THINK INDIA JOURNAL ISSN: 0971-1260
Vol-22-Issue-16-August-2019

The Studyof Approaches of Content Based Image Retrieval

Reshma Narayan
Research Scholar,CS &E,
VTU RRC, Chickballapur,Karnataka

Dr Venkatesh T
Asso Professor, CS &E
Ghousia Engg.,Ramnagar,Karnataka,India

Satheesh Chandra Reddy
HOD , IS & E
SJCIT,Chickballapur Karnataka,India

Lakshmi Narayan
Principal ,BGS Polytechnic
Chickballapur,Karnataka,India

Anantha Murthy
AVP ,Bank of America,Texas
United States of America

ABSTRACT

In a content-based image retrieval system (CBIR), the most issue is to extract the imagefeatures that effectively represent the image contents as more information. Such an extraction needsa detailed analysis of retrieval performance of image options and in order to increase the retrieval efficiency of an image, there are various algorithms represented in a content based image retrieval process and such algorithms are explainedhere and this paper attempts to provide a very effective survey of the recent technical approaches in the current world of image retrieval. The recent publications are included in this literature survey covering all the aspects of the research in the content based image retrieval , including the images that has low image feature extractions and also tells the effective categorization of the image retrieval.

Keywords—CBIR,image retrieval ,image descriptors, color,shape,text

I. INTRODUCTION

As associate degree idiom aforesaid "An Image price thousands words", even a little image willconvey varied data. In early image retrieval system, it needs humanannotation and classification on the image assortment.The basic CBIR fundamentals and area unit divided intothree elements like feature extraction, multidimensional classification and Retrieval systemarchitecture. Theextraction of appropriate options from an image is the basic stepby which the query image and the images with more featuresmay becompared. The Feature Extraction are dividedinto two classes that consists of text based and visualbased. The Visual based feature extraction include unit color, space andtexture etc.Visual options include many optionsof a picture for arrangement recognition.CBIR observed inmany fields likeagriculture, recognizing of images, Mathematics, military, forensics, Artificial Intelligence, Machine Learning, Pattern recognition, Analysis on images in Study of Medicine...etc.The architecture of the content based of image retrieval is as shown below in the figure 1.

The main functionalities that support content based image retrieval are

ISSN: 0971-1260
Vol-22-Issue-16-August-2019

- Data Insertion :The data insertion is defined as the features that are extracted from the image and by storing the extracted features into the image database.
- Query Processing: The query processing can be defined in which the module that extracts a feature vector from thequery which are in the database and then evaluating the query by Euclidian distance and the similarity between the questionnaires and the database images. Next, it ranks the information pictures during a decreasing order of similarity tothe question image and forwards the foremost similar pictures to the interface module.

The below diagram shows a typical design of a content-based image retrieval system. Mainly the fundamentals of the content based image retrieval are feature extraction, indexing and retrieval. In the feature extraction ,the main features of the content based image retrieval consists of the color, text and shape.

