A Review on Content Based Image Retrieval

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Abstract - Content-based image retrieval, a technique which uses visual contents to search images from large scale image databases according to users' interests, has been an active and fast dvancing research area since the 1990s. During the past decade, remarkable progress has been made in both theoretical research and system development. However, there remain many challenging research problems that continue to attract researchers from multiple disciplines. This paper presents a brief review about the techniques and approaches of content based image retrieval.

Keywords: Image processing, CBIR, Content, Colour, Histogram.etc.

I. INTRODUCTION

As information technology proliferates throughout our society, digital images and video or visual objects are becoming as important as traditional textual based information. This phenomenon has several reasons: demilitarization of imaging and satellite technology, the emergence of the World Wide Web as a digital communications infrastructure, the impending convergence of computers and television, and the increase in use and availability of digital cameras and video recorders.

With the massive growth in the amount of visual information available, there exists a real need for systems to catalogue and provide retrieval from digital image and video libraries. Content-based image retrieval, a technique which uses visual contents to search images from large scale image databases according to users' interests, has been an active and fast advancing research area since the 1990s. During the past decade, remarkable progress has been made in both theoretical research and system development. However, there remain many challenging research problems that continue to attract researchers from multiple disciplines.

Information retrieval is the process of converting a request for information into a meaningful set of references. Early work on image retrieval can be traced back to the late 1970s. In 1979, a conference on Database Techniques for Pictorial Applications was held in Florence. Since then, the application potential of image database management techniques has attracted the attention of researchers. Early techniques were not generally based on visual features but on the textual annotation of images.

In other words, images were first annotated with text and then searched using a text-based approach from traditional database management systems. c

In the early 1990s, as a result of advances in the Internet and new digital image sensor technologies, the volume of digital images produced by scientific, educational, medical, industrial, and other applications available to users increased dramatically. The difficulties faced by text-based retrieval became more and more severe. This need formed the driving force behind the emergence of content-based image retrieval techniques.

Since 1997, the number of research publications on the techniques of visual information extraction, organization, indexing, user query and interaction, and database management has increased enormously. Similarly, a large number of academic and commercial retrieval systems have been developed by universities, government organizations, companies, and hospitals [1-4].

II. FUNDAMENTAL ASPECTS OF CBIR

Previous CBIR systems can be classified into two categories according to the type of queries: text query or pictorial query. In text query based systems, images are characterized by text information such as keywords and captions. Text features are powerful as a query, if appropriate text descriptions are given for images in an image database. However, giving appropriate descriptions must be done manually in general and it is time consuming.

There are many ways one can pose a visual query. A good query method will be natural to the user as well as capturing enough information from the user to extract meaningful results.

In pictorial query based systems, an example of the desired image is used as a query. To retrieve similar images with the example, image features such as colours and textures, most of which can be extracted automatically, are used.

The typical CBIR system performs two major tasks. The first one is feature extraction (FE), where a set of features, called image signature or feature vector, is generated to accurately represent the content of each image in the database. A feature vector is much smaller in size than the original image, typically of the order of hundreds of elements (rather than millions).

The second task is similarity measurement (SM), where a distance between the query image and each image in the database using their signatures is computed so that the top "closest" images can be retrieved [5-7].

III. BACKGROUND AND LITERATURE SURVEY

There are various method has been proposed to extract the features of images from very large database. In this paper various algorithms are discussed to retrieve the image:

a) Jisha. K. P, Thusnavis Bella Mary. I, Dr. A. Vasuki [8]:proposed the semantic based image retrieval system using Gray Level Co-occurrence Matrix (GLCM) for texture attribute extraction. On the basis of texture features, semantic explanation is given to the extracted textures. The images are regained according to user contentment and thereby lessen the semantic gap between low level features and high level features.

b) Swati Agarwal, A. K. Verma, Preetvanti Singh [9]:The proposed algorithm is enlightened for image retrieval based on shape and texture features not only on the basis of color information. Firstly the input image is decomposed into wavelet coefficients these wavelet coefficients give generally horizontal, vertical and diagonal features in the image. Subsequent to wavelet transform (WT) and Edge Histogram Descriptor (EHD) is then used on preferred wavelet coefficients to gather the information of foremost edge orientations. The grouping of DWT and EHD methods increases the performance of image retrieval system for shape and texture based retrieve. The performance of diverse wavelets is also compared to find the appropriateness of meticulous wavelet function for image retrieval. The proposed algorithm is skilled and examined for large image database. The results of retrieval are conveyed in terms of exactitude and recall and compared with different other proposed schemes to show the supremacy of our scheme.

