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A Review on Research and Challenges in Modern Image Retrieval Techniques in Big Data Systems

Julie Verma
Computer Science and Engg
B.I.E.T., Lucknow
julieverma0908@gmail.com

Urooj Fatima
Computer Science and Engg
B.I.E.T., Lucknow

Abstract--**In modern context of high speed big data access environment content-based image retrieval (CBIR) is one of the challenging areas of search engines in terms of speed and retrieval accuracy. CBIR is an user interactive and intelligent technique that process the image features like color, shape, texture, etc. to differentiate the similar image of query images in large databases by using unique descriptors of the query image. Significant amount of research is completed and still going on in the past decade to develop an efficient real time CBIR techniques from a large image databases but presently none of them is universally accepted in terms of feature extraction and retrieval as a online search availability option. In this paper, an analytical study of many CBIR systems in terms of their behavior, feature extraction, data processing and texture analysis is provided as a detailed literature review.**

Keywords: Image Processing, Data mining, feature extraction, CBIR.

1. Introduction:

To aid big scale image database retrieval, Content-primarily based image retrieval (CBIR) was added in the early 1990's. CBIR indexes pictures with the aid of their very own visual contents, inclusive of colour, form, texture. There are a few industrial products and experimental prototype structures evolved in the past decade, along with QBIC system [1], Photobook gadget [2], Netra system [3], SIMPLIcity device [4], etc. Although many sophisticated algorithms had been designed for colour, form, and texture description, such low-stage image capabilities in many instances can't properly describe the excessive stage semantic concepts within the person's mind. The discrepancy between the restrained descriptive strength of low-degree image capabilities and the richness of person semantics, is referred to as the 'semantic gap [5][6][7]. In order to enhance the retrieval accuracy of CBIR structures, research focus in CBIR has been shifted from designing state-of-the-art feature extraction algorithms to reducing the semantic hole among the low-stage visual capabilities and the richness of the person semantics [8]. Literature assessment show that the methods evolved for narrowing down the 'semantic hole' may be kind of categorised into 3 categories: 1) Region-based photo retrieval (RBIR). RBIR represents pix at vicinity stage intending to be near the perception of human visual device [9]. 2) Relevance remarks (RF). RF is brought into photo retrieval machine for continuous gaining knowledge of thru online interplay with users to improve retrieval overall performance [7]. Three) High-stage semantic functions. Mapping low-degree photograph capabilities to high-level principles to reduce the 'semantic gap' [5]. In this paper, we expand an picture retrieval device combining RBIR with semantic shade capabilities so as to reduce the 'semantic gap'. Although millions of colours may be described in pc machine, the colours that can be named via users are limited [10]. Color naming models intends to narrate a numerical coloration area with semantic shade names utilized in herbal language. In Berk, Brownston and Kaufman proposed a semantic coloration category system named 'CNS'(Color Naming System') which quantized HSL space into 627 wonderful colours. In [12], the writer provides a color naming version, wherein each of the 179 color names corresponds to a specific point in HSL colour area and to its neighborhood (defined by Euclidean distance). The creator additionally affords two different associated fashions for contrast. Inspired by the above work, we implemented a shade naming approach which maps HSV colour area to ninety three semantic shade names. HSV colour area become created by way of A.R. Smith in 1978. It is the most natural shade area in visible. By defining a coloration name for every segmented region, the gadget relates low-degree HSV space colour functions to high-degree semantics (as an instance, 'purple', 'light sky blue'), for this reason permit customers to carry out question with the aid of keywords (for instance, 'find pix with sky blue areas'). This is different from traditional methods of the usage of colour histogram or shade moments to explain regions.

2. Related Work:

[1]. Arbter K 1999 presented here an implementation of NeTra, a prototype image retrieval system that uses color,

texture, shape and spatial location information in segmented image regions to search and retrieve similar regions from the database. A distinguishing aspect of this system is its incorporation of a robust automated image segmentation algorithm that allows object- or region-based search. Image segmentation significantly improves the quality of image retrieval images contain multiple complex objects. Images are segmented into homogeneous regions at the time of ingest into the database, and image attributes that represent each of these regions are computed. In addition to image segmentation, other important components of the system include an efficient color representation, and indexing of color, texture, and shape features for fast search and retrieval. This representation allows the user to compose interesting queries such as "retrieve all images that contain regions that have the color of object A, texture of object B, shape of object C, and lie in the upper of the image", where the individual objects could be regions belonging to different images.