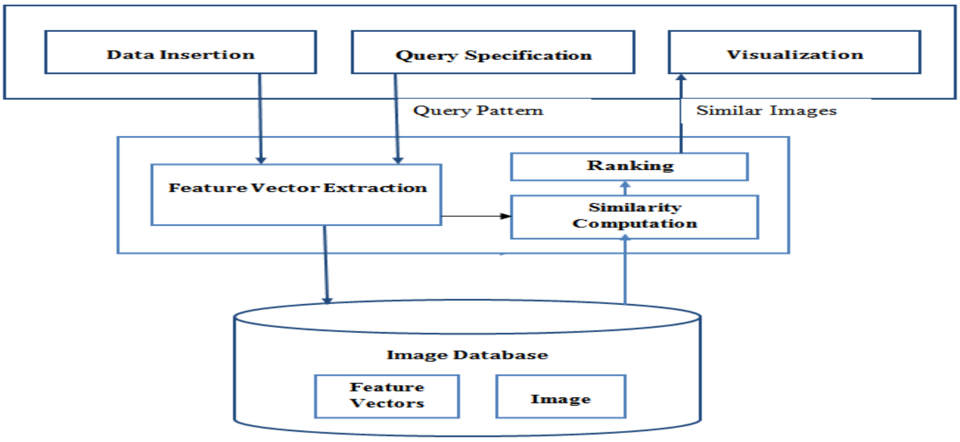


Figure 1 : The Block Diagram Of CBIR

Feature Extraction: Feature extraction involves reducing the number of resources needed to explain the set of information. .An analysis with more number of variables usually needs more memory and computation power, additionally it should cause a classification formula to over fit tosamples and generalize poorly to new samples. Feature extraction can be defined as the extracting the more features from the particular image for the future computation.The learning practitioners believe that properly optimized feature extraction is that the key to effective model construction. the image consists of the various features such as color, text and shape and finally transformed into feature vector. the mathematical model of feature extraction is as shown below.

$$f{:}I \times \theta \rightarrow R^{d}$$

- f -> the feature specific method
- I ->image operation
- θ-> parameters of extraction
- d->dimension vector
- R->result of the vector

Here in the feature extraction consists of the image descriptors and the image descriptors consists of the vector extraction function and distance function and the basically image descriptors consists of the color image descriptors , text image descriptors and shape image descriptors.

Color Image Descriptors:Color is one amongst the foremost wide used options forimage retrieval. Color is invariant to quality and really much sensitive to humans than the greyscale pictures.Researches during this field will be sortedinto 3 main subareas: (a)defining of the adequate color area for a given image ,(b) proposing of the best extraction algorithms, andc) evaluation of similaritymeasures.Color could be a powerful descriptor that simplifies object identification and is one amongst the foremost often used visual options for content-based image

ISSN: 0971-1260
Vol-22-Issue-16-August-2019

retrieval. To extract the colour options from the content of a picture, a correct color house and an efficient color descriptor have to be compelled to be determined.

The various color models that can be represented is as shown below they are RGB, HSI,YIQ,L*U*V,L*a*b, CMY, CMYK and these color systems or color models or color spaces can be represented in the three dimensional image. Basically the color spaces consists of the co-ordinate systems and a subspace .Here RGB, HSV,CMY,CMYK color spaces are implemented on the hardware and these are called as hardware oriented for hardware called color monitors and the other color models are L*U*V,YIQ and L*a*b are called as user oriented because they tell the color differences.

- RGB color space consists of the primary space colors namely Red, Green and Blue. This space model can be represented as cube based on Cartesian Co-ordinate System. In the cube red, green and blue are at the one corner and at the other end we have cyan, magenta and yellow. we have black color at the origin and the white color is far from the origin. Here the colors are normalized hence the cube is called as the unit cube.

- CMY and CMYK color spaces consists of the various secondary colors namely cyan, magenta and yellow and for the example when the surface gets coated with the cyan color obviously it illuminates the white light when the cyan is composed of equal amounts RGB colors. Basically color printers consists of the CMY data input or it performs RGB to CMY .The basic conversion operation is as shown below

$$\begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

- HSI color space model : As human sees the image , the image can be perceived as Hue, Saturation and Intensity or brightness. The Hue can be defined as the attribute that defines the pure color .Saturation is nothing but the white color is diluted by the pure color and brightness is defined as key which describes
the color sensation. As mentioned the RGB ,CMY and CMYK are basically hardware oriented ,But HSI model is basically user oriented because defined to quantify color variations as perceived by humans. The RGB can be converted into HSI and the hue ,saturation and intensity is as shown below. The pixel of RGB is obtained as shown in the equation

$$H = \begin{cases} \theta & \text{if } B<=G \\ 360- \theta & \text{if } B > G \end{cases}$$

The hue can be defined as shown in the equation and can be represented as θ

$$\theta = \cos^{-1}\frac{\frac{1}{2}[(R-G)+(R-B)]}{[(R-G)^2+(R-B)(G-B)]^{1/2}}$$

The saturation can be defined in the equation is as shown below

$$I = 1/3(R+G+B)$$

- Color Moments : The color moments do not consider the spatial distribution .Color moments are measures that can be used differentiate pictures primarily based on their features of color.Once the color moments are calculated and these moments will give you the measurement of color similarity between images and this can be compared to the images which are stored in the database .Stricker and Orengo [4] use three central moments of a image's color distribution.

