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Design of Enhanced Entropy based Feature for CBIR

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Abstract: In modern sciences and technologies, images gain much broader scopes due to the ever growing importance of scientific visualization. The search for similar images in large-scale image databases has been an active research area in the last couple of years. A very promising approach is content based image retrieval (CBIR). Content-Based Image Retrieval (CBIR) is a technique that uses image visual features such as color, texture, shape etc. to retrieve the images from set of large image database according to user's request which is in the form of query image. The combination of Color and Texture information have been the most important property of any image and provides robust feature set for image retrieval. The information gained by feature extraction is used to measure the similarity between two images. For the comparison of query image and the database image, similarity measures such as Euclidean Distance, Jeffrey Divergence, color histogram matching etc. are used. In this paper, we have used the enhanced entropy feature which works best for textures with small variances and thus improving retrieval results from existing entropies.

Key words: content based image retrieval, color feature, texture feature, entropy.

I. INTRODUCTION

CBIR has been an active area of research for the last two decades and it has made much progress in short time period. Image retrieval based on color and texture feature has proved to be effective for large image database. Earlier, text-based image retrieval systems were in use. In text-based approach, images were first manually annotated with texts, keywords etc. and then searched, based on the metadata of the image. The text-based approach can be tracked back to early 1970's. There are some disadvantages associated with the text—based approach. One is: it requires manual annotations and another disadvantage is: the inaccuracy in the annotations due to increasing size of the image database. As the size of the database was increasing, it became difficult to manually annotate every image. This is inefficient and expensive. Therefore, CBIR came into existence in 1990. IBM was the first one, who take the initiative for proposing the Query by Image Content (QBIC). Content-Based Image Retrieval (CBIR) is a technique that uses the visual features of an image such as color, texture, shape etc. for the retrieval of images from the large set of image database according to the user's request which is a query image. It takes the query image as input and the images similar to the query image from the large image database are retrieved on the basis of color and texture feature and provides the results.

II. RELATED WORK

Content based image retrieval for general-purpose image databases is a highly challenging problem because of the large size of the database, the difficulty of understanding images, both by people and computers, the difficulty of formulating a query, and the issue of evaluating results properly.
Wasim Khan, Shiv Kumar, Neetesh Gupta, Nilofar Khan in their paper "A Proposed Method for Image Retrieval Using Histogram Values and Texture Descriptor Analysis"[10] proposed a method for image retrieval using histogram values and texture descriptor analysis of image. For extracting the color feature of the image, they used color histogram and for the texture extraction of an image, three different measures have been used.
Texture = (Entropy + Standard Deviation + Local Range).
When a query image is submitted, its extracted feature values (color and texture) are compared with the feature values of database images. The

images having the closest value compared to the query image are retrieved from the database.

F.Joshi "Analysis of existing CBIR systems: improvements and validation Using Color Features"[4] presented the contribution towards the process by using the visual contents available into the image itself. He proposed an efficient CBIR both for similar and sub-image searching.
The author calculated the performance of image retrieval system using two dimensions, Recall and Precision. The sorted image distance measure in ascending order between the query image and the database image feature vectors are used to calculate the precision and recall to measure the retrieval performance.

III. METHODOLOGY

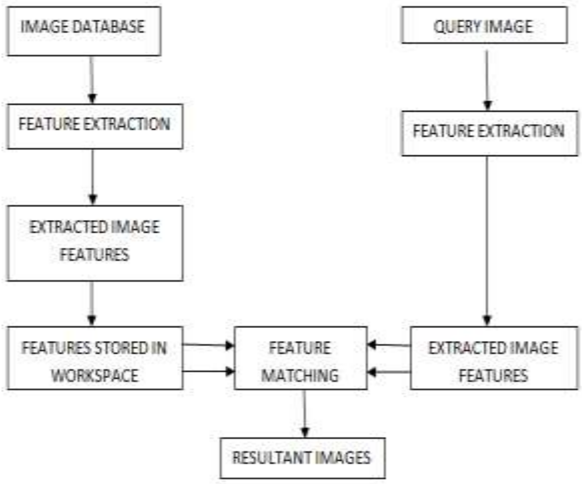
Any search engine, whether it is text-based or otherwise, is facing the problem of un-related matches. In case of text-based search engines, this problem arises due to the use of ambiguous keywords like bank, interest. Content-based image retrieval system allows a user to set query by taking an example image removing the ambiguity in setting up of queries.

Dominant Color of an image is used here as a visual image feature. It is the particular color level that has the highest frequency in the image.

The process of CBIR consists of the following stages:

1. Feature Extraction: The color and texture feature of the image from the large set of image database are extracted. The extracted features are stored in the workspace.
2. Feature Extraction of Query Image: This module calculates the features of the query image. A query image is an image in which the user is interested and wants to find similar images from database. The features extracted are then compared with features extracted for the database images.
3. Similarity Measure: It compares the feature database of existing images with the query image on the basis of Euclidean distance similarity measure.

