A survey on Image Indexing and Retrieval based on Content Based Image

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***Abstract*— Image indexing and retrieval became an interesting field of research nowadays due to the lack of advanced methodologies to index and retrieve images and to the existence of huge quantities of images available everywhere; especially on the web. The available solutions are able to find similar items having the exact shape but not the same item if it has a different shape. In this paper, we present different available technique concerning image indexing and retrieval. The first procedure that comes to mind is Content Based Image retrieval (CBIR). Many years of researching have been made on this topic using this methodology. Then, we explain the functionality of this technique and shows all work done in CBIR and also we discuss the Description Based Image Retrieval (DBIR).**

Keywords*— *Image; indexing; retrieval; shape

I. INTRODUCTION

Image indexing is a mandatory preliminary step in the process of the retrieval of an image. This will lead to the process called "image indexing and retrieval" that will be comprehensively covered in this paper with all its available techniques. The most important techniques are to be exploited. The first procedure that comes to mind is Content Based Image retrieval (CBIR). Many years of researching have been made on this topic using this methodology. in this paper, we explain the functionality of this technique and shows all work done in CBIR. Then we discuss the Description Based Image Retrieval (DBIR) also called technique of the web, the second widely used technique. Therefore, we summarize the job done in general feature extraction techniques (Figure 1), then more precisely, shape extraction and color extraction techniques are explained.

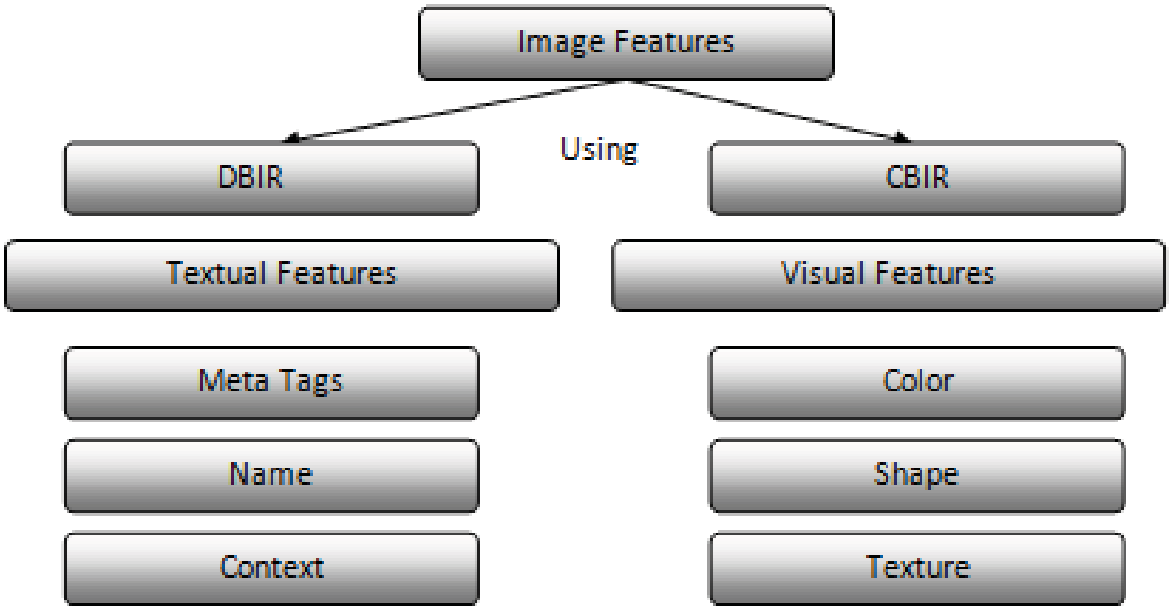

Fig. 1. Image Features

Content Based Image Retrieval is one of the most researched topics in image indexing and retrieval. It is known for its capability of functioning with minimum human being intervention. The indexing is very objective and is done without any human intervention by using feature extraction of shapes, colors and/or textures. One of the disadvantages of this method is that user has to provide a similar image of the one he/she is searching. The second problematic occurs in

seeing the image as a collection of features without any semantic description which creates a semantic gap when retrieving.

Huge databases can be automatically indexed using this methodology with an objective way because human annotations are always subjective. If a human was asked to annotate an image containing different textures like sea, sand, sky, sun and clouds, plus a boy with a ball, he/she will most likely tag the boy and the ball and ignore all the rest, because he/she is mainly concerned with relativity. In addition to that, querying a database of images by example is not practical for users. Indexing technique using this methodology consists of extracting the features of the image and storing the features with the image in the database. As for the retrieval (Figure 2), the algorithm extract the feature of the query and compare it with the database to find similar images having the same features colors, shapes and/ or textures.

