IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
nCORETech
LBS College of Engineering, Kasaragod
Vol. 3, Special Issue 1, February 2016

A Review of Feature Extraction Methods in Content Based Image Retrieval

Naveena A.K[1], N.K. Narayanan[2]

Department of Computer Science & Engineering, College of Engineering Trikaripur, Kerala, India[1]

Department of Information Technology, Kannur University, Kerala, India[2]

Abstract: Image retrieval is an active research area for the last two decades. This area is gaining more importance as the growth of multimedia content over the internet is increasing. Content Based Image Retrieval (CBIR) uses the visual content of images like color, shape and texture for image comparison and retrieval. Compared to the text based retrieval content based image retrieval is used for better accuracy. Content based means search makes use of the visual content of the images. These contents are extracted from the images and are described by multi-dimensional vectors. Similarity measurement and visual feature extraction are two important issues in CBIR. The accuracy of the retrieved images mainly depends on the features extracted. A review of feature extraction methods is present in this paper.

Keywords: Content Based Image Retrieval, Feature Extraction, Color, Shape, Texture.

I. INTRODUCTION

In various computer vision applications retrieving the desired image from a large collection of images automatically using selected features is required. These systems called Content Based Image Retrieval (CBIR) have become an important area for research with increasing demand and use in digital images in various fields. Traditional text based retrieval cannot describe the content of the images thus hampering the performance of the retrieval. In text based retrieval image annotation provides information about the images. In text based firstly the images are annotated with text and then searched based on the textual tags or keywords. Text based retrieval become more difficult in large dataset. To overcome the limitations of text based image retrieval content based image retrieval system is used by the people. The challenge in content based image retrieval is to develop methods to represent each image in a unique way to make accurate identification of the image.

II. OVERVIEW OF CBIR

The figure 1 shows the basic components of a Content based Image retrieval system. The basic processing steps in CBIR are a) Feature extraction of image database: Extracts effective features from each image in the database. These multi-dimensional vectors form the feature database. b) Feature extraction of query image: the same sets of features are extracted for the query image also. c) Similarity Matching: The query image feature is compared with the feature vectors in the feature database. The similarity between the query image and the images in the databases are computed using feature vectors. Images with the zero distance i.e., the exact image and the set of images with the minimum distance i.e., the closest distance are determined and retrieved.

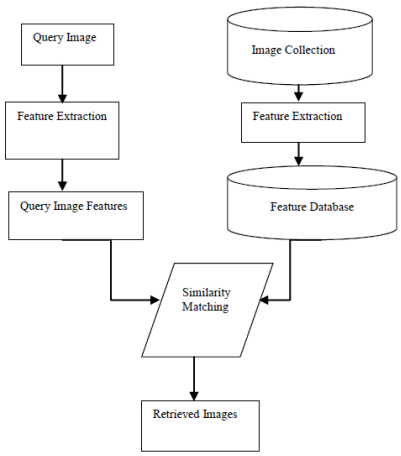

Fig 1: Basic Components of CBIR

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
nCORETech
LBS College of Engineering, Kasaragod
Vol. 3, Special Issue 1, February 2016

III. EXISTING FEATURE EXTRACTION TECHNIQUES

Features are the characteristics of objects of interest or say they are the representative of maximum relevant information that object has. Feature extraction plays an important role in CBIR, the accuracy of the system depends on how exactly the unique features are extracted. Researchers consider retrieval techniques at different levels. Eakins [1] distinguished image retrieval techniques into three distinct levels.

- Level 1: Retrieval by primitive features like color, shape, texture and spatial locations of image elements. It does not consider the semantics.
- Level 2: Retrieval by derived attribute or logical features, involving some degree of inference about the identity of object.
- Level 3: Retrieval by abstract attribute involving complex reasoning about significance of the object.

Majority of the CBIR systems operate at Level 1 some experimental systems use level 2 also. But none of the systems are currently using Level 3. Level 2 and Level 3 require more artificial intelligence (AI) techniques. In general all image features are widely classified as low level features and high level features [2]. Low level features can be directly extracted from the original image pixels. High level features are extracted from low level features to represent the real world. Early CBIR systems used any one of the primitive features for retrieval.

