Content Based Image Retrieval Using CCM Based Algorithm

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Abstract

Digital Image Processing basically deals in converting the nature of the image as needed. An image is a group of pixels in terms of Image processing. To improve the Pictorial information mainly images are processed. Content Based Image Retrieval (CBIR) is a rising and growing trend in Digital Image Processing. CBIR is used to search and retrieve the query image from broad range of databases. Lots of Features and algorithms can be used for efficient image retrieval. In this paper an efficient image retrieval algorithm grounded on CCM (Colour Co-occurrence Matrix) is proposed. By using the Hue Saturation Value (HSV) of the pixel CCM for each pixel of an image is found and then compared with CCM of the images in the database and the images are retrieved.

Keywords: *Content based image retrieval (CBIR), Pixels, Image, Hue Saturation Value (HSV), Colour Co-occurrence Matrix (CCM)..*

I. INTRODUCTION

Image processing is any class of signal processing where we can give input as a photograph or a video frame and the output may be either an image or a set of parameters associated to the image. An image retrieval system is a system which grants us to browse, search and retrieve the images. Content Based Image Retrieval is the method of retrieving the desired query image from a large number of databases based on the contents of the image. Colour, shape, texture, and local features are some of the general methods used for retrieving a specific image from the images in the database. Content Based Image Retrieval system deal with all the images and the search is grounded on comparison of features with the query image [1].

The basic and main components of CBIR are the features which includes the Geometric shape, texture and the colours of the image. There can be two types of Features like local features and global features. Using the local features object identification can be done easily. The next component is the linked text in which the images can also be retrieved using the text linked with the image. The other component is the relevant feedback where it helps to be more accurate in searching the similar images by taking up the feedbacks of the user.

Biomedicine, Military, Education, Web image classification and searching are some of the areas where the CBIR methods find its prime importance. Some of the examples for the CBIR are Viper which is Visual Information Processing for increased Retrieval, QBIC which is Query by Image Content and Visual seek which is a web tool for browsing images and videos. CBIR basically decreases the heavy workload and gets over the problem of heavy subjectivity. Images can be compared by producing the CCM (Colour Co-occurrence Matrix) for the query image as well as the images in the database. For this the Hue Saturation Value can be found for each and every pixel of the image and the CCM is formed using the related formulas. This CCM of the query image is compared with those images in database and the resulting images are grouped based on the similarity. This method can increase the precision and helps the user to obtain the results quickly [10].

II. CONTENT BASED IMAGE RETRIEVAL

In early period of time because of very large image collections the manual annotation approach was truly difficult. To overcome these problems Content Based Image Retrieval (CBIR) was introduced. Content-based image retrieval (CBIR) is the application of computer vision to the image retrieval problem. In this process instead of being manually annotated by textual keywords, images would be indexed using their own visual contents .The visual contents may be texture, shape and colour. This process is said to be a general framework of image retrieval. The three fundamental bases for Content Based Image Retrieval are visual feature extraction, multidimensional indexing and retrieval system design. The colour aspect can be attained by the techniques like averaging and histograms. The texture aspect can be attained by using transforms or vector quantization. The shape aspect can be attained by using gradient operators or morphological operators. Several of the major areas of application are Medical diagnosis, Crime prevention, Military, Art collections, Intellectual property, Architectural and engineering design and Geographical information and Remote sensing systems. [7,13].

2.1 RETRIEVAL BASED ON COLOUR

Various methods for retrieving images on the basis of colour similarity are being used. Each image saved to the database is analysed and a colour histogram is computed showing the proportion of pixels of each colour within the image. For each image this colour histogram is stored in the database. Throughout the search time, the user can either define the desired proportion of each colour (75% olive green and 25% red, for example), or submit a mentioned image from which a colour histogram is calculated. The equating process then retrieves those images whose colour histograms match those of the query most closely [4,13].