1. The mean can be defined as the average color value in the image and can be represented as shown below

$$E_i = \sum_{N}^{j=1} \frac{1}{N} P_{ij}$$

ISSN: 0971-1260
Vol-22-Issue-16-August-2019

2. The standard deviation can be defined as the square root of the variance of the distribution and the formulae is as shown below

$$E_i = \sqrt{\frac{1}{\mathrm{N}} \sum_{N}^{j=1} \frac{1}{\mathrm{N}} (\mathrm{P_{ij}} - \mathrm{E_i})^2}$$

3. The skewness can be defined as the degree of asymmetry in the distribution and the formulae can be denied as shown below

$$S_i = \sqrt[3]{\frac{1}{\mathrm{N}} \sum_{N}^{j=1} \frac{1}{\mathrm{N}} (\mathrm{P_{ij}} - \mathrm{E_i})^3}$$

- Color Histogram: The color histogram for an image is defined by counting the number of pixels of each color in particular image.An image histogram defined as the probability mass function of the image.The extended color images to capture the joint probabilities of the image intensities of the three color channels. Basically , the color histogram is defined as shown below

$$h_{A,B,C}(a,b,c) = N\,.Prob(A = a, B = b, C = c)$$

here the a,b,c are called as R,G,B color spaces or HSV color spaces and N can be represented as the number of the pixels.

- Color Coherence Vector CCVs are created by computing, for each color, the total number of coherent (α_i) and incoherent pixels (β_i). A pixel is considered coherent if it belongs to a largelyuniformly-colored region. The CCV is defined as $V_c = \langle (\alpha_1, \beta_1), (\alpha_2, \beta_2), \ldots, (\alpha_N, \beta_N) \rangle$,where N is the number of colours.[8]

Texture Image Descriptors:Texture is that the alternative feature of image utilized in image retrieval method. Texture feature will be extracted by severalways like gabor Filters, co-occurrence matrix, Waveletdecomposition, Tamura feature ,wavelet transform, coherence matrix etc.,Textures are re placed into a number of sets, depending on how many textures are detected in the image.[9].

- Gabor Filter:The major CBIR engine uses the gabor filters. Let Gabor filter can be represented Gmn (x, y) that is applied to the original image represented as I(x, y) of size PxQ. The magnitudes can be represented as E (m, n) can be written as [10],

$$E_{mn} = \sum\sum |g(x,y)|$$

- CoherenceMatrix :Thea grey scale image can be represented by I and it is defined by Z^n . The gray level co-occurrence matrix is a square matrix and can be represented byG_d of size N where,
  - The total number of grey levels in the image can be represented as N.
  - The distance is represented as k and k is a nonnegative integer and the direction is represented as d is specified by d=(d_1,d_2,d_3...d_n) , where d€{0,k ,-k } $\forall_i$ =1, 2,3,...n.
  - Consider an example of the grey scale image in Z^3 with the 4 intensity values 0, 1, 2 and 3. The image is represented as a matrix of size three n*n in which the equation can be represented as shown below

$$M_{co} = \sum_{x=1}^{K} \sum_{y=1}^{K} \{ 1, \; if\; I(x,y) = i \; and \; I(x + d_x,\; y + d_y) = j\,; 0, \quad otherwise \}$$