c) Xiang-Yang Wang, Hong-Ying Yang, Dong-Ming Li [10]: proposed a new content-based image retrieval technique using color and texture information, which achieves higher retrieval effectiveness..Initially, the image is altered from RGB space to adversary chromaticity space and the individuality of the color contents of an image is incarcerated by using Zernike chromaticity distribution moments from the chromaticity space. In next, the texture attributes are extracted using a rotation-invariant and scale-invariant image descriptor in contour-let domain, which presents the proficient and flexible estimation of early processing in the human visual system. Lastly, the amalgamation of the color and texture information provides a vigorous feature set for color image retrieval. The experimental results reveal that the proposed color image retrieval is more accurate and efficient in retrieving the user-interested images.

d) S. Manoharan, S. Sathappan [11]: They Implemented the high level filtering wherever they are using the Anisotropic Morphological Filters, hierarchical Kaman filter and particle filter proceeding with feature extraction method based on color and gray level feature and subsequent to this the results were normalized.

e) Heng Chen and Zhicheng Zhao [12]: authors described relevance feedback method for image retrieval. Relevance feedback (RF) is an efficient method for content-based image retrieval (CBIR), and it is also a realistic step to shorten the semantic gap between low-level visual feature and high-level perception. SVM-based RF algorithm is proposed to advances the performance of image retrieval. In classifier training, a model expanding method is adopted to stability the proportion of positive samples and negative samples. After that a fusion method for multiple classifiers based on adaptive weighting is proposed to vote the final query results. SVM-based RF scheme is proposed to improve performance of image retrieval. In classifier training, a sample intensifying scheme is accepted to balance the proportion of positive and negative samples and then fusion scheme for multiple classifiers based on adaptive weighting is anticipated to vote the final query results.

f) Monika Daga, Kamlesh Lakhwani [13]: Proposed a new CBIR classification was being developed using the negative selection algorithm (NSA) of ais. Matrix laboratory functionalities are being used to extend a fresh CBIR system which has reduced complexity and an effectiveness of retrieval is increasing in percentage depending upon the image type.

g) S. Nandagopalan, Dr. B. S. Adiga, and N. Deepak [15]: They proposed a novel technique for generalized image retrieval based on semantic contents is offered. The grouping of three feature extraction methods specifically color, texture, and edge histogram

descriptor. There is a prerequisite to include new features in future for better retrieval efficiency. Any combination of these techniques, which is more suitable for the application, can be used for retrieval. This is presented through User Interface (UI) in the form of relevance feedback. The image properties analyzed in this work are by using computer vision and image processing algorithms. Anticipated for color the histogram of images are calculated, for texture co-occurrence matrix based entropy, energy etc are calculated and for edge density it is Edge Histogram Descriptor (EHD) that is found. To retrieval of images, a new idea is developed based on greedy approach to lessen the computational complexity.

h) G. Pass [16]: They proposed a novel method to describe spatial features in a more precise way. Moreover, this model is invariant to scaling, rotation and shifting. In the proposed method segmentations are objects of the images and all images are segmented into several pieces and ROI (Region of Interest) technique is applied to extract the ROI region to enhance the user interaction.

i) Yamamoto [17] proposed a content-based image retrieval system which takes account of the spatial information of colours by using multiple histograms. The proposed system roughly captures spatial information of colors by dividing an image into two rectangular sub-images recursively. The proposed method divides an image into dominant two regions using a straight line vertically or horizontally, even when the image has three or more color regions and the shape of each region is not rectangular. In each sub-image, the division process continues recursively until each region has a homogeneous color distribution or the size of each region becomes smaller than a given threshold value. As a result, a binary tree which roughly represents the color distribution of the image is derived. The tree structure facilitates the evaluation of similarity among images.

IV. FEATURE EXTRACTION

Feature Extraction In the broad sense, the features may be text based and visual based. Textual (text based) features are keywords, tags, annotations etc. Visual (visual based) image features are color, shape, texture etc. The visual features are further classified as general features and domain specific features. General features are color, texture, shape and domain specific features are application dependent for e.g. human faces and finger prints. Domain specific features are related to pattern recognition. A feature is defined as an interesting part of an image and features are used as a starting point for many computer vision algorithms. Since features are used as the starting point and main primitives for subsequent algorithms, the overall algorithm will often only be as good as its feature detector. 1.) Color: color describes one of the important visual features in content based image retrieval. There are number of examples, where color features in retrieving image are used like histograms, moments, block-based. Color histogram is used for computing distance measures based on color similarity for each image. A color histogram is used to describe the global color distribution in an image and is more frequently used method because of its advantages like high efficiency. Other feature representation like color moments and color sets are also used than color histogram. The color is a widely used important feature for image representation. This is very important as it is invariant with respect to scaling, translation and rotation of an image [2]. Color space, color quantification and similarity measurement are the key components of color feature extraction. Color feature is not dependent upon size of image. The color models can be classified as User & Hardware based models; such as RGB and HSV. Many color spaces are there which offers different applications.

