An Effective CBIR using Texture

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ABSTRACT
Content Based Image Retrieval is one of the active research areas. With emerging technologies of multimedia ,communication and processing large volume of image database is used . Current approaches include the use of color, texture and shape information for CBIR. Texture feature is a kind of visual characteristic that does not rely on color and intensity and reflects the intrinsic phenomenon of images. It is total of all intrinsic surface properties. This enforces use of texture widely for image retrieval. Texture may consists of some basic primitives and may also describe the structural arrangement of a region and the relationship of the surrounding regions. Our approach uses the statistical feature using Gray Level Co-occurrence Matrix. For the texture based image retrieval Gray Level Co-occurrence Matrix can be used. A one to one matching scheme is used to compare the query and target image. Experimental results demonstrate that the propose method is very efficient and superior to some other existing method.

General Terms
Computer Vision, Image Processing, Pattern Recognition, .

Keywords
GLCM ,Homogeneity,Energy.

1. INTRODUCTION
With the rapid increase in computer speed and decrease in memory cost, image databases containing thousands or even millions of images are used in many application areas such as medicine, satellite imaging, and biometric databases, where it is important to maintain a high degree of precision. With the growth in the number of images, manual annotation becomes infeasible both time and cost-wise. Image retrieval systems attempt to search through a database to find images that are perceptually similar to a query image. CBIR is an important alternative and complement to traditional text-based image searching and can greatly enhance the accuracy of the information being returned. It aims to develop an efficient visual-Content-based technique to search, browse and retrieve relevant images from large-scale digital image collections.

Most proposed CBIR techniques automatically extract low-level features (e.g. color, texture, shapes and layout of objects) to measure the similarities among images by comparing the feature differences. Because low level visual features of the images such as color and texture are especially useful to represent and to compare images automatically. In the concrete selection of texture description, we use Gray-level cooccurrence matrix.

Texture is also an important visual feature that refers to innate surface properties of an object and their relationship to the surrounding environment. Many objects in an image can be distinguished solely by their textures without any other information. There is no universal definition of texture. Texture may consist of some basic primitives, and may also describe the structural arrangement of a region and the relationship of the surrounding regions [3]. In our approach we have used the statistic texture features using gray-level cooccurrence matrix (GLCM).So a technique is developed which captures color and texture features of sub-blocks of the image. For each subblock cumulative histogram and static texture features using GLCM are determined. A one to one integrated matching procedure is used to find the image similarity. Content-Based Image Retrieval (CBIR) is a powerful tool since it searches the image database by utilizing visual cues alone. In Content-Based image Retrieval Systems, low level features vectors ,which may include texture ,color and shape , are extracted from image for storage ,manipulation and retrieval purpose. The system during retrieval uses a query in the form of feature vector and the result is calculated based on the similarity of feature vectors.

CBIR systems extract features from the raw images themselves and calculate an association measure between the query image and database images based on these features. The feature extraction and selection techniques adopted in content based image retrieval (CBIR), is a technique that uses the visual content of a still image to search for similar images in large scale image databases, according to a user's interest. All the solutions, in general, perform the retrieval process in two steps. The first step is the feature extraction step, which identifies unique signatures, termed as feature vector, for every image based on its pixel values. The feature has the characteristics that describe the contents of an image. Visual features such as color, texture and shape are used more commonly used in this step. The classification step matches the features extracted from a query image with the features of the database images and group's images according to their similarity. Of these two steps the extraction of features is considered to be important because the features selected for discrimination affects the effectiveness of classification [2].

In our experiment we used SIMPLIcity image database with 1000 images ,divided into 10 categories ,each category containing 100 images including landscapes ,horses , elephants , flowers ,buses .The results reflect that content based image retrieval using texture outperforms with respect to retrieval accuracy and recall rate as compared with classical color feature specially for images that are not colorful but have an even texture.

The rest of the paper is organized as follows: Section 2 details the structure of the proposed CBIR and feature extraction techniques. Section 3 presents the Image retrieval mode using GLCM used for texture feature. Section 4 presents the Similarity Measure Section 5 gives the retrieval system. Section 6 experimental results and finally Section 7 concludes this paper.