2.2 RETRIEVAL BASED ON STRUCTURE

The ability to match on texture similarity can frequently be useful in recognizing between areas of images with similar colour. A variety of methods has been used for computing texture similarity in which the best established rely on equating values of what are known as second order statistics calculated from query and stored images. Essentially, these computed the relative brightness of selected pairs of pixels from each image. From these it is possible to compute measures of image texture such as the degree of contrast, directionality and regularity, or periodicity, coarseness, directionality and randomness. Substitutive techniques of texture analysis for retrieval include the use of Gabor filters and fractals. Texture queries are also formulated in a similar manner to colour queries, by taking examples of desired textures from a palette, or by issuing an example query image. A recent extension of the technique is the texture thesaurus, which retrieves textured areas in images on the basis of similarity to automatically-derived code words representing crucial classes of texture within the collection.

2.3 RETRIEVAL BASED ON SHAPE

The ability to retrieve by shape is possibly the most obvious necessity at the primitive level. Unlike texture, shape is a pretty well-defined concept and there is significant evidence that natural objects are primarily acknowledged by their shape. A number of features characteristic of object shape (but independent of size or orientation) are calculated for every object identified within each stored image. Queries are then replied by calculating the same set of features for the query image, and retrieving those saved images whose features most closely match those of the query. Two main types of shape feature are usually used global features such as aspect ratio, circularity and moment invariants and local features such as sets of successive boundary segments. Alternative techniques proposed for shape matching have included comparison of directional histograms of edges extracted from the image, elastic deformation of templates, and shocks, skeletal representations of object shape that can be equated using graph matching techniques. Queries to shape retrieval systems are developed either by identifying an example image to act as the query, or as a user-drawn sketch. Shape matching of three-dimensional objects is a more difficult task particularly where only a single 2-D view of the object in query is available.

2.4 RETRIEVAL BASED ON OTHER FEATURES

One of the oldest-established intends of accessing pictorial data is retrieval by its position within an image. Accessing data by spatial location is an necessary aspect of geographical information systems, and effective methods to achieve this have been around for many years. Similar methods have been used to image collections, granting users to search for images containing objects in defined spatial relationships with each other. Amended algorithms for spatial retrieval are still being proposed. Spatial indexing is seldom useful on its own, though it has proved to be effective in combination with other factors such as colour and shape. Many other kind of image feature have been proposed as a basis for CBIR.. Majority of these rely on complex transformations of pixel intensities which have no obvious counterpart in any human description of an image. Majority of such techniques aim to extract features which reflect some aspect of image similarity which a human subject can perceive, even if he or she finds it hard to describe. The well-researched technique of this kind uses the wavelet transform to model an image at several unlike resolutions. Promising retrieval results have been described by matching wavelet features computed from query and stored images. Another technique giving interesting results is retrieval by appearance. The advantage of all these techniques is that they can report an image at varying levels of detail (useful in natural scenes where the objects of interest may seems in a variety of guises), and avoid the need to segment the image into area of interest before shape descriptors can be computed. In spite of recent advances in techniques for image segmentation, this remains a troublesome problem.

III. RELATED WORKS

Ahonen.T presented a paper where content based image retrieval systems are used for facial recognition and texture categorization in image retrieval. An operator called local binary pattern is applied for image retrieval, where the LBP value is found for each pixel in Query image and equated with the LBP value of data base images and images are retrieved. [6]

Rui.Y in his paper has proposed a survey of technical achievements in region of image retrieval. They have brought into light, the requirement for the CBIR in real time application. They also proposed the past and current accomplishments in indexing and extracting the visual feature of the images [2] A.W.M.Smeulders has supplied the steps carried out in content based image retrieval process. The features applied for retrieval are also spoken here. The disadvantages like need for databases, function of similarity and problems of evaluation are also discussed [3].

Tai X.Y in his paper has given the use of content based image retrieval systems in the Medical field and it supplies more cognition about how the CBIR can be applied in real time medical application [12].

Huang.P.N has proposed a design of a two stage content based image retrieval system which basically used the similarity measure, based on texture. Thus image retrieval method is more enhanced.