A. Color

Color is an important feature that makes possible the recognition of object by humans. Color [3] is a rotation and translation invariant feature and most of the color feature extraction methods do not require any segmentation. Its three dimensional values makes it description superior to on-dimensional gray level values of images. Each pixel of the image can be represented as a point in 3D color space [4]. Commonly used color space for image retrieval are RGB, CIE L*a*b* and HSV. RGB is the widely used color space for image display. CIE L*a*b* space are device independent and considered to be perceptually uniform. This consists of Luminance or lightness component L and Chromatic components a and b. HSV space is widely used in computer graphics and is a more intuitive way of describing color. Some commonly used color descriptors are color histogram, color coherence vector, color correlogram, and color moments. In [5] Duan et.al used three channel color moments in LAB color space for color feature extraction since color moment performs better in LAB. Since only nine numbers are used to represent the color contents in the case of color moments it is very compact representation compared to the other color features. Mathematically, three moments are described as

$$\mu_i = \frac{1}{N}\sum_{j=1}^{N} f_j$$

$$\sigma_i = \left(\frac{1}{N}\sum_{j=1}^{N}(f_j - \mu_i)^2\right)^{1/2}$$

$$s_i = \left(\frac{1}{N}\sum_{j=1}^{N}(f_j - \mu_i)^3\right)^{1/3}$$

Where fj is the value of the jth pixel and N is the number of pixels in the image.

If color pattern is unique with the rest of the data, color histogram is an effective representation of the color content of an image. Color histogram is easy to compute and effective in characterizing both global and local distribution of color in an image. Hence color histogram is used as one of the feature in [6,7] for comparing the visual similarity. Color histogram does not take spatial information of pixels in to consideration, thus different images can have similar color distributions.

This problem is solved by dividing the image into sub area and calculate the histogram of each sub area. A different way of incorporating spatial information into the color histogram, Color Coherence Vector is proposed in [8]. Each histogram bin is partitioned into either coherent or incoherent if it belongs to a large uniformly colored region or not. In [9] a new color feature is proposed for image retrieval called the color correlogram.

This feature includes the spatial correlation of colors, it describes the global distribution of local spatial correlation of colors, and it is easy to compute and the size is also small. A color correlogram is a table indexed by color pairs, where the k-th entry for (i, j) specifies the probability of finding a pixel of color j at distance of k from a pixel of color i in the image. If we consider all possible combination of color pairs the size of the color correlogram will be very large, therefore a variation of the color correlogram called auto color correlogram is often used.

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
nCORETech
LBS College of Engineering, Kasaragod
Vol. 3, Special Issue 1, February 2016

B. Texture

Texture is one of the important characteristic used in identifying objects or regions of interest in an image. Texture is an innate property of virtually all surfaces- the grain of wood, the pattern of weave of fabric [10]. Texture gives information about spatial arrangement of colors or intensities in an image. There are two main approaches in the texture analysis: structural and statistical [11]. In structural approach, Texture is a set of primitive texels in some regular or repeated relationship.

This includes morphological operator and adjacency graph. Statistical approach is a quantitative measure of arrangement of intensities in a region. Wavelet transform provide multi resolution approach to texture analysis and classification. In [12] Manesh Kokare et.al. have done a comparison of pyramid and tree structured wavelet transform by considering the mean, standard deviation and energy. They proved that the standard deviation and energy of tree structured wavelet decomposition gives the best result for content based image retrieval. One of the most popular statistical methods to analyses spatial distribution of gray levels in an image is Gray level cooccurance matrix. Here the probability of co-occurrence of gray values in different distance and orientation is considered. Haralick [10] defined fourteen textural features based on the spatial dependence probability distribution such as homogeneity, contrast and gray tone linear dependencies. In [13] Tamura proposed features designed in accordance with psychological studies on human perception of texture called Tamura feature which includes coarseness, contrast, directionality, likeliness, regularity and roughness. Another important texture feature extraction method is using Gabor filters. Gabor filters are group of wavelet capturing energy at specific frequency and at specific direction. The feature is computed by filtering the image with a bank of orientation and scale sensitive filters and computing mean and standard deviation in the frequency domain[14].

