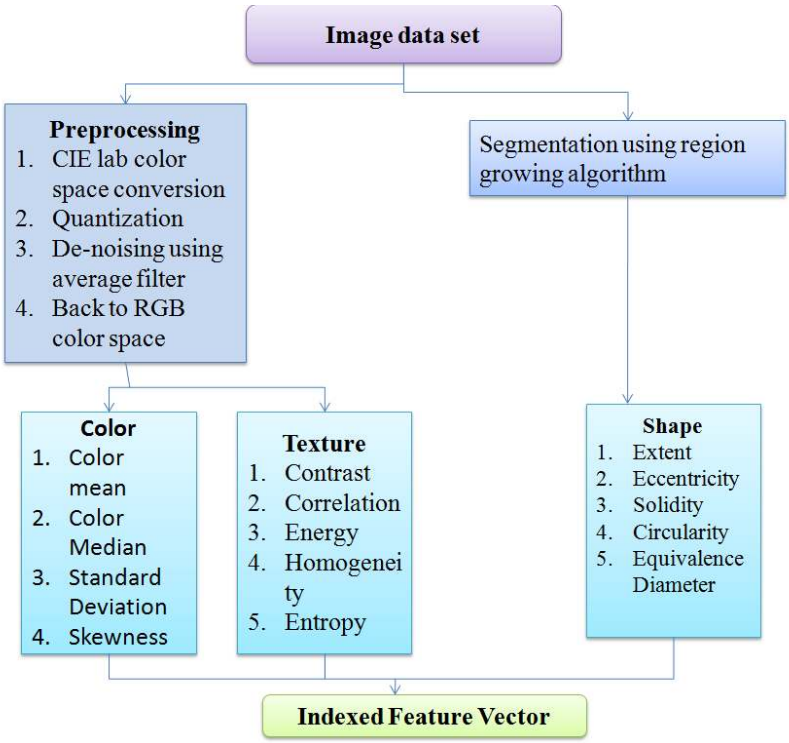

Fig. 1. Process of image indexing

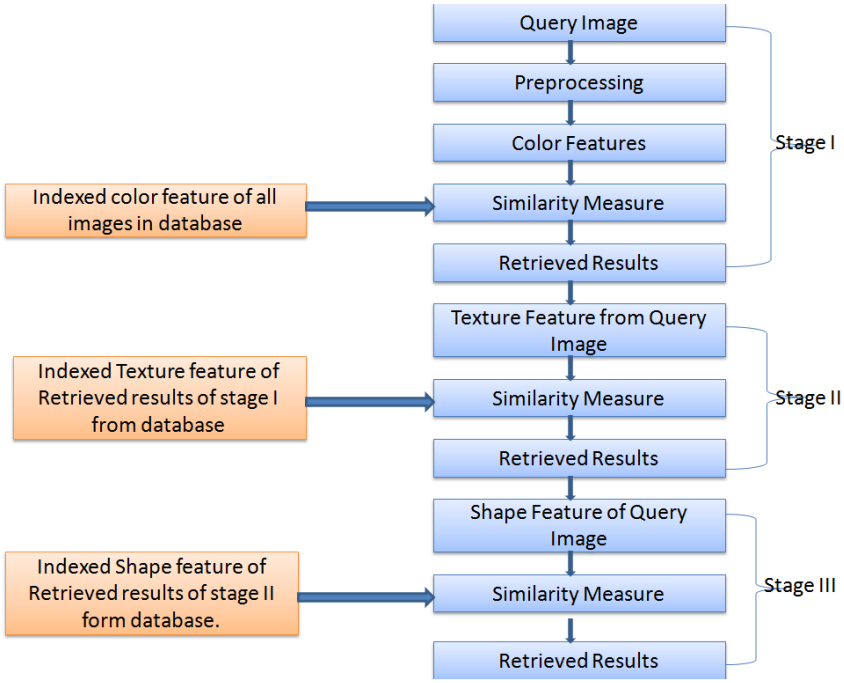

Fig. 2. Process of image retrieval

4 Feature Extractions

Feature extraction is means of extracting dense but semantically valuable information from images. This type of information is used as a signature for the image. Similar images must have similar signatures. Representation of images needs to think about which features are most useful for representing the contents of images and which approaches can effectively rules the attributes of the images. Feature extraction of the image in the database is usually conducted off-line hence calculation complexity is not a significant issue. This segment introduces three features: texture, shape, and color are used most frequently to extract the features of an image [32].

4.1 Color

Color is the most important features visually recognized by humans in images. Humans tend to distinguish images based mostly on color features. Due to this, color features are the most extensively used in CBIR systems and the most considered in literature. Color is a dominant descriptor that simplifies object identification, and most frequently used visual features for content-based image retrieval. For extraction of the color features from the content of an image, a proper color space and an effective color descriptor have to be determined. The aim of a color space is to facilitate the design of colors. A single point representation in a coordinate system of all color in the color space. A number of color spaces, such as RGB, HSV, CIE Lab have been developed for different purposes [21]. Although there is no agreement on which color space is the best for CBIR and a right color system is required to ensure perceptual uniformity. Color features are extracted by using color moments, color histogram and dominant color, invariant color histogram.

4.2 Texture

Texture descriptor provides a measure of properties such as smoothness, roughness, and regularity. The texture of the region is structural, statistical and spectral are three principal approaches used in image

processing. Properties of the texture are the visual patterns in an image that have properties of homogeneity are not affected by presence of only a single color or intensity. Different texture properties as perceived by the human eye are regularity and directionality. Texture features are extracted by using Gray Level Co-occurrence matrix (GLCM), Gabor Transform and Tamura Features [33,34].

4.3 Shape

Shape refers to the shape of a particular region that is being sought out. Shapes will frequently be determined applying segmentation or edge detection to an image. Other methods like use shape filters to identify given shapes of an image.

4.3.1 Classification of shape representation and description techniques

Shape representation techniques can be usually classified into two modules of methods: boundary based methods and region-based methods. The classification is on the basis of shape features are extracted from the contour only or are extracted from the whole shape region. In each class, the different methods are more divided into structural approaches and global approaches. Sub-class is based on whether the shape is represented as an entire or represented by segments or sections. Approaches of this type can be more eminent into space domain and transform domain, based on whether the shape features are derived from the spatial domain or from the transformed domain. The entire hierarchy of the classification is shown in Fig. 3. In the following sections, these techniques are discussed in details [19].

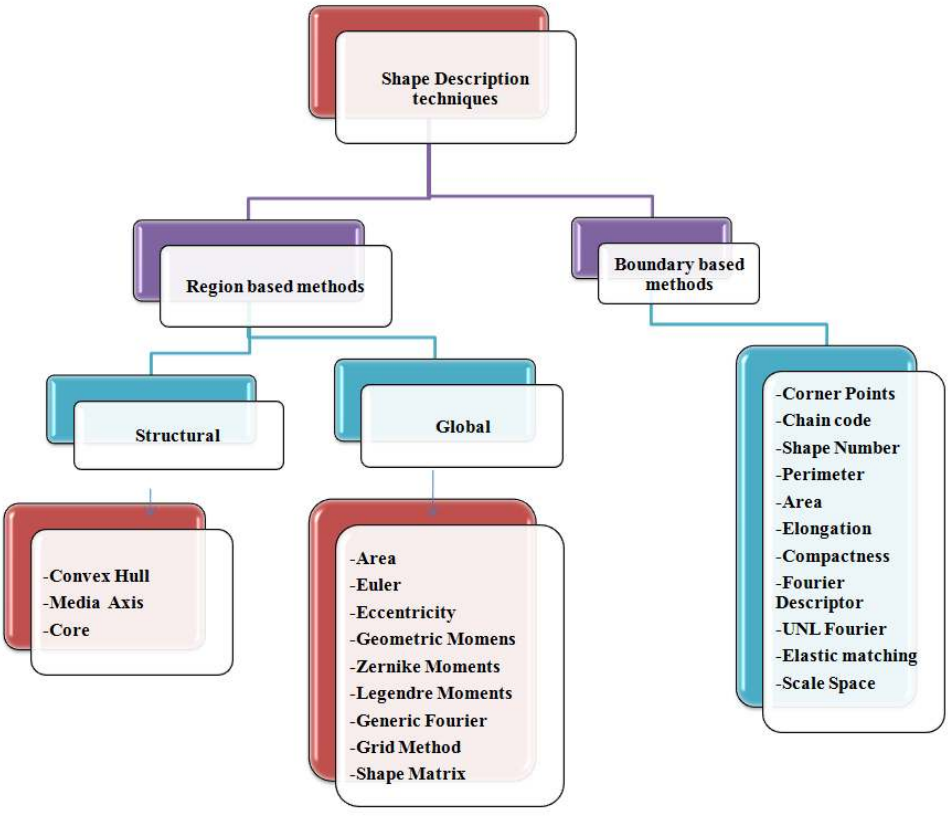

Fig. 3. An overview of shape description techniques

Table 1. Comparative study of various CBIR TECHNIQUES

Year	Author	Feature extraction	Feature selection method	Method	Dataset used	Parameter	Distance	Result
2013	N. Shrivastava et al. [16]	Texture	LBP	Neural network	Outex, Curet, UIUC	-	Chi-square statistics	The average results for RLSP patterns are better than CLBP and CLSP in all cases.
2014	Dubey et al. [20]	Color and texture	RSHD, SEH, CDH	-	COREL-1000	Precision and recall	Two distance measure used in SEH, CDH	RSHD descriptor performs better than the other descriptor.
2013	N. Shrivastava et al. [18]	Color and texture	ROI, LBP	Neural network	MPEG-7 CCD and corel	Precision and recall	Euclidean distance	This approach increases the accuracy and reduces image retrieval time.
2012	N. Shrivastava et al. [17]	Color, shape and texture	Color moments, statistical approach for texture and region based for shape	Three layer feed forward network	Corel	Precision and recall	Euclidean distance	This system can improve the retrieval accuracy while consuming less computation time.
2015	Guo et al. [14]	Color and texture	ODBTC, CCF, BPF		COREL, BRODATZ, VISTEX, A LOT	Precision and recall, ARR, ANMRR	-	This method is superior to the block truncating coding image retrieval system.
2013	Chauhan et al. [35]	Color, shape and texture	Color moments, statistical approach for texture and region based for shape	Three layer feed forward network	Corel	Precision and recall	Euclidean distance	Apply k-means clustering and relevance feedback for a better output.
2015	Lingadalli et al. [36]	Color, shape and texture	GLCM for texture		Corel	Precision and recall	Canberra distance	This algorithm is improved the accuracy and performance of retrieval of images.
2012	Soman et al. [37]	Color and texture	DCT on texture		Corel	Efficiency of CBIR	-	The proposed system provides an efficiency of 60%.

Year	Author	Feature extraction	Feature selection method	Method	Dataset used	Parameter	Distance	Result
2014	N. Shrivastava et al. [15]	Color, shape and texture	Color histogram for color, gabor filter, and fourier descriptor.	Three layer feed forward network	Corel, cifar-10	Precision and recall	Histogram intersection	This method provides flexibility of controlling the size of the database according to the user interest.
2014	S. Shrivastava et al. [38]	Color, shape and texture	LBP, SEH, CCH, CDH, SSLVP	SVM	Manual	ARR, APR, ART	Euclidean, Canberra, Histogram intersection	Here no. of methods performance is represent but SSLVP provides better results.

4.3.2 Boundary-based shape representation and description techniques

Boundary shape techniques only develop shape boundary information. There are generally two types of different approaches for contour shape modeling are continuous approach (global) and discrete approach (structural). Continuous approaches do not break up shape into sub-parts; usually a feature vector derived from the integral boundary is used to describe the shape. The results of shape similarity are usually a metric distance between the acquired feature vectors. The discrete approaches break the shape boundary into segments, called primitives using a particular criterion. The final last representation is usually a string or a graph the similarity measure is done by string matching or graph matching [39].

5 Discussion

1. In multiple ROI-based image retrieval, searching additional locations than those designated as ROIs and taking into consideration relative locations of ROIs improves the efficiency of retrieval and superior reflects the user's intent.
2. To retrieve color images from large databases by using three-layer feed-forward architecture. Each layer narrows down the search range by filtering irrelevant images based on color, texture and shape features respectively. Retrieving images in this manner helps in reducing the semantic gap and to an extent eliminate the need of precise segmentation technique.
3. The local structure patterns (LSP) can more exactly classify different textural structures as they utilize both local and global information. The local structure patterns can be combined with a simple local structure patterns and center pixel pattern to give a completed local structure pattern to achieve higher classification accuracy.
4. An efficient image color and texture hybrid feature description for the content-based image retrieval. The RSHD descriptor used the concept of structure element into local neighborhood of any pixel to achieve the inherent rotation invariance. RGB color space is quantized into 64 shades to represent the color feature of the image and local neighboring structure patterns are used to encode the textural information of the image.
5. The different shape measures implemented include outline based features like as chain code based string features, Fourier descriptors, UNL Fourier features, region based features like as invariant moments, Zemike moments, pseudo-Zemike moments, and combined features like as invariant moments & Fourier descriptors, invariant moments & UNL Fourier features. Given an image, all these shape feature vectors are computed automatically, and the feature vector can either be used for the retrieval intention or can be stored in the database for future queries.
6. Structural approaches are useful in applications where fractional matching is needed; methods based on the Hausdorff distances are useful for locating objects in an image or sub-image matching. Both types of methods have limited applications. For general shape applications, methods based on complex moments and spectral transforms, such as Zernike moments and GFD, are the best choices.

6 Conclusion

This paper provides an overview of the latest literature on CBIR in the all domain. We evaluate that after a long time of developments the need for image retrieval and presents concrete scenarios for promising future research direction. CBIR methods can be used on a large variety of images and in a wide area of applications. Currently more work requirements to be done to construct running applications and not only research prototypes. Another alternative access method to the currently used, text based methods in data information retrieval is detailed. The need of it due to large amount of visual data produced and unused information that these data contain, which could be used for teaching and research. The system described in the literature for image retrieval in used image categories and technologies. Here short overview of medical image retrieval is also given. The lack of evaluations of the retrieval quality of systems becomes visible along the unavailability of large image databases free of cost. The idea for creating such image databases and evaluation methods are proposed. Several research areas for improving the retrieval quality based on the

experience from other related research fields are also give in this paper. A critical point in of CBIR is the semantic gap wherever the meaning of an image is rarely obvious. The aim of CBIR systems must be to provide maximum support in bringing the semantic gap between the simplicity of available visual feature and the richness of the semantics. To resolve the semantic gap comes from sources outsides the image by integrating other sources of information about the images in the query.

Competing Interests

Authors have declared that no competing interests exist.

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