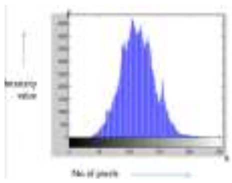
4. Retrieval and Result: This module will display the results in the form of images. The images having Euclidean distance lower than the query image will be displayed as the retrieved result.



Color Feature Extraction: Color focuses on the spectral content of an image. One of the very basic image feature to extract the color of an image is Color Histogram. For the representation of the image color information in CBIR, Color Histogram is used. The representation of color histogram is some kind of bar graph, in which each bar corresponds to some color of the color space which is being involved. To extract the color feature of an image, first the color image is converted into gray level image and then its histogram is generated.

a.Color image

b. Gray mage



c. Color Histogram

Texture Feature Extraction: Texture refers to the variation of the intensity in a neighborhood of pixels. The texture feature of an image is computed by using Gray level co-occurrence matrix (GLCM). For texture extraction, the color image is converted into 2-D gray image and then entropy measure is applied on it. Entropy is defined as the statistical measure of randomness that is used to characterize the texture of an image. The existing Shannon entropy and the Log Energy entropy have been used to calculate the texture of an image.

Shannon entropy is given by Claude E. Shannon and named it as Shannon entropy. This is a wavelet entropy. It is given by:

$S(p) = - \sum_i p_i^2 \log (p_i^2)$

Where p_i = pixel value at ith position

Log energy entropy also comes under wavelet entropy. It is given by:

$E(p) = \sum_i log(p_i^2)$

Where p_i = pixel value at ith position

Similarity Measure: The features of the query image extracted are matched with the extracted features of the image from the large image set database. The similarity measure which has been used here is the Euclidean distance as it gives the better results than any other similarity measures such as Jeffery Divergence, L1 norm, and χ^2 statistics. The similarity is measured in terms of closeness of color, texture and the dominant color distributions of an image.

Consider two images, one is the query image I_Q and other is the target image I_T to measure the distance. The dominant color of both the images are represented in the LAB color space and denoted by CQ (L_q, a_q, b_q) and CT(L_t, a_t, b_t) respectively. The other two entropy based features that is color entropy and texture entropy of query image and the target image are denoted by $ColorEnt_Q$, $ColorEnt_T$, $TextEnt_Q$, $TextEnt_T$ respectively. The first distance is measured between the two dominant colors (for query image and target image) and the lower value of this distance indicates the closeness of the images with the query image. The distance between the dominant colors is given by:

$$D_1 = \sqrt{(L_q - L_t)^2 + (a_q - a_t)^2 + (b_q - b_t)^2}$$

The other distance is measured between the entropy based features that are color and texture entropy of image. The amount of information contained in an image (color distribution and textural pattern) is indicated by entropy (which is a real number). The closeness of this distance indicates the image similarity in terms of content. It is given as:

$$D_2 = \sqrt{(ColorEnt_T - ColorEnt_Q)^2 + (TextEnt_T - TextEnt_Q)^2}$$

The distance between the two images I_Q and I_T is given as:

$$Dist(I_Q, I_T) = \alpha * D_1 + (1-\alpha) * 100 * D_2$$

where, $0 \le \alpha \le 1$

The range for α varies from 0 to 1. Higher the value of α, more importance to the dominant color rather than the information content in the retrieval of similar images.

Let ξ_{color} and $\xi_{texture}$ represent the entropy values of color entropy and texture entropy of query image respectively. The expressions are as follows:

$$\xi_{color} = \sqrt{1/n \sum_{i=1}^{n} (cEnt_i - qColorEnt)^2}$$

$$\xi_{texture} = \sqrt{1/n \sum_{i=1}^{n} (tEnt_i - qTextEnt)^2}$$

where $cEnt_i$ and $tEnt_i$ denotes the color and texture entropy of i^{th} image respectively and n is the size of the feature space.

An expression for ε is coined by:

$$\varepsilon = k * Max(\xi_{color}, \xi_{texture})$$

where k is any positive real integer.

The interim result set contains all those images which are having the distance less than or equal to ε from the query image. The objective of creating the interim result set size is to reduce the search space without affecting the correctness of result of the retrieval process.

The algorithm for interim result set[2]:

1. For (Each feature point in feature database)
2. {
3. Let cEnt = Color Entropy of a feature point and
4. tEnt = Texture Entropy of a feature point
5. if (Euclidean_distance ((qColorEnt, qTextureEnt), (cEnt, tEnt)) < ε)
6. {
7. Include image (cEnt, tEnt) into the interim result set
8. } // End of if ()
9. } // End of for()

If the Euclidean distance of the target image and the query image is less than the value of ε, then that image will be retrieved from the database and included in the interim result set.

IV. PROPOSED WORK

The design of enhanced entropy feature provides the better results than the existing Shannon entropy and the Log Energy entropy used in this paper. This entropy is most effective for textures with long range pixel interaction and strong correlation. The advantage of the enhanced entropy feature is its texture discriminating capability which is more than any other entropy. It is efficient for the textures with small variances which indicates that if the texture is similar, even though the enhanced entropy will provide good results.
The enhanced entropy is given by the formula:

$$H(p)=\sum_{i=1}^{n} p_i\, e^{-p_i^2}$$

where H(p) = enhanced entropy
p_i = pixel value at ith position

The enhanced entropy feature has been applied to the real data set as well as to database of 9908 images and the results are more accurate than the results of existing entropies used in this work.

V. EXPERIMENTAL RESULTS AND DISCUSSIONS

The random samples of different sizes are used to minimize the human subjectivity. Our retrieval system is using 9908 images. To provide numerical results, 4 samples are considered randomly. The accuracy of Shannon entropy and Log energy entropy are compared with the accuracy of enhanced entropy and the results of enhanced entropy came out to be better from these two.

Table 1: Shannon entropy for different query images

SHANNON ENTROPY			
Query Images	**K**	**Result Set Size**	**Reduction Factor (%)**
1	1	6318	36.2333
2	1	6110	38.2333
3	1	4592	53.6536
4	1	4917	50.3734

Table 2: Log Energy Entropy for different query images

LOG ENERGY ENTROPY			
Log Energy Entropy	**K**	**Result Set Size**	**Reduction Factor (%)**
1	1	4736	52.2002
2	1	3345	66.2394
3	1	4949	50.0505
4	1	4633	53.2398

Table 3: Enhanced Entropy for different query images

ENHANCED ENTROPY			
Enhanced Entropy	**K**	**Result Set Size**	**Reduction Factor(%)**
1	1	4713	52.4324
2	1	5181	47.7089
3	1	3525	64.4227
4	1	4011	52.7957

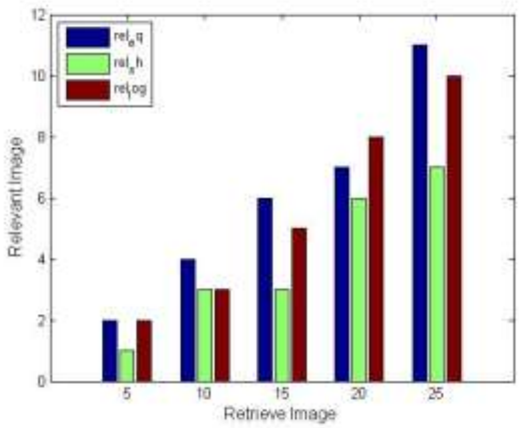


Figure: Bar graph of different entropies

VI. CONCLUSION

The two types of entropy based image features: color and texture entropy has been utilized in this work. Both of these features have been derived in such a manner that they rely on the color and texture distributions of an image. Consequently, the dominant color value is considered as the third image feature. For the dominant color, we have transformed the RGB color space to the LAB color space due to the property of perceptual uniformity of the latter one. For color feature extraction, color histograms are used and for extracting the texture feature, entropy measures are used. The best results are achieved from the enhanced entropy feature because it is best for long range pixel interaction and strong correlation. The Shannon entropy and the Log Energy entropy are not suitable for long range pixel interaction and they are not good for textures with small variances. If the texture is similar, these entropies will not work good. This drawback is overcome by using the enhanced entropy feature. The size of the database is reduced considerably. The results of Shannon entropy, Log energy entropy and enhanced entropy are evaluated and compared. On comparison, results are shown on bar graph depicting the better results in case of enhanced entropy. Exploring the enhanced entropy feature to achieve even more good results will be the next phase of this work.

REFERENCES

[1] Abebe Rorissa, "Image Retrieval Benchmarking Visual Information Indexing and Retrieval Systems. The information association for the information age", Bulletin, February/March 2007.

[2] Anirban Das, "Entropy-Based Indexing On Color And Texture In Image Retrieval". IEEE Defence Science Journal, vol. 61, No. 5, 2011, pp-415-430.

[3] Battiato, S., Gallo, G. & Nicotra, S. "Perceptive visual texture classification and retrieval". In the 12th International Conference on Image Analysis and Processing, 2003, Mantova,Italy,17-19 September 2003, pp. 524-29.

[4] Fuhar Joshi, "Analysis of existing CBIR Systems: improvements and validation using Color Features", IJETAE, volume 3, Issue 5, May 2013.

[5] L. Carlucci, " A formal system for texture languages". In Pattern Recognition, pages 53–72, 1972.

[6] Rong Zhao and William I. Grosky , "Bridging the Semantic Gap in Image Retrieval",Wayne State University, USA, Idea group publishing, 2002.

[7] Seba Susan, "A non-extensive entropy feature and its application to texture classification", Elsevier.

[8] Shannon, C.E., "A mathematical theory of communication". *Bell Syst. Tech. J.*, 1948, **27**, 379-423.

[9] Source : www.mathworks.com.

[10] Wasim Khan, "A proposed method for image retrieval using Histogram values and Texture Descriptor Analysis", IJSCE, ISSN:20231-2307,Vol-I issue-II, May 2011.