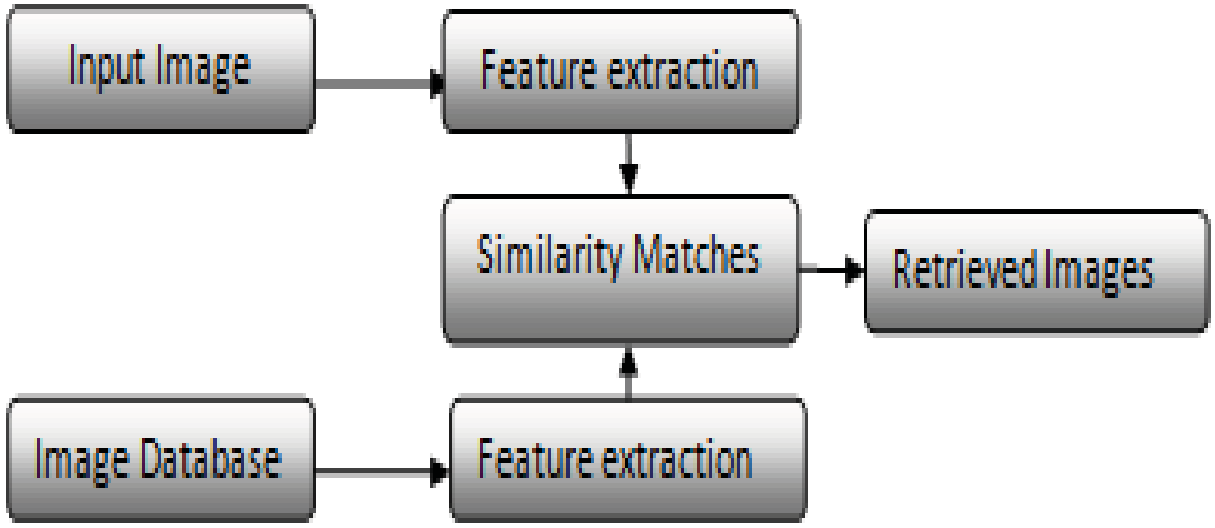

Fig. 2. Content Based Image Retrieval (CBIR)

II. Related Research

Extended Image retrieval with a thesaurus of shapes was discussed using CBIR method [1]. While indexing an image, not only features extraction is needed, but also text annotation to be stored in a shape thesaurus. This thesaurus will contain a precompiled list of shapes for major objects, statistics about those shapes, textual and semantic annotation that describe those shapes, and finally for each shape its set of shapes that are similar to it. Then he talks about relationships between objects and shapes that can be Hierarchical or Related for the first and Part-of or variant-of for the shapes.

A. Perceptual Approach

Mikolajczyk, Zisserman and Schmid have provided a method [2], to recognize an object by detecting its edges, that is invariant to similarity transformations and scaling. They work on neighborhood descriptors which were generalized from The SIFT method (Scale Invariant Feature Transform). The edge based descriptors can identify well drawn edges in objects like a bicycle.

Md., Farooque [3] has well defined in his article image attributes that were identified as three categories perceptual, interpretive and reactive. Perceptual is mainly literal objects, people, color, location, visual elements and description. Interpretive goes more into people qualities, abstract concepts and content story. The reaction is based on external relationships by comparing the image to a set of images like in the thesaurus. The use of this approach defines perceptual as low level features, interpretive as semantics and meanings, and reactive for relations with other related objects.

B. Feature Extraction

Feature extraction can lead into object extraction as shown by Zlattof, Ryder, Tellez and Baskurt when they grouped extracted features in order to get assembled object [4]. Those are two similar and different techniques the first in image retrieval and the second for image indexing. Segmenting an image using Expressive Fuzzy Description Logics by Simou, Athanasiadis, Stoilos and Kollias was really efficient using Semantic Recursive Shortest Spanning Tree and fuzzy Logic [5]. First they divide the image into regions by using low level feature and color extraction, second they extract available visual descriptors and spatial relations between regions and then the different parts of the images are classified based on different extracted regions.

Images could contain more than one object, the fact that led into working on image segmentation and categorization.

Object categorization is important to build up the thesaurus and index images, therefore some of the selected chosen article describe how to segment and categorize image. The initial tree containing the possible categories is explicitly shown by Djeraba [6], classifies a small set of objects into a tree having a one level of root and four sub levels of first child that goes from Naturals like water, flowers, mountains and snow to people, industries and transports. As for Chen and Wang they went further with categories to show 20 different detailed categories as beaches, flowers, sunsets, waterfalls, cars, buses, antiques, dogs, elephants, lizards and many more. A small set of categories could go to 20 different categories (Figure 3), but what is needed is a lot more than that, which could go to millions of categories that are a must in image indexing and retrieval. Some went further also by combining segmentation and categorization for fuzzy knowledge based semantic annotation [7].

C. Other Techniques

A variety of techniques have been discussed in the last decade, starting by shape descriptor using polar plot [8], illumination of invariant features [9], geometric shape recognition [17], salient points reduction [10], noise tolerant approaches, comparing dissimilarity measures [11], object retrieval based on rough set theory [12], real valued boundary point [13], new algorithms using wavelet correlogram [14], ontology-based information retrieval using expressive resource descriptions [15], local scale invariant feature extraction [16], global and region features extraction [17] and last but not least, scalable color image using vector wavelets [18].

In all researching approach, the main issue was to fill the semantic gap produced between description based and content based. Description based image indexing and retrieval count on human interactive, which is not objective, to annotate images. Content based uses feature extraction to annotate images that can extract shape, color and texture. CBIR is more efficient than DBIR and is used while researching the image indexing and retrieval topic but CBIR cannot give a semantic meaning to what it extracts. Some techniques focus on minimizing the gap between low level feature and semantics. Obeid, Jedynak and Daoudi have introduced what is called “Intermediate features” [19] to fill the semantics gap. Stan and Sethi mapped low-level image features to semantic concepts [20].

III. CONCLUSIONS

In this paper, we explain in details the different techniques available for image indexing and retrieval. CBIR, the most important technique in image indexing and retrieval and all the different techniques that are related, fill the semantics gap between low level features and human understandings of objects. In addition to that, techniques used in image segmentation and categorization are described in details.

REFERENCES

[1] Hove, L.J. "extending image retrieval systems with a thesaurus for shapes." The Norwegian Information Technology Conference, 2004.

[2] Mikolajczyk, K. and Zisserman, A. and Schmid, C. "Shape recognition with edge-based features." Proceedings of the British Machine Vision Conference, 2003. 779-788.

[3] Md., Farooque. "Image Indexing and Retrieval." DRTC Workshop on Digital Libraries: Theory & Practice, 2003.

[4] Zlatoff N., Ryder G., Tellez, B., Baskurt A. "Content-Based Image Retrieval: on the Way to Object Features." 18th International Conference on Pattern Recognition. ICPR 2006, 2006. 153-156.

[5] N. Simou, Th. Athanasiadis , G. Stoilos, S. Kollias. "Image indexing and retrieval using expressive fuzzy description logics ." Signal, Image and Video Processing, 2008.

[6] Djeraba, C. "When image indexing meets knowledge discovery." ACM MDM/KDD, 2000. 73-81.

[7] G. Papadopoulos, T. Athanasiadis, N. Simou, R. Benmokhtar, K. Chandramouli, V. Tzouvaras, V. Mezaris, M. Phiniketos, Y. Avrithis, Y. Kompatsiaris, B. Huet, E. Izquierdo. "Combining Segmentation and Classification Techniques for Fuzzy Knowledge-based Semantic Image Annotation." 3rd international conference on Semantics And digital Media Technologies . Koblenz: (SAMT), 2008.

[8] Pillai, Brijesh. "shape descriptor using polar plot for shape recognition." Clemson University, 2008.

[9] Ronald Alferez, Yuan-Fang Wang. "Image Indexing and Retrieval Using Image-Derived, Geometrically and Illumination Invariant Features." IEEE International Conference on Multimedia Computing and Systems. IEEE Computer Society, 1999.

[10] Tsai, Yao-Hong. "Salient Points Reduction for Content-Based Image Retrieval." Pwaset.World Academy of Science, Engineering And Technology, 2009. 656-659.

[11] Haiming Liu, Dawei Song, Stefan Rüger, Rui Hu, Victoria Uren. Comparing Dissimilarity Measures for Content-Based Image Retrieval. Asia Information Retrieval Symposium , 2008.

[12] Gaber A. Sharawy, Neveen I. Ghali, Wafaa A. Ghoneim. "Object-Based Image Retrieval System Based On Rough Set Theory." International Journal of Computer Science and Network Security (IJCSNS International Journal of Computer Science and Network Security) 9 (2009): 160-165.

[13] D. J. Buehrer, C. S. Lu and C. C. Chang. "A Shape Recognition Scheme Based on Real-Valued Boundary Points." Tamkang Journal of Science and Engineering, 2000: 55-77.

[14] H. Abrishami Moghaddama, T. Taghizadeh Khajoieb, A.H. Rouhib, M. Saadatmand Tarzjana. "Wavelet correlogram: A new approach for image indexing and retrieval." Pattern Recognition (Elsevier B.V.) 38, no. 12 (2005): 2506-2518.

[15] Tran Thanh, Bloehdrrn Stephan, Cimiano Philipp, Haase Peter. Expressive Resource Descriptions For Ontology-Based Information Retreival. 2007. CiteSeerX - Scientific Literature Digital Library and Search Engine (United States) .

[16] Lowe, David G. "Object Recognition from Local Scale-Invariant Features." The Proceedings of the Seventh IEEE International Conference. IEEE International Conference on In Computer Vision, 1999. 1150-1157.