They have described an implementation of NeTra, a toolbox for organizing and searching image regions based on local image properties. The system includes a robust image segmentation scheme, and color, texture, and shape features representing region information. The edge-flow-based segmentation is used to process a large and diverse collection of images with very little parameter tuning. With the capability of analyzing and representing individual image regions, the image retrieval performance improves dramatically. However, much work remains to be done in evaluating and quantifying performance of such image retrieval systems. NeTra uses a compact color feature representation appropriate for segmented regions. In contrast with traditional color histogram methods which use a fixed number of color bins to characterize the color information, our approach sequentially increases the number of colors to cluster the colors in the region until the mean squared error of the clustering is below a pre-defined threshold. Since segmented regions are quite homogeneous in color and/or texture, much fewer colors, typically 5–15, are usually sufficient for representing a region color. An efficient color-indexing scheme based on the compact color representation is also proposed. This indexing scheme utilizes dominant colors in the query image to prune the search space. This initial search involves only boolean operations such as AND and OR, and thus can be efficiently implemented. Color quantization and similarity computations are currently performed in the RGB space and, as the results indicate, do provide visually acceptable retrievals. Incolor vision research it is shown that color spaces correspond better to human color perception. However, Euclidean distance metric for distance computations may not be appropriate in these spaces and new quantization schemes need to be developed. These issues are being investigated. In addition to color, NeTra uses texture and shape of the segmented regions in indexing them in the database.

Content-based image retrieval is a very important area of research nowadays. Content Based mage Retrieval (CBIR) is a technique which uses visual features of image such as color, shape, texture, etc. CBIR technologies provide a method to find images in large databases by using unique descriptors from a trained image. A lots of research works had been completed in the past decade to design efficient image retrieval techniques from the image or multimedia databases. Large number of retrieval techniques has been introduced, but there is no universally accepted feature extraction and retrieval technique available. In this work, **[2].T. Dharani and I. Laurence Aroquiaraj .2012** presented a study of various content-based image retrieval systems and their behaviour, texture analysis and various feature extraction with representation.

CBIR is a fast developing technology with considerable potential. Research in CBIR in past has been focused on image processing, low level feature extraction etc. It has been believed that CBIR provides maximum support in bridging 'semantic gap' between low level feature and richness of human semantics. This work provides comprehensive survey on feature extraction in various CBIR systems and texture analysis with various applications. Various features with their method of representation are discussed. The area of content-based image retrieval is a hybrid research area that requires knowledge of both computer vision and of database systems. The technology is exciting but immature, but few operational image archives shown interest in adoption. The field appears to be generating interesting and valid results, even though it has so far led to few commercial applications.

This work describes a computational approach to edge detection. The success of the approach depends on the definition of a comprehensive set of goals for the computation of edge points. These goals must be precise enough to delimit the desired behavior of the detector while making minimal assumptions about the form of the solution. **[3] R. J. Beattie.1986** defined detection and localization criteria for a class of edges, and present mathematical forms for these criteria as functionals on the operator impulse response. A third criterion is then added to ensure that the detector has only one response to- a single edge. We use the criteria in numerical optimization to derive detectors for several common image features, including step edges. On specializing the analysis to step edges, we find that there is a natural uncertainty principle between detection and localization performance, which are the two main goals. With this principle we derive a single operator shape which is optimal at any scale. The optimal detector has a simple approximate implementation in which edges are marked at maxima in gradient magnitude of a Gaussian-smoothed image. We extend this simple detector using operators of several widths to cope with different signal-to-noise ratios in the image. We present a general method, called feature synthesis, for the fine-to-coarse integration of information from operators at different scales. Finally we show that step edge detector performance improves considerably as the operator point spread function is extended along the edge. This detection scheme uses several elongated operators at each