ISSN: 0971-1260
Vol-22-Issue-16-August-2019

- Wavelet Transform : The wavelets are defined as the waves in which the frequency varies due to the limited variations .Here in this the images are represented as the two dimensional matrices of the intensities values that forms the objects.This consists of a set of base functions which represent the sign, and these signs are in different frequency bands, each frequency bands consists of the corresponding different resolutions in each scale. The advantage of the wavelet transform is multi resolution analysis. The examples of wavelet transforms are discrete wavelet transform , Daubechies4 Wavelet Transform.
    (a) Discrete Wavelet Transform : The Discrete wavelet transform and the wavelets expansion of function f (x) € L^2 (R) which is relative to the wavelet ψ (x) and scaling function ϕ (x) is defined as shown below

    $$f(x) = \sum_{k} c_{j_0}(k)\varphi_{j_{0k}}(x) + \sum_{j=j_0} d_j(k)\Psi_{j,k,}(x)$$

    Where arbitrary starting scale is represented as j_0, approximation coefficients is represented as c_{j_0} (k).

    (b) Daubechies4 Wavelet Transform :This is a second order member of the Daubechies wavelet transform family. This Daubechies4 wavelet transform consists of four scaling and four wavelet coefficients. All these scaling and wavelet coefficients are applied to images to extract the features from theparticular images.
    The wavelets coefficients are as follows

    $$g_1 = -h_2, g_0 = h_3, g_2 = h_1, g_3 = -h_0$$

    The scaling co-efficients are as shown below

    $$h_{0=}\frac{1+\sqrt{3}}{4\sqrt{2}}, h_{1=}\frac{3+\sqrt{3}}{4\sqrt{2}}, h_{2=}\frac{3-\sqrt{3}}{4\sqrt{2}}, h_{3=}\frac{1-\sqrt{3}}{4\sqrt{2}}$$

- Tamura Feature : This feature can be defined as the studies of the characterizing the various features such as Contrast, Directionality ,Coarseness, Line likeness , Regularity and Roughness and one of the contrast features can be computed as shown below

    $$contrast = \frac{\sigma}{(\alpha_4)^n}$$

    Where
    n = 0.25

    $$\sigma^2 = (q-m)^2 \Pr(q|I).$$

    $$\alpha_4 = \frac{1}{\sigma^4}\sum_{q=0}^{q_{max}} (q-m)^4 \Pr(q|I)$$

Shape Image Descriptors : Shape is an important feature that helps in identifying the characterising and distinguishing objects and if we need any images that needs to be retrieved accurately here we need shape of objects .The shape image descriptors have some essential properties they are identifiability ,translation, rotation and scale invariance,affine invariance,noise resistance,occultation invariance,statistically independent and reliability.

The shape image can be represented and viewed as binary function as shown below

$$f(x,y) = \begin{cases} 1 & if(x,y) \in D \\ 0 & other \end{cases}$$

where

D is represented as the domain function of the binary shape descriptors

The centroid can be represented as shown below for (g_x, g_y)

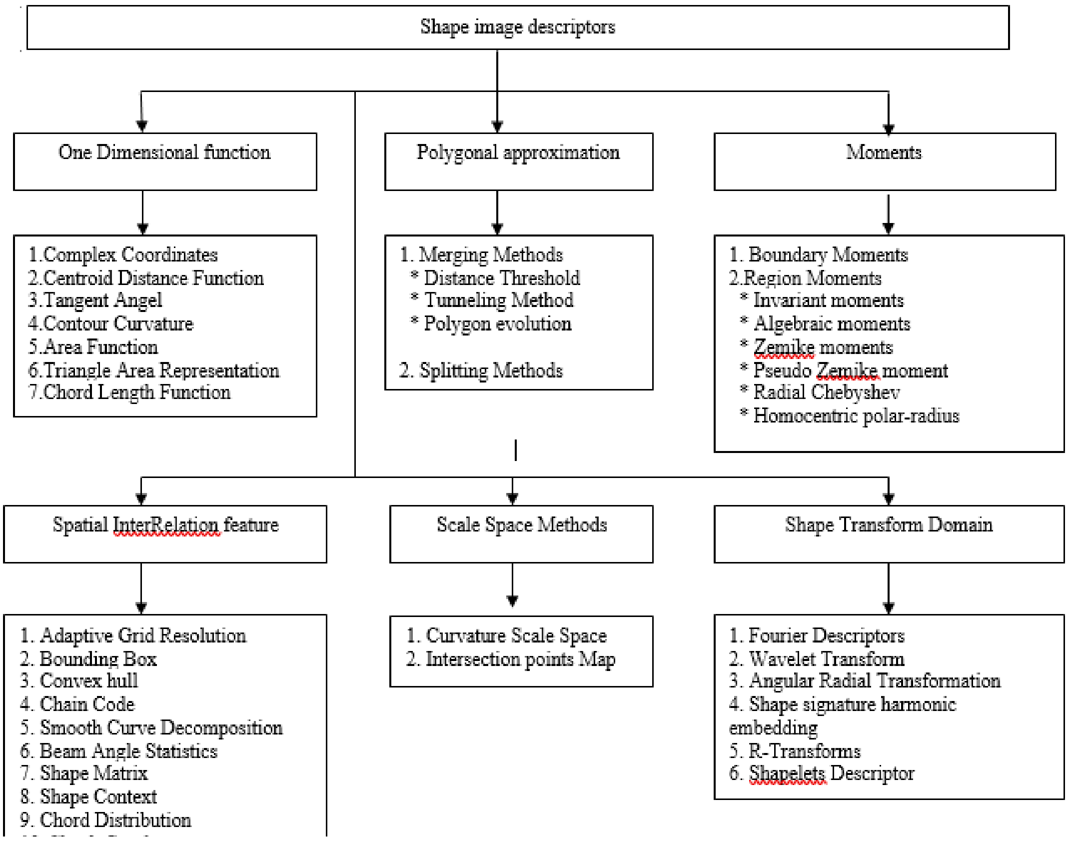
ISSN: 0971-1260
Vol-22-Issue-16-August-2019

$$g_{x=}\frac{1}{N}\sum_{i=1}^{N}x_i$$

$$g_{y=}\frac{1}{N}\sum_{i=1}^{N}y_i$$

The N is represented as the number of point in shape (x_i, y_i) € $\{(x_i, y_i)$ |f(x_i, y_i) =1}

The overview of the shape image descriptors is as shown below



The below table shows the various approaches of the recent works on the content based image retrieval.

COLOR FEATURE	TEXTURE FEATURE	SHAPE FEATURE
Color Moments	Gabor Filter	One Dimensional function
Color Histogram	Wavelet Transform	Polygonal Shape descriptors
Color Correogram	Tamura feature	Spatial interrelation feature
Color Coherence vector	Fourier Transform	Moments

ISSN: 0971-1260
Vol-22-Issue-16-August-2019

Region Histogram	Convex parts	Statistical
Color Cluster	Coherence Matrix	Scale Space Methods
Bit Signature	Autoregressive models	Shape Transform Domains

Table 1 :Various Approaches Of The CBIR

CONCLUSION

This paper provides a detail information in the field of the content based image retrieval and explains about the various techniques based on the feature extractions like color image descriptors, texture image descriptors and the shape image descriptors and. On same note, other face of coin - scanning, identifying, retrieving required images from those huge database is big challenge. In fact, it isvery complex process. As the challenge exists, we need to come-up with efficient, reliable, Trustable, retrieval feature extraction techniques. As extraction process serves as moral fiber of Content Based Image retrieval.

REFERENCES

[1] M.J. Swain and D.H. Balllard. Color Indexing. Intern. Journal of Computer Vision, 7(1):11 32,1991
[2] R. Shen, N. S. Vemuri, W. Fan, R. da S. Torres, and Edward A. Fox. Exploring Digital Libraries: Integrating Browsing, Searching, and Visualization. In *Proceedings of the 6th ACM/IEEE-CS Joint Conference on Digital libraries*, pages 1–10, Chapel Hill, NC,USA, June 2006.
[3] A. del Bimbo. *Visual Information Retrieval*. Morgan Kaufmann Publishers, San Francisco,CA, USA, 1999.
[4] M. Stricker and M. Orengo, “Similarity of color images”, In SPIE Conference on Storage and Retrieval for Image and Video Databases III, volume 2420, pages 381-392, Feb. 1995.
[5] G. Pass, R. Zabih, and J. Miller. Comparing Images Using Color Coherence Vectors. In *Proceedings of the fourth ACM international conference on Multimedia*, pages 65–73,1996.
[6] B. S.Manjunath, J. R. Ohm, V. V. Vasudevan, and A. Yamada.Color and Texture Descriptors. *IEEE Transactions on Circuits and Systems for Video Technology*, 11(6):703–715, June2001.
[7] R.O. Stehling,M.A. Nascimento, and A.X. Falcão. A Compact and Efficient Image Retrieval Approach Based on Border/Interior Pixel Classification. In *Proceedings of the 11th ACM International. Conference on Information and Knowledge Management*, pages102–109,McLean, Virginia, USA, November 2002.
[8] Ricardo da Silva Torres and Alexandre Xavier Falcão Content Based Image Retrieval : theory and its applications ,RITA ,Volume xiii, Numero 2,2006
[9] Nitin Jain &Dr. S. S. Salankar” Color& Texture Feature Extraction for Content Based Image Retrieval”, IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) e-ISSN: 2278-1676, p-ISSN: 2320-3331, PP 53-58 .
[10] Y. Rui, T. S. Huang, and S. F. Chang. Image Retrieval: Current Techniques, Promising Directions, and Open Issues. *Journal of Communications and Image Representation*,10(1):39–62,March 1999.
[11] Ricardo da Silva Torres ,Alexandre Xavier Falcão,Content-Based Image Retrieval: Theory and Applications,RITA ,Volume XIII , Número 2 , 2006
[12] Younes RAOUI, El Houssine BOUYAKHF, Michel DEVY,Fakhita REGRAGUI, Global and Local Image Descriptors for Content Based Image Retrieval and Object Recognition, Applied Mathematical Sciences, Vol. 5, 2011, no. 42, 2109 - 2136.
[13] R.Datta, D. Joshi, J.Li, J.Z. Wang, " Image retrieval: ideas, influences, and trends of the new age ", ACM Computing Surveys 40(2), 2008, pp. 1-60.
[14] Y. Rui, T.S. Huang, M. Ortega, S. Mehrotra, " Relevance feedback : a power tool for interactive content based image retrieval ",IEEE Circuits and Systems for Video Technology , Vol. 8, No. 5, 1998, pp. 644-655
[15] M.J. Swain and D.H. Balllard. Color Indexing. Intern. Journal of Computer Vision, 7(1):1132,1991
[16] Xiang-Yang Wang, Yong-Jian Yu, Hong-Ying Yang,” An effective image retrieval scheme using color, texture and shape features”, Published in: · Journal Computer Standards & Interfaces archive Volume 33 Issue 1, January, 2011 Elsevier Science Publishers B. V. Amsterdam, The Netherlands, The Netherlands.
[17] R. Haralick, K. Shanmugam, and I. Dinstein, (1973) “Textural Features for Image Classification”, IEEE Trans. on Systems, Man and Cybernetics, SMC–3(6):610–621
[18] T. Ojala, M. Pietikainen, T. Maenpaa, (2004) “MultiresolutionGray-Scale and Rotation Invariant Texture Classification with Local Binary Patterns”, IEEE. Trans. On Pattern analysis and Machine intelligence, Vol.24
[19] Yang, M., Kpalma, K. and Ronsin, J. (2010) A Survey of Shape Feature Extraction Techniques. Pattern Recognition, 1-38
[20] Mallat, S.G. (1989) A Theory for Multiresolution Signal Decomposition: The Wavelet Representation. IEEE Transactions on Pattern Analysis and Machine Intelligence, 11, 674-693.