2.) Texture: Texture contains important information about the structural arrangement of surfaces and their relationship to the surrounding environment. It is an inherent property of virtually all surfaces including clouds, trees, bricks, hair, and fabric. Texture provides useful information of the surfaces about their structures and the relationship with the surrounding. texture analysis can be studied at three levels i.e. on statistical level, a set of statistics extracted from the image is called texture. On the structural level, the primitives of the image and their placement rules are known as its texture. On the spectral level, the texture is defines as a set of coefficients in the transform domain. With the help of these levels the textures can be identified but the textures may not agree with human way of evaluating the textures.[3] These reasons are semantic gap and human perception subjectivity. Texture feature describes spectral features which are taken using wavelet transform, statistical features, tamura texture features etc. Tamura explored the texture representation from a different viewpoint. [4]Texture and color queries can be formulated in similar way, by selecting desired textures or by supplying an query image.

3.) Shape: Shape does not refer to the shape of an image but to the shape of a particular region that is being sought out. In image retrieval, depending on the applications, some require the shape representation to be invariant to translation, rotation, and scaling, while others do not. Shape features of objects or regions have been used in many content-based image retrieval systems. Compared with color and texture features, shape features are usually described after images have been segmented into regions

or objects. Shape features are divided into two categories boundary based and region based. Boundary based shape features uses only boundary of the shape whereas region-based shape features uses entire shape region[5]. The term shape refers to the information that can be deduced directly from the image. Shape is represented through perceptually grouped geometric cues such as edges, contours, joints, and polygonal regions extracted from an image. Such a grouping can serve as a spatial layout or as a rough sketch by additional post processing. Shape features are known as geometric features. shape feature are commonly used – global features such as aspect ratio, circularity and moment invariants and local features such as sets of consecutive boundary.[6]

V. WAVELET IN CBIR

The wavelet transform was introduced in 1990s and its theoretical framework was established. The statistics (mean and variance) extracted from the wavelet sub bands as the texture representation is used in 1994 by researchers. This approach achieved over 90% accuracy. The wavelet transform was also combined with other techniques to achieve better performance. The use of the wavelet transforms, together with KL expansion and Kohonen maps, to perform texture analysis. There is another way by evaluating the texture image annotation by various wavelet transform representations including orthogonal and bi-orthogonal wavelet transforms, the tree-structured wavelet transform, and the Gabor wavelet transform. There are mainly two ways of research for image retrieval. The first is focusing on image indexing and other one is by describing the image content in the form of features. Most of the images indexing approaches are based on color, texture or shape. The performance can be improved by combining these three features. The size of the feature vector plays an important role in the retrieval of images. The Walsh matrix is a set of m number of rows and can be denoted by Wk for 0,1,…….,m-1.The Walsh matrix can have number of properties. Walsh transform matrix row is the row of the Hadamard matrix specified by the Walsh code index, which must be an integer in the range [0,..., m-1]. For the Walsh code index equal to an integer j, the respective Hadamard output code has exactly j zero crossings, for j = 0, 1,..., m-1. Haar used these functions to give an example of a countable orthonormal system for the space of square-integrable functions on the real line. The Haar wavelet is also the simplest possible wavelet. The technical disadvantage of the Haar wavelet is that it is not continuous, and therefore not differentiable. This property can, however, be an advantage for the analysis of signals with sudden transitions, such as monitoring of tool failure in machines. Kekre's transform matrix can be of any size NxN, which need not have to be in powers of 2 (as is the case with most of other transforms). All upper diagonal and diagonal values of Kekre's transform matrix are one, while the lower diagonal part except the values just below diagonal is zero. [8] Wavelet based approaches uses wavelet moment and wavelet transform. In wavelet transform a CBIR system decomposes the images of database in offline mode, and then performs feature extraction using F-norm theory. And apply progressive retrieval strategy to retrieve the images from the database when compared with the query image was introduced. [9] To provide a more accurate image retrieval method various features can be combined to provide accurate image. So features are combined with certain other techniques for feature extraction, similarity matching, clustering to provide effective results. In spite of the significant advances made in imaging techniques, several practical factors often led to the average results in image retrieval of images .Therefore, it is necessary to improve the quality of the content based system for image retrieval. Content based image retrieval, allowing to automatically extracting targets according to objective visual contents of images. With appealing time frequency localization and multi-scale properties, wavelet transform proved to be effective in visual feature extraction and representation. It can be used to characterize textures using statistical properties of the gray levels of the points/pixels comprising a surface image. Wavelet transform can be used to characterize textures using statistical properties of the gray levels of the pixels comprising a surface image. The wavelet transform is a tool that cuts up data or functions or operators into different frequency components and then studies each component with a resolution matched to its scale.