Subrahmanyam Murala introduced a novel image indexing and retrieval algorithm is proposed using local tetra patterns (LTrPs) for content-based image retrieval (CBIR). The standard local Ternary pattern (LTP) and local Binary pattern (LBP) encodes the relationship between the referenced pixel and its surrounding neighbours by calculating gray-level difference. By applying this difference, the images are compared and retrieved [8].

Aigrain et al has discussed the main principles of Automatic Image Similarity matching for database retrieval, emphasizing the difficulty of showing this in terms of automatically generated features. They have surveyed a selection of current methods for both still image retrieval and video data management, including video parsing, key frame extraction, shot detection, and video skimming. The paper resolves that the field is expanding rapidly, but that many major research disputes remain, including the difficulty of expressing semantic information in terms of primitive image features, and the requirement for substantially improved user interfaces. CBIR methods are likely to be of most use in restricted subject domains, and where synergies with other types of data can be used.

IV. PROPOSED METHOD

4.1 RGB Colour model

This model has principal colours like red, green, blue. Majority of the CRT monitors and colour raster graphics make use of the RGB colour model. This model uses Cartesian coordinate arrangement system. The colours in this model are called "Additive primaries", because desired colours can be produced by summing them together.

4.2. HSV Colour model:

HSV colour model stands for Hue Saturation Value colour model. This model offers a more intuitive representation of relationship between colours. This model depicts colours in terms of their shades and brightness (Luminance). Fundamentally a colour model is the specification of coordinate system and a subspace within that, where each colour is presented in single point.

4.2.1 Saturation

Saturation represents the dominance of hue in colour. Saturation can also be thought as the intensity of the colour. It is defined as the degree of purity of colour. A extremely saturated colour is vivid, whereas a low saturated colour is muted. The image is said to be a grey image when there is no saturation in the image.

4.2.2 Hue

HUE represents the dominant wavelength in light. Hue is expressed from 0º to 360º. It is the term for the pure spectrum colours. It represents hues of red (starts at 0º), yellow (starts at 60º), green (starts at 120º), cyan (starts at 180º), blue (starts at 240º) and magenta (starts at 300º). Eventually all hues can be fused from three basic hues known as primaries.

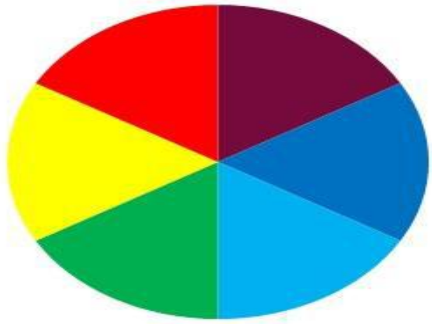


Figure 1. Colours of hue

4.2.3 Value

It describes the intensity or brightness of the colour. In other words value is specified as a relative lightness or darkness of colour.

The saturation of the point **P** is the length between the point **P** and centre of the triangle. The intensity of the point **P** is presented as height of the line perpendicular to the triangle and passing through its centre. The grey scale points are located onto the same line. Conversion formulas are given below as follows.

$$H = \cos^{-1}\left\{\frac{1/2\,[(R-G)+(R-B)]}{\sqrt{(R-G)^2+(R-B)(G-B)}}\right\} \quad \text{........ (1)}$$

$$S = 1 - \frac{a}{R+G+B}\,[\min(R,G,B)] \quad \text{.......(2)}$$

$$V = 1/a\,(R+G+B) \quad \text{.......(3)}$$

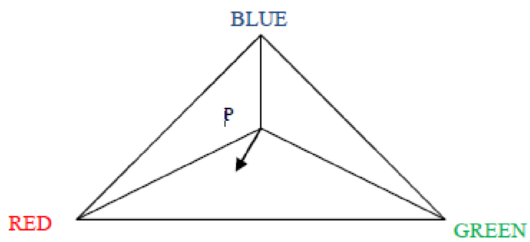
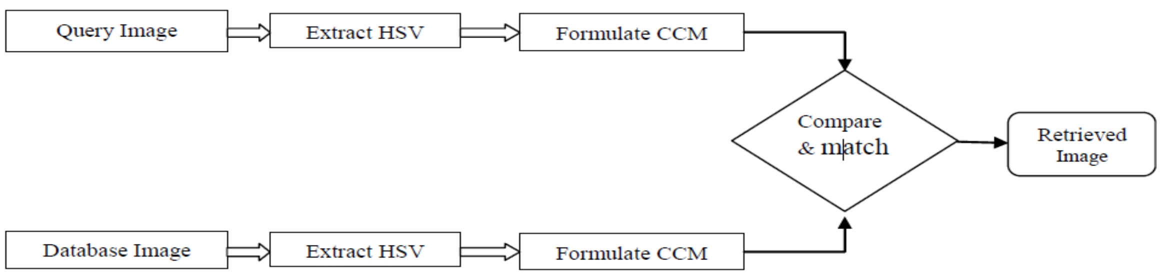


Figure 3. RGB to HSV conversion



Where H, S & V represents Hue, Saturation & Value. R, G & B represents RED, GREEN & BLUE respectively [9].

4.3 Converting RGB to HSV colour model

HSV colours are said to lie within a triangle and the vertices are specified by the three primary colours in RGB space. The hue of the point **P** is given by the angle between the line joining **P** to the centre of the triangle and line joining the RED point to the centre of the triangle.

4.4 Colour Co-occurrence Matrix (CCM)

A co-occurrence matrix is a matrix that is defined over an image to be the distribution of co-occurring values at a granted offset. Value of an image is originally the grey scale value of a defined pixel. In our case we take the values to be the H, S and V of a specified pixel. The co-occurrence matrix is mainly used for texture analysis. Features generated using these methods are also called as Haralick features, because this construct was first introduced by Robert M Haralick. Texture measures like co-occurrence matrix and wavelet transforms have found applications in medical image analysis in particular. A query image is selected to carry out the retrieval process, and the Hue, saturation and value of the pixels are taken and in the end the colour co-occurrence matrix if formed using the formula below.

$$\text{Colour co-occurrence matrix} = 9H + 3S + V \quad \textbf{.... (4)}$$

The Hue values are from 20 to 316, saturation values are 0 to 1 and values ranges from 0 to 1. In the same way CCM is found for the database images and the feature difference is found applying the Euclidean distance. The images are matched for similarity using both HSV of the pixels of the image and the textural features. This process supplies accurate retrieval results so that the query image is retrieved [5].

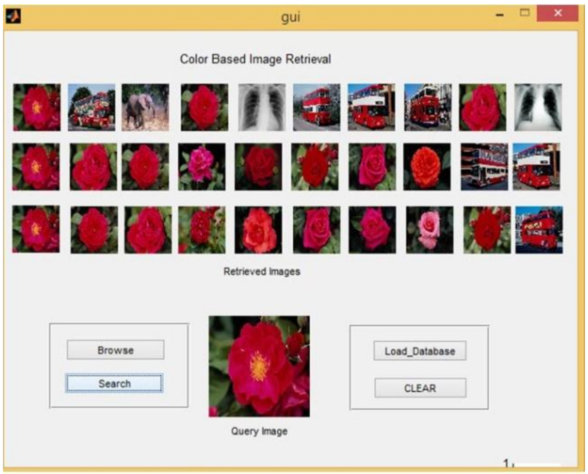
4.5 Euclidean distance

Euclidean distance computes the similarity between the two different feature vectors. The formula for Euclidean distance is shown below. D and Q are feature vectors of the Database image and Query image.

$$\text{Euclidean distance} = \sqrt{\sum_{i=0}^{n} [Qi\text{-}Di]^2} \quad \text{........(5)}$$

V. EXPERIMENTAL RESULTS

After receiving all essential terms like Hue, saturation and value, colour co-occurrence matrix for number of images in the database, the results are computed by applying the Euclidean distance. According to their Euclidean distances the result is sorted and shown below.



VI. CONCLUSION

The Retrieval algorithm presented in this paper mainly increases the user interaction and reduces the computational time at the same time. The retrieval accuracy is also raised to greater extent as the images are retrieved on the basis of both colour feature and pixel information. The results received are also less in number so that there is no need for the user to spend more time in analysis. Also the construct proposed here scales down the semantic gap. Since this idea is implemented in high level language like Mat lab, it can be used readily in many real time applications. The efficiency could be even more raised by taking into account several features at a time and calculate the similarity to receive more accuracy.

REFERENCES

[1] Moghaddam, H.A., Khajoie, T. T. , and A. H. Rouhi , “A new algorithm for image indexing and retrieval using wavelet correlogram,” in Proc. ICIP, 2003, pp. 497-500

[2] Rui.Y, and Huang.T.S, “Image retrieval: Current techniques, promising directions and open issues,” *J.* Visual Commun. Image Represent., vol. 10, no.1, pp. 39–62, Mar. 1999.

[3] Smeulders.A.W.M, Worring.M, Santini.S,Gupta.A, and R. Jain, “Content- based image retrieval at the end of the early years,” IEEE Trans. Pattern Anal.Mach. Intell.,vol. 22, no. 12, pp. 1349–1380, Dec. 2000.

[4] Liao, S., Law, M.W. K. , and A. C. S. Chung,“Dominant local binary patterns for texture classification,” IEEE Trans. Image Process., vol.18, no.5, pp. 1107–1118, May 2009.

[5] Liu, Y., Zhang, D. , G. Lu, and W.-Y.Ma, “A survey of contentbased image Retrieval with high-level semantics,” Pattern Recogn., vol. 40, no. 1,pp. 262–282, Jan.2007.

[6] Ahonen,T., Hadid, A., and M. Pietikainen, “Face description with local binary patterns Applications to face recognition,” IEEE Trans. Pattern Anal. Mach. Intell., vol. 28, no.12, pp. 2037–2041, Dec. 2006

[7] Guo, Z., Zhang, L. , and D. Zhang, “A completed modeling of local binary pattern operator for texture classification,” IEEE Trans. Image Process., vol. 19, no. 6, pp. 1657– 1663, Jun. 2010.

[8] Subrahmanyam Murala, R. P. Maheshwari, and R. Balasubramanian, “Local Tetra Patterns: A New Feature Descriptor for Content-Based Image Retrieval,” IEEE Trans. Image Process., vol. 21, no. 5, pp. 2874–2886, May 2012

[9] J. Han and Ka. Ma. “Fuzzy Color Histogram and Its Use in Color Image Retrieval”. IEEE Transactions on Image Processing, vol. 11, no. 8, pp. 944-952, Aug. 2002.M. Shell. (2002) IEEEtran homepage on CTAN.[Online].Available:http://www.ctan.org/texarchive/ macros/latex/contrib/supported/IEEEtran/

[10] Ritendra Datta, Dhiraj Joshi, Jia Li, James Z. Wang, "Image retrieval:Ideas, influences, and trends of the new age," ACM Computing Surveys, vol. 40, pp. 1-60, 2008.

[11] Young Deok Chun, Nam Chul Kim, Ick Hoon Jang, "Content-Based Image Retrieval Using Multiresolution Color and Texture Features,"IEEE Transaction on Multimedia, vol. 10, pp.1073-1084, 2008.

[12] Tai X. Y., Wang L. D. , "Medical Image Retrieval Based on Color-Texture Algorithm and GTI Model, " Bioinformatics and Biomedical Engineering, 2008, ICBBE 2008, The 2nd International Conference on, pp. 2574-2578.

[13] Content based image retrieval by John Eakins, Margaret Graham, University of Northumbria. http://www.wikipedia.org.