[17] Suresh Pabboju, Dr. A.Venu Gopal Reddy. "A Novel Approach for Content-Based Image Indexing and Retrieval System using Global and Region Features." IJCSNS International Journal of Computer Science and Network Security 9, no. 2 (2009): 119-130.

[18] Elif Albuz, Erturk Kocalar , Ashfaq A. Khokhar. "Scalable Image Indexing and Retrieval using Wavelets." 1998.

[19] Mohamad Obeid, Bruno Jedynak, Mohamed Daoudi. "Image indexing & retrieval using intermediate features." Proceedings of the ninth ACM international conference on Multimedia . ACM, 2001. 531-533.

[20] Stan Daniela, Sethi Ishwar K. "Mapping low-level image features to semantic concepts." Storage and Retrieval for Media Databases , 2001: 172-179.

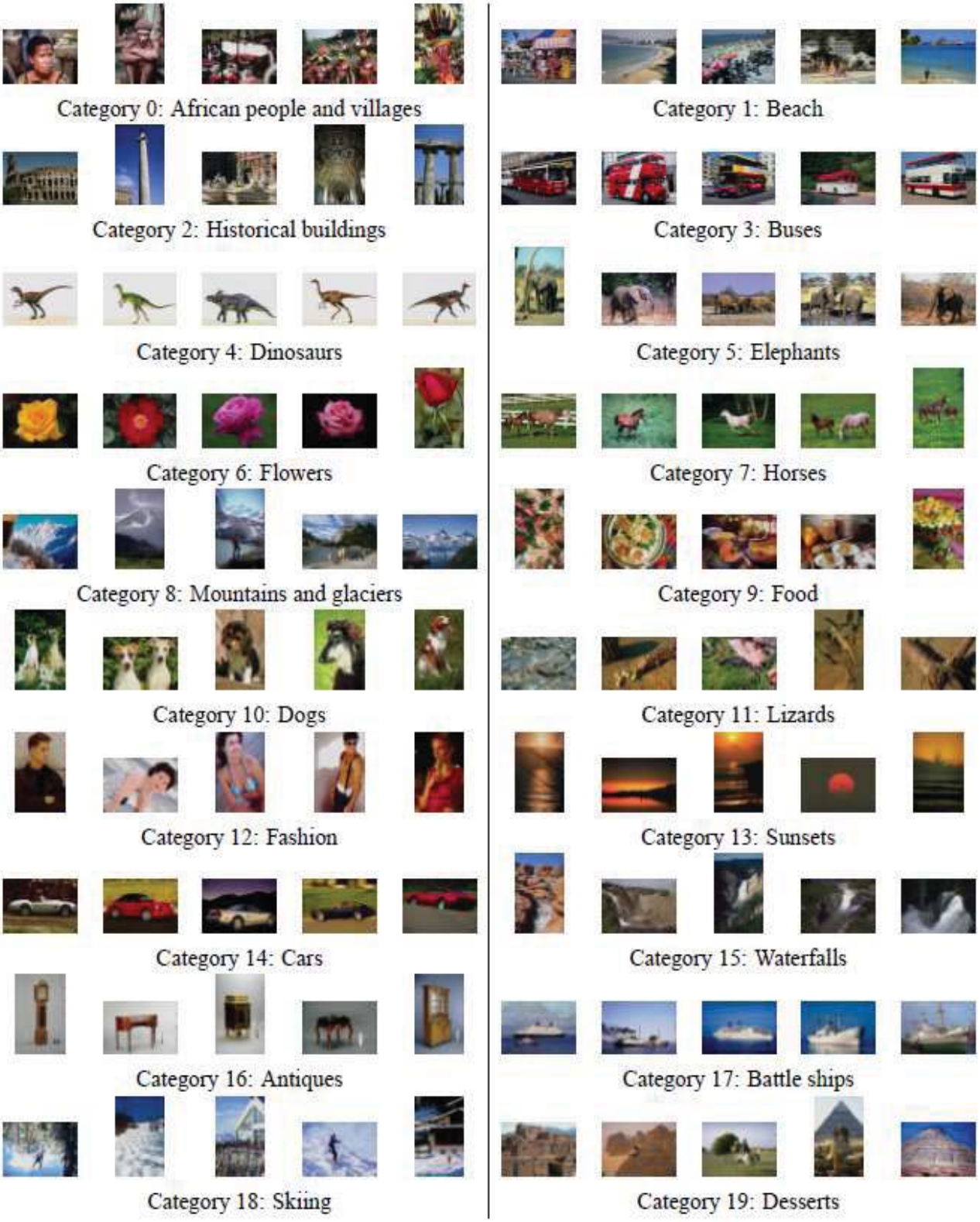

Fig. 3. Image Categories [7]