REFERENCES

[1]. H. Mohamadi, A. Shahbahrami, J. Akbari, " Image retrieval using the combination of text-based and content-based algorithms", Journal of AI and Data Mining, Published online: 20, February-2013.

[2]. Pabboju , S. and gopal, R. (2009). A Novel Approach For Content- Based Image Global and Region Indexing and Retrieval System Using Features. International Journal of Computer Science and Network Security. 9(2), 15-21.

[3]. Li, X., Shou, L., Chen, G., Hu, T. and Dong, J. (2008). Modelling Image Data for Effective Indexing and Retrieval In Large General Image Database. IEEE Transaction on Knowledge and Data Engineering. 20(11), 1566-1580.

[4] Demerdash, O., Kosseim, L. and Bergler, S. (2008). CLaC at Image CLEFphoto 2008, ImageCLEF Working Notes.

[5]. K. C. Sia and Irwin King. "Relevance feedback based on parameter estimation of target distribution" In IEEE

International Joint Conference on Neural Networks, pages 1974–1979, 2002.

[6] Simon Tong and Edward Chang. "Support vector machine active learning for image retrieval. In MULTIMEDIA "in Proceedings of the ninth ACM international conference on Multimedia, pages 107–118.2001.

[7] M. E. J. Wood, N. W. Campbell, and B. T. Thomas. "Iterative refinement by relevance feedback in content-based digital image retrieval" In ACM Multimedia 98, pages 13–20. ACM, 1998.

[8] Jisha.K.P, Thusnavis Bella Mary. I, Dr. A.Vasuki, "An Image Retrieve Al Technique Based On Texture Features Using Semantic Properties", International Conference on Signal Processing, Image Processing and Pattern Recognition [ICSIPR], 2013.

[9] Swati Agarwal, A. K. Verma, Preetvanti Singh, "Content Based Image Retrieval using Discrete Wavelet Transform and Edge Histogram Descriptor", International Conference on Information Systems and Computer Networks, proceeding of IEEE xplore-2013.

[10] Xiang-Yang Wang, Hong-Ying Yang, Dong-Ming Li "A new content-based image retrieval technique using color and texture information", Computers & Electrical Engineering, Volume 39, Issue 3, April 2013, Pages 746-761

[11] S. Manoharan, S. Sathappan, "A Novel Approach For Content Based Image Retrieval Using Hybrid Filter Techniques", 8th International Conference on Computer Science & Education (ICCSE 2013) April 26-28, 2013. Colombo, Sri Lanka

[12] Heng chen, zhicheng zhao "an effective relevance feedback algorithm for image retrieval" 978-1-4244-6853-9/10/ 2010 IEEE.

[13] Monika Daga, Kamlesh Lakhwani, "A Novel Content Based Image Retrieval Implemented By NSA Of AIS", International Journal Of Scientific & Technology Research Volume 2, Issue 7, July 2013 ISSN 2277-8616.

[14] Patheja P.S., Waoo Akhilesh A. and Maurya Jay Prakash, "An Enhanced Approach for Content Based Image Retrieval", International Science Congress Association, Research Journal of Recent Sciences, ISSN 2277 – 2502 Vol. 1(ISC-2011), 415-418, 2012.

[15] S. Nandagopalan, Dr. B. S. Adiga, and N. Deepak, "A Universal Model for Content-Based Image Retrieval", World Academy of Science, Engineering and Technology, Vol:2 2008-10-29.

[16] ROI Image Retrieval Based on the Spatial Structure of Objects, Weiwen ZOU1 , Guocan FENG2, 12Mathematics and Computational School, Sun Yat-sen University, Guangzhou, China, 510275 paper: 05170290.

[17] H. Yamamoto, H. Iwasa, N. Yokoya, and H. Takemura, "Content- Based Similarity Retrieval of Images Based on Spatial Color Distributions", ICIAP '99 Proceedings of the 10th International Conference on Image Analysis and Processing.