C. Shape

Shape features of objects or regions are used in many content based image retrieval. Shape representation can be generally classified as contour based and region based method. This classification is based on whether the shape features are extracted from the contour only or extracted from the whole region. A good shape representation should be invariant to translation rotation and scaling. The objective of shape descriptor is to measure the geometric attribute of the object, which can be used for matching and recognizing object. Some of the simpler attributes are length, area and radius of the shape boundary [15].

Some important contour based shape representations are chain code, Fourier descriptor and UNL Fourier feature [15,16]. Chain code also known as Freeman code can be used to represent the boundary of any shape. The boundary can be traced in either clockwise or anti-clockwise and eight codes for every pixel are assigned according to the direction of next pixel with respect to the current pixel. Fourier descriptors are complex coefficients of Fourier series expansion of waveforms.

From the boundary trace of the shape, a pair of one dimensional wave forms x(t),y(t) can be generated. Fourier descriptors are invariant to the starting point of sampling, rotation, scaling as well as reflection [17]. UNL Fourier features are an extension and improvement over the Fourier descriptors in that they handle open curve and lines [15]. The shape of a boundary segment can also be described quantitatively by using statistical moments such as mean, variance and higher order moments.

In region based descriptors, all the pixels within the shape are taken in to account to obtain the shape representation. Some simple region descriptors are area which is the number of pixels in the region, compactness defined as (perimeter)2/area and circularity ratio defined as the ratio of the area of a region to the area of a circle[17]. Invariant moments, and Zernik moments are generally used in recent CBIR systems as moment descriptors [16]. The common practice in shape representation is to combine both boundary and region descriptors. In [18] a content based retrieval system based on shape feature alone is proposed.

They have used two convex hulls and convex hull area ratio is computed and taken as the feature. In many case a single feature may not represent the object correctly, moreover, different features are combined for exact representation of the image. An image retrieval using color and shape is given in [19, 20].

A novel framework in fuzzy approach which use invariant color feature to develop significant feature points and select an optimal set of features suitable for retrieving set of images relevant to the query image is proposed in [21].

Although content based methods increase the retrieval accuracy, the retrieval result based on pure visual feature are not necessarily semantically meaningful. To overcome this problem interactive relevance feedback was introduced. Relevance feedback establish a link between low level features and high level semantic concepts. A click based relevance feedback mechanism is used in [22] to index the images.

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering
nCORETech
LBS College of Engineering, Kasaragod
Vol. 3, Special Issue 1, February 2016

IV. SIMILARITY MEASURES

Similarity measurement is another important step in CBIR. In content based image retrieval instead of exact matching similarity between query image and the images in the database are calculated. Moreover, result is not a single image but a list of images ranked by their similarity with the query image. The important similarity measures used by current systems are Euclidean distance, Cosine distance, Histogram intersection, quadratic distance, Manhattan distance, Chebyshev distance etc. Researchers found that the performance of the distance metric vary depends on the feature selected and the type of the images.

V. CONCLUSION

The explosive growth of multimedia content in the internet and dramatic increase in the size of large image databases stirred the development of an effective image retrieval system. The traditional text based retrieval systems are blind to the actual content of the images, So to improve the precision of the retrieval system content based image retrieval system was introduced. CBIR retrieve images based on the visual features like color, texture and shape. In this paper a brief review of the feature extraction technique is given.

REFERENCES

[1]. John P. Eakins, "Towards Intelligent Image Retrieval", Pattern Recognition 35 (2002), pp. 3-14.
[2]. Ryszard S. Choras, "Image feature Extracto Techniques and their application for CBIR and Biometrics Systems", International journal of Biology and Biomedical Engineering, Vol 1, pp. 6-16, 2007
[3]. Sven Siggelkow, Hans Burkhardt "Image Retrieval based on Color and nonlinear texture invariants", Noblesse Workshop on nonlinear model based image analysis, July 1998
[4]. Dr. Fuhui Long, Dr. Hongjiang Zhang and Prof. David Dagan Feng, Fundamentals of Content Based Image Retrieval
[5]. Lixin Duan, Wen Li, Ivor Wai-Hung Tsang, and Dong Xu, Member, IEEE "Improving Web Image Search by Bag-Based Re ranking", IEEE Transactions on Image Processing, vol. 20, no. 11, November 2011
[6]. M. Wang, H. Li, D. Tao, K. Lu and X. Wu, "Multimodal graph-based re-ranking for web image search", IEEE Trans. Image Process., vol. 21, no. 11, pp. 4649–4661, 2012.
[7]. Yongdong Zhang, Xiaopeng Yang and Tao Mei, "Image Search Re-ranking with Query-Dependent Click-Based Relevance Feedback", IEEE transactions on image processing, vol. 23, no. 10, 2014
[8]. Greg Pass and Ramin Zabih, "Histogram Refinement for Content-Based Image Retrieval", IEEE workshop on Applications of Computer Vision, pp96-102,1996
[9]. Jing Huang, S. Ravikumar, Madar Mitra, Wei Jing-Zhu and RaminZabih, "Image Indexing using Color Correlogram", IEEE International Conference on Computer vision and Patern Recognition, pp. 762-768, June 1997
[10]. Harlick R M., Shanmugam K and Dinstein I., "Texture Feature For Image Classification", IEEE Tran on Systems, Man and Cybernetics, Vol. 3, No. 6. 1973
[11]. Shapiro and Stockman, Texture, Computer Vision, March 2000.
[12]. Manesh Kokare, B.N. Chatterji and P.K. Biswas, "Wavelet Transform Based Texture Feature for Content Based Image Retrieval"
[13]. H. Tamura, S. Mori and T. Yamawaki, "Texture Features corresponding to Visual Perception", IEEE Transaction on Systems, Man and Cubernitics, vol, smc-8, No.6, June 1978.
[14]. Peter Howarth and Stefan Ruger,"Evaluation of Texture feature for Content Based Image Retrieval", Springer-Verlag Berlin Heidelberg 2004,pp 326-334.
[15]. Babu M. Mehtre, Mohan S. Kankanhalli, and Wing Foon Lee,"Shape Measures for Content Based Image Retrieval: A Comparison", Information Processing and Management, vol-33,No.3, pp- 319-337,1997
[16]. Dengsheng Zhang and Guojun Lu "Review of Shape Representation and Description Technique"
[17]. Rafael G. Gonzalez and Richard E. Woods, Digital Image Processing, 3rd Edition, Pearson
[18]. Santhosh P. Mathew, Valentina E. Bala and Zachariah K.P, "A content Based Image Retrieval System Based on Convex Hull Gepmetry", Acta Ploytechnica Hungarica, Vol 12, No.1, pp- 103-116,2015
[19]. Anil K.Jain and Aditya vailaya, "Image Retrieval Using Color and Shape",1995
[20]. Theo Gevers and Arnold W. M. Smeulders," PicToSeek: Combining Color and Shape Invariant Features for Image Retrieval", IEEE Transaction on Image Processing, vol-9, No.1 January 2000
[21]. M. Banerjee et.al." Content based Image Retrieval using visually Significant Point Features", Fuzy Sets, Systems ,2009.
[22]. Yongdond Zang, Xiaopeng Yang and Tao Mei, "Image Search Re ranking with Query-Dependent Click-Based Relevance Feedback", IEEE Transaction on Image Processing Vol.23, No.10, October2014

BIOGRAPHIES

Naveena A.K. has received her B.Tech in Computer Science and Engineering from Calicut University in1998 and M.Tech from Kerala University in 2007. She is currently a PhD student under Prof. Dr. N.K Narayanan at Department of Information Technology, Kannur University Kerala, India. Her research interest includes Computer Vision and Image Processing.

Dr. N.K. Narayanan is a Senior Professor of Information Technology, Kannur University, Karala, India. He earned a Ph.D in speech signal processing from Department of Electronics, CUSAT, Kerala, India in 1990. He has published more than hundreds of research papers in national & international journals in the area of Speech processing, Image processing, Neural networks, ANC and Bioinformatics. He has served as Chairman of the School of Information Science & Technology, Kannur University during 2003 to 2008, and as Principal, College of Engineering, Vadakara, Kerala, India during 2009-10. Currently he is the Director, UGC IQAC, Kannur University.