2. RELATED WORK

There are some common methods for extracting content from images so that they can be easily compared. The methods outlined are not specific to any particular application domain.

2.1 Color Retrieval

Color is the most extensively used visual content for image retrieval. Its three dimensional values make its discrimination potentiality superior to the single dimensional gray values of images. Before selecting an appropriate color description, color space must be determined first. Retrieving images based on color similarity is achieved by computing a color histogram for each image that identifies the proportion of pixels within an image holding specific values. The first order (mean), the second order (variance) and the third order (skewness) color moments have been proved to be efficient and effective in representing color distributions of images.[1]

A different way of incorporating spatial information into the color histogram, color coherence vectors (CCV), was proposed. Color histograms are popular because they are trivial to compute, and tend to be robust against small changes in camera viewpoint. Another method called color correlogram expresses how the spatial correlation of pairs of colors changes with distance. [1]

2.3 Texture Retrieval

Texture is a widely used and intuitively obvious but has no precise definition due to its wide variability. Visual texture in most cases is defined as a repetitive arrangement of some basic pattern. Identifying a patch in an image as having uniform texture or discriminating different visual textures obeys the law of similarity. In this case, the texture property is used to produce similarity groupings.

Basically, texture representation methods can be classified into two categories: structural and statistical. Structural methods, including morphological operator and adjacency graph, describe texture by identifying structural primitives and their placement rules. They tend to be most effective when applied to textures that are very regular. Statistical methods, including Fourier power spectra, co-occurrence matrices, shift-invariant principal component analysis (SPCA), Tamura feature, World decomposition, Markov random field, fractal model, and multi-resolution filtering techniques such as Gabor and wavelet transform, characterize texture by the statistical distribution of the image intensity.

2.4 Shape Retrieval

Shape may be defined as the characteristic surface configuration of an object; an outline or contour. It permits an object to be distinguished from its surroundings by its outline Shape representations can be generally divided into two categories: Boundary-based, and Region-based.

Boundary-based shape representation only uses the outer boundary of the shape. This is done by describing the considered region using its external characteristics; i.e., the pixels along the object boundary. Region-based shape representation uses the entire shape region by describing the considered region using its internal characteristics; i.e., the pixels contained in that region

3. PROPOSED METHOD

The proposed method strives for a light weight computation with effective feature extraction. This method is based on texture features of image sub-blocks with matching based on most similar highest priority principle. First the image is partitioned into equal sized non-overlapping sub-blocks The texture feature of each sub-block as statistic feature of GLCM

3.1 Extraction of Texture of an Image

Most natural surfaces exhibit texture, which is an important low level visual feature. Texture recognition will therefore be a natural part of many computer vision systems. In this paper, we propose a texture representation method for image retrieval based on GLCM. Gray level co-occurrence method use grey-level co-occurrence matrix to sample statistically the way certain grey-levels occur in relation to other grey-levels. GLCM expresses the texture feature according to the correlation of the couple pixels gray-level value at different positions. Gray-level matrix is a matrix whose elements measure the relative frequencies of occurrence of grey level combinations among pairs of pixels with a specified spatial relationship. The gray level co-occurrence matrix C(i j) is defined by first specifying a displacement vector $d_{x,y}$ = (6x, 6y) and then counting all pairs of pixels separated by displacement d_{xy} and having gray levels i and j. The matrix C(i,j) is normalized by dividing each element in the matrix by the total number of pixel pairs. At first the co-occurrence matrix is constructed, based on the orientation and distance between image pixels. Then meaningful statistics can be extracted from the matrix as the texture representation. The texture features such as entropy, energy, contrast, and homogeneity, can be extracted from the co-occurrence matrix of gray levels of an image. The energy of a texture describes the uniformity of a texture. In a homogeneous image there are very few dominant grey-tone transitions, hence the co-occurrence matrix of this image will have fewer entries of large magnitude. So the energy of an image is high when the image is homogeneous. The second descriptor, entropy, measures the randomness of the elements of the matrix, when all elements of the matrