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Image Retrieval Using BTC with GLCM

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Abstract: ***The images are described by its content like color, texture, and shape information present in them. In this paper novel image retrieval methods discussed based on shape features extracted using Block Truncation Coding (BTC) using Gray Level Co-occurrence Matrix. The proposed image retrieval techniques are tested on generic image database images spread across different categories. In Block Truncation Coding (BTC) features are extracted using Gray Level Co-occurrence Matrix (GLCM). BTC can be used for grayscale as well as for color images. The average precision and recall of all queries are computed and considered for performance analysis.***

Keywords : CBIR, GLCM, BTC

I. INTRODUCTION

Information retrieval (IR) is the science of searching for documents, for information within documents, and for metadata about documents, as well as that of searching relational databases and the World Wide Web. There is overlap in the usage of the terms data retrieval, document retrieval, information retrieval, and text retrieval, but each also has its own body of literature, theory and technologies. IR is interdisciplinary, based on computer science, mathematics, cognitive psychology, linguistics, statistics, and physics. Automated information retrieval systems are used to reduce what has been called "information overload"[1,2]. Many universities and public libraries use IR systems to provide access to books and journals. Web search engines are the most visible IR applications. Images do have giant share in this information being stored and retrieved.

Content Based Image Retrieval (CBIR)

The images are very rich in the content like color, texture, and shape information present in them. Retrieving images based on color similarity is achieved by computing color histogram for each image that identifies the proportion of pixels within an image holding specific values (that humans express as colors).Color searches will usually involve comparing color histograms, though this is not the only technique in practice. Texture measures look for visual patterns in images and how they are spatially defined. The identification of specific textures in an image is achieved primarily by modeling texture as a two-dimensional gray level variation[3]. The relative brightness of pairs of pixels is computed such that degree of contrast, regularity, coarseness and directionality may be estimated. Shape does not refer to the shape of an image but to the shape of a particular region that is being sought out. Some other CBIR systems with their disadvantages are QBIC – Query by Image Content requires long indexing time [4].The problem associated with Virage are weights attached to each image. VisualSEEk considers spatial relationships between objects. Global features like mean color, color histogram can give many false positives. Disadvantage of MARS are weight updating, Modification of distance function. Disadvantage of Pic-Hunter is Probability associated with each image [5, 6].

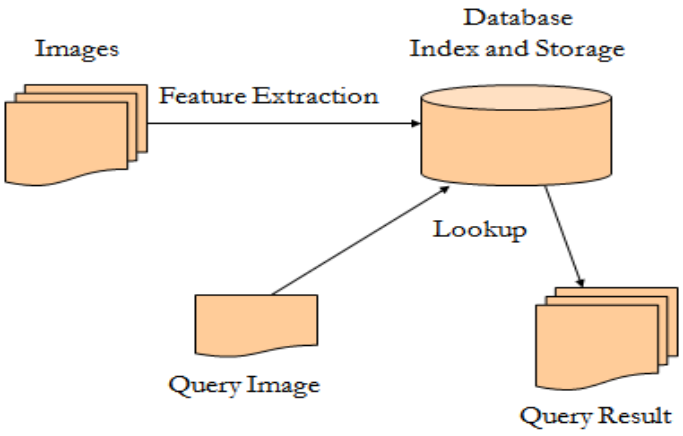

Figure1: Basic CBIR System

II. BLOCK TRUNCATION CODING (BTC)

Block truncation coding (BTC) is a relatively simple image coding technique. The method first computes the mean pixel value of the whole block and then each pixel in that block is compared to the block mean. If a pixel is greater than or equal to the block mean, the corresponding pixel position of the bitmap will have a value of 1 otherwise it will have a value of 0.Two mean pixel values one for the pixels greater than or equal to the block mean and the other for the pixels smaller than the block mean are also calculated. At decoding stage, the small blocks are decoded one at a time. For each block, the pixel positions where the corresponding bitmap has a value of 1 is replaced by one mean pixel value and those pixel positions where the corresponding bitmap has a value of 0 is replaced by another mean pixel value.[7,8].

Algorithm for BTC

•Step1: The given image is divided into non overlapping rectangular regions. For the sake of simplicity the blocks were let to be square regions of size m x m.

• Step 2: For a two level (1 bit) quantizer, the idea is to select two luminance values to represent each pixel in the block. These values are the mean *x* and standard deviation σ.

$$X' = \frac{1}{n}\sum_1^n xi$$

$$\sigma = \sqrt{\frac{1}{n}\sum_1^n (xi - x'i)^2}$$

Where xi represents the ith pixel value of the image block and n is the total number of pixels in that block.

• Step3: The two values *x* and σ are termed as quantizers of BTC. Taking *x* as the threshold value a two-level bit plane is obtained by comparing each pixel value xi with the threshold. A binary block, denoted by B, is also used to represent the pixels. We can use"1" to represent a pixel whose gray level is greater than or equal to *x* and "0" to represent a pixel whose gray level is less than

$$B = \begin{matrix} 1 & xi > x' \\ 0 & xi < x' \end{matrix}$$

By this process each block is reduced to a bit plane. For example, a block of 4 x 4 pixels will give a 32 bit compressed data, amounting to 2 bit per pixel (bpp).

• Step 4: In the decoder an image block is reconstructed by
replacing '1's in the bit plane with H and the '0's with L, which are given by:

$$H = x' + \sigma\sqrt{\frac{p}{q}}$$

$$L = x' - \sigma\sqrt{\frac{p}{q}}$$

Where p and q are the number of 0's and 1's in the compressed bit plane respectively.

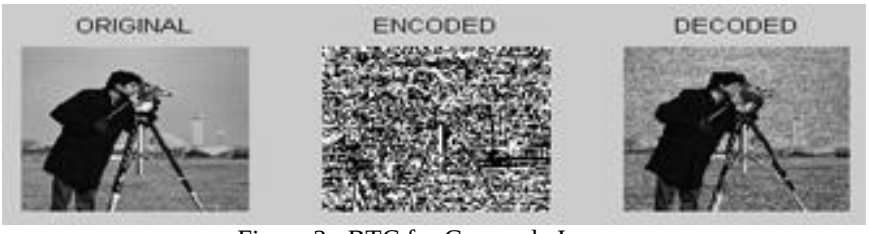

Figure 2 : BTC for Grayscale Image.

GLCM

A statistical method of examining texture that considers the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix. The GLCM functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix. To create a GLCM, use the graycomatrix function. The graycomatrix function creates a gray-level co-occurrence matrix (GLCM) by calculating how often a pixel with the intensity (gray-level) value ***i*** occurs in a specific spatial relationship to a pixel with the value ***j*.**

III. PROPOSED CBIR TECHNIQUES

The paper proposes image retrieval techniques using BTC. The performance of proposed image retrieval methods is compared with precision and recall parameters.

BTC using GLCM

We use BTC technique with matrices of 2x2,4x4,8x8 the feature are extracted using GLCM from decoded image. The extracted feature is applied for finding the similarity with database images.

IV. IMPLEMENTATION

The discussed image retrieval methods are implemented using MATLAB 2008b on Intel Core i3-380M processor with 2 GB of RAM. To check the performance of proposed technique a database of 1000 variable sized images spread across different categories has been used.

Figure 3: Sample Images from Generic Image Database

Figure 3 shows sample image of generic image database. The queries each category are fired on the image database.

To assess the retrieval effectiveness, we have used the precision and recall as statistical comparison parameters for our proposed technique of CBIR. The standard definitions of these two measures are given by following equations.

$$\text{Precision} = \frac{\text{Number of relevant images retrieved}}{\text{Total number of images retrieved}} \qquad \text{Recall} = \frac{\text{Number of relevant images retrieved}}{\text{Total number of relevant image in database}}$$

Table 1: Performance analysis of discussed CBIR technique

Parameter	PRECISION	RECALL
BTC 2X2	0.4	0.2857
BTC 4X4	0.6	0.3764
BTC 8X8	1	0.7142

The values of crossover points of precision and recall for all proposed image retrieval methods are given in above table. Among all BTC technique BTC 8X8 gives maximum result compare to other BTC as shown in figure 5 and figure 6.

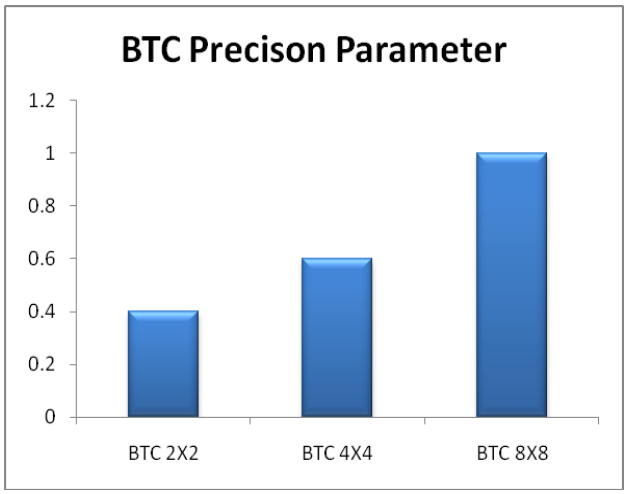

Figure 5: Performance for Precision Parameter.

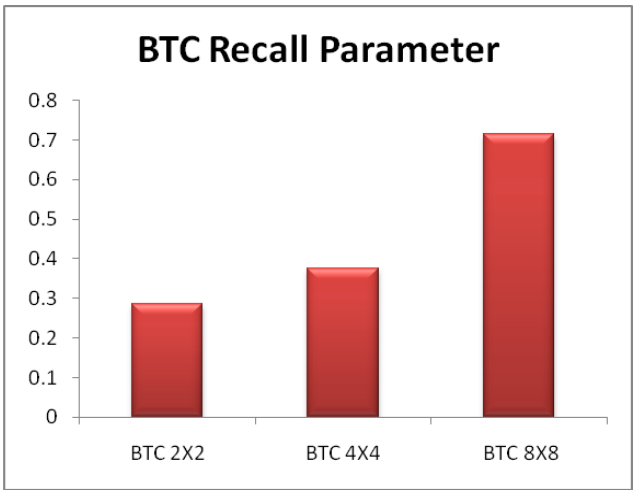

Figure 6: Performance for Recall Parameter.

V. CONCLUSION

Image Retrieval is gaining momentum among researchers working in image processing and computer vision areas because of the wide number of applications. We use BTC technique with matrices of 2x2,4x4,8x8 among them BTC 8X8 gives good results compare to other the feature are extracted using GLCM from decoded image. The extracted features are applied for finding the similarity with database images.

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