point, and the directional operator outputs are integrated with the gradient maximum detector. We have described a procedure for the design of edge detectors for arbitrary edge profiles. The design was based on the specification of detection and localization criteria in a mathematical form. It was necessary to augment the
original two criteria with a multiple response measure in order to fully capture the intuition of good detection. A mathematical form for the criteria was presented, and numerical optimization was used to find optimal operators for roof and ridge edges. The analysis was then restricted to consideration of optimal operators for step edges. The result was a class of operators related by spatial scaling. There was a direct tradeoff in detection performance versus localization, and this was determined by the spatial width. The impulse response of the optimal step edge operator was shown to approximate the first derivative of a Gaussian. A detector was proposed which used adaptive thresholding with hysteresis to eliminate streaking of edge contours. The thresholds were set according to the amount of noise in the image, as determined by a noise estimation scheme. This detector made use of several operator widths to cope with varying image signal-to-noise ratios, and operator outputs were combined using a method called feature synthesis, where the responses of the smaller operators were used to predict the large operator responses. If the actual large operator outputs differ significantly from the predicted values, new edge points are marked. It is therefore possible to describe edges that occur at different scales, even if they are spatially coincident. In two dimensions it was shown that marking edge points at maxima of gradient magnitude in the gradient direction is equivalent to finding zero-crossings of a certain nonlinear differential operator. It was shown that when edge contours are locally straight, highly directional operators will give better results than operators with a circular support. A method was proposed for the efficient generation of highly directional masks at several orientations, and their integration into a single description. Among the possible extensions of the work, the most interesting unsolved problem is the integration of different edge detector outputs into a single description. A scheme which combined the edge and ridge detector outputs using
feature synthesis was implemented, but the results were inconclusive. The problem is much more complicated here than for edge operators at different scales because there is no clear reason to prefer one edge type over another. Each edge set must be synthesized from the other, without a bias caused by overestimation in one direction. The criteria we have presented can be used with slight modification for the design of other kinds of operator. For example, we may wish to design detectors for nonlinear two-dimensional features (such as corners). In this case the detection criterion would be a two-dimensional integral similar to (3), while a plausible localization criterion would need to take into account the variation of the edge position in both the x and y directions, and would not directly generalize from (9). There is a natural generalization to the detection of higher-dimensional edges, such as occur at material boundaries in tomographic scans. As was pointed out in Section VII, (47) can be used to find edges in images of arbitrary dimension, and the algorithm remains efficient in higher dimensions because n-dimensional Gaussian convolution can be broken down into n linear convolutions.

[4]. Niblack 1993 proposed a novel histogram generation technique using the HSV color space. The histogram retains a perceptually smooth color transition that enables us to do a window-based comparison of feature vectors for the purpose of effective retrieval of similar images from very large databases. During retrieval, we use a vector cosine distance measure for the ordering of image feature vectors. This distance measure shows an improvement in the retrieval result over the traditional Euclidean distance.
They have suggested a novel histogram that has perceptually smooth transition of colors for the purpose of fast retrieval of similar images from very large databases. While it is well established that color itself cannot retain semantic information beyond a certain degree, we have shown that retrieval results can be considerably improved by choosing a better histogram. Window-based comparison of feature vectors further enhances the performance of the histogram-based approach. The properties of the vector cosine distance measure are being looked into further since we get promising results as compared to Euclidean distance.

Content Based Image Retrieval is a challenging method of capturing relevant images from a large storage space. A new low level feature contains histogram, color and texture information. This element is intended for use in image retrieval and image indexing systems. **[5] Hirata K.2014** work experiments various methods available for Content based image retrieval System, they are RGB Color Histogram, Tamura Texture and Gabor Feature. The methods are implemented and tested based on three parameters like Precision value, Recall value and Accuracy rate. The Experimental results show that Gabor Feature method is more efficient when comparing with other methods. The Gabor Feature 81.7%Accuracy in Content Based Image Retrieval system. Content Based Image Retrieval is a challenging method of capturing relevant images from a large storage space. A new low level feature contains histogram, color and texture information. This element is intended for use in image retrieval and image indexing systems. This work experiments various Content based image retrieval methods which is widely used. Three methods used for experimentation is RGB Color Histogram, Tamura Texture and Gabor Feature. From the experimentation Gabor Texture Feature method gives better when comparing with other methods used for experimentation.
The Gabor Texture Features81.7% Accuracy in content based image retrieval system. The Gabor Texture Features can be enhanced with the needs. This research work is useful for image searching, in future it is planned to connect semantic web-based image retrieval and facial recognition. It can be

further developed to include more operations and analysis, as changes are required in the system to adapt to the external developments. Future enhancement can be made to the system at any later points. The codes are efficiently written to make it reusable and chargeable.

With the rapid development of multimedia and network technology, people can access a large number of multimedia information. For people who want to make full use of multimedia information resources, the primary question is how to query the multimedia information of interest. Text query can be applied to multimedia information retrieval, but it has inherent deficiencies. One hand, text annotation of multimedia information will spend a lot of manpower and resources and it is inefficient. On the other hand, annotated text is usually a person's perception of multimedia information. It is subject to impact of individual difference and state of human and environment, and the described results may be more one-sided. In addition, it is clearly incomplete to describe content-rich multimedia information with a small amount of text. Content Based Image Retrieval (CBIR) techniques appeared in 1990s. It solves the above problems well. It uses low-level features like color, texture and shape to describe image content, and breaks through the limitation of traditional text query technique. **[6] Rui, Y., Huang 2006** proposed an image retrieval method based on multi-feature similarity score fusion using genetic algorithm. Single feature describes image content only from one point of view, which has a certain one-sided. Fusing multi-feature similarity score is expected to improve the system's retrieval performance. In this work, the retrieval results from color feature and texture feature are analyzed, and the method of fusing multi-feature similarity score is described. For the purpose of assigning the fusion weights of multi-feature similarity scores reasonably, the genetic algorithm is applied. For comparison, other three methods are implemented. They are image retrieval based on color feature, texture feature and fusion of color-texture feature similarity score with equal weights.
This work presents an approach based on HSV color space and texture characteristics of the image retrieval through the quantification of HSV color space, I combine color feature and gray level co-occurrence matrix as well as CCM separately, using normalized Euclidean distance classifier. This work proposed an image retrieval method based multi-feature similarity score fusion. Then using genetic algorithm multi-feature similarity score are fused and better image retrieval results are gained. However the location of an image in retrieval result reflects directly the similarity of it and query image. So this factor should be taken into account when evaluating the fitness of individual, which is my future work.

With the advancement and popularity of multimedia technologies and internet mediums, user cannot satisfy with the conventional methods of information retrieval. Because of this, the content based image retrieval is becoming a new and fast method of information retrieval. Content based image retrieval is the method of retrieving the data particularly images from a wide collection of databases. The retrieval is done by using features. Content Based Image Retrieval (CBIR) is a method to organize the wide variety of images by their visual features. In modern days with the development of social networking mediums, so many digital images are uploaded day by day. In order to access this huge data collection new techniques are very essential. These techniques will ease the data handling and the user can easily access the data. Content Based Image Retrieval is such a technique which uses features for searching a particular image from a database. **[7] Ja-Hwung Su 2014** represented visual features like edges, spatial information, texture, shape. Here, in this work the content based image retrieval techniques are discussed.
The mail goal of this survey is to provide an overview of the functionality of content based image retrieval systems. Most CBIR systems uses color, texture, edge features etc. Few systems use spatial information and shape for feature extraction. Fuzzy logic is one of the new technique introduced into CBIR field. As fuzzy method is mainly used for user oriented applications and is more similar to human visual features. It is the correct technique that can be used in CBIR field. There are various applications of CBIR in every fields of life like blood cell detection, archeology, criminal investigation, satellite etc. Thus, field of CBIR is very useful and it‟s a real boon to the human life.

To address the emerging needs of applications that require access to and retrieval of multimedia objects, we are developing the *Multimedia Analysis and Retrieval System* (MARS) **[29].** In this work, we concentrate on the retrieval sulbsystem of MARS and its support for content-based queries over image databases. Content-based retrieval techniques have been extensively studied for textual documents in the area of automatic information retrieval**. [8]J.R. Bach 1998** described how these techniques can be adapted for ranked retrieval over image databases. Specifically, we discuss the ranking and retrieval algorithms developed in MARS based on the Boolean retrieval model and describe the results of our experiments that demonstrate the effectiveness of the developed model for image retrieval. To address the emerging needs of applications that require access to and retrieval of multimedia objects, we are developing the *Multimedia Analysis and Retrieval System* (MARS).
In this work, we described the retrieval subsystem of MARS and its support for content-based queries over image databases. To support content-based retrieval, in MARS many visual features are extracted from image color, texture, shape, color, and texture layout. Information retrieval (IR) techniques, modified to work over visual features, are then used to map user’s queries to a collection of relevant images. Specifically, extended Boolean models based on a probabilistic and fuzzy interpretation of Boolean operators are used to support ranked retrieval. Our results
show that using IR techniques for content-based retrieval in image databases is a promising approach. The work reported in this work is being extended in many important directions. In

our current system, we have concentrated on adapting the Boolean retrieval model for content-based retrieval of images. Many other retrieval models that have a better retrieval performance compared to the Boolean approach have been developed in the IR literature for textual database. They are currently exploring how these models can be adapted for content based image retrieval. Furthermore, our current work has concentrated on image databases. We are also generalizing our approach to content-based retrieval in multimedia databases. Weighting is an important tool for the user to communicate to the system the relative importance of query components. We plan to explore the approach described in [13] and compare the impact of the weighting strategies on the quality of the retrieval. Finally, we are also exploring the use of relevance feedback techniques in our extended Boolean model.

[9] C. Carson et al 2002 have analyzed the properties of the HSV (Hue, Saturation and Value) color space with emphasis on the visual perception of the variation in Hue, Saturation and Intensity values of an image pixel. We extract pixel features by either choosing the Hue or the Intensity as the dominant property based on the Saturation value of a pixel. The feature extraction method has been applied for both image segmentation as well as histogram generation applications – two distinct approaches to content based image retrieval (CBIR). Segmentation using this method shows better identification of objects in an image. The histogram retains a uniform color transition that enables us to do a window-based smoothing during retrieval. The results have been compared with those generated using the RGB color space.
They have studied some of the important properties of the HSV color space and have developed a framework for extracting features that can be used both for image segmentation and color histogram generation – two important approaches to content based image retrieval. Our approach makes use of the Saturation value of a pixel to determine if the Hue or the Intensity of the pixel is more close to human perception of color that pixel represents. The K-means clustering of features combines pixels with similar color for segmentation of the image into objects. We are also able to generate a histogram that enables us to perform a window-based smoothing of the vectors during retrieval of similar images. While it is well established that color itself cannot retain semantic information beyond a certain degree, we have shown that retrieval results can be considerably improved by choosing a better histogram.

[10]. R.Bajcsy1989 presented a new Euclidean distance for images, which we call IMage Euclidean Distance (IMED). Unlike the traditional Euclidean distance, IMED takes into account the spatial relationships of pixels. Therefore it is robust to small perturbation of images. We argue that IMED is the only intuitively reasonable Euclidean distance for images. IMED is then applied to image recognition. The key advantage of this distance measure is that it can be embedded in most image classification techniques such as SVM, LDA and PCA. The embedding is rather efficient by involving a transformation referred to as Standardizing Transform (ST). We show that ST is a transform domain smoothing. Using the Face Recognition Technology (FERET) database and two state-of-the-art face identification algorithms, we demonstrate a consistent performance improvement of the algorithms embedded with the new metric over their original versions. It is desirable to define an image metric that can be efficiently embedded in the existing image recognition methods. Euclidean distance is consequently a candidate because, representing images as points in a high dimensional Euclidean space, the so-called image space, is a common starting point of most recognition algorithms. Although there are infinitely many Euclidean distances for images (for every symmetric and positive definite matrix G defines a Euclidean distance, see Section 2), they often provide counter intuitive results. For example, the traditional Euclidean distance is sensitive to deformation and translation due to the lack of consideration of the spatial relationship of pixels. IMED, to a certain extent, overcomes this defect. Experiments on FERET datasets demonstrated a consistent performance improvement of two state-of-the-art algorithms when embedded with IMED. By an analysis on the Standardizing Transform, we relate smoothing to image Euclidean distance. This theoretical result indicates that smoothing noiseless images can still increase the recognition rate. One limitation of IMED is that it does not always provide the best recognition result comparing with some other intelligent metrics under the nearest neighbor rule. We think there are two future directions:
1) Find an efficient way (if possible) to embed, for instance the tangent distance, in those image recognition algorithms.
2) Looking for new image metrics that are good at direct matching as well as embedding ability.

3. Conclusion:

The improvement and world degree research at the multimedia technologies and statistics transmission over net the current facts usage aren't matching up with the traditional approaches of facts retrieval. Due to such excessive call for specifications the content material based picture retrieval is getting popularity as a complicated and fast technique of information search and retrieval. Content based totally photograph retrieval is the technique of retrieving the information in particular pictures from a extensive collection of databases. The retrieval is accomplished by using the usage of features. Content Based Image Retrieval (CBIR) is a way to arrange the huge style of photographs by means of their visual functions. In cutting-edge days with the improvement of social networking mediums, such a lot of digital pics are uploaded daily. In order to get entry to this large records series new techniques are very crucial. These techniques will ease the information managing and the user can easily get entry to the information. Content Based Image Retrieval is such a way which makes use of features for looking a specific image from a database. It represents visible functions like edges, spatial

records, texture, shape. Here, in this paper the content primarily based photo retrieval strategies are mentioned. The purpose of this survey is to provide a top level view of the capability of content based photo retrieval systems. Most CBIR systems uses color, texture, facet capabilities etc. Few structures use spatial facts and shape for feature extraction. Fuzzy logic is one of the new approach added into CBIR field. As fuzzy approach is specially used for consumer orientated applications and is extra similar to human visual features. It is the suitable approach that may be utilized in CBIR discipline. There are numerous applications of CBIR in each fields of existence like blood mobile detection, archeology, criminal investigation, satellite tv for pc and so forth. Thus, discipline of CBIR is very beneficial and its a real boon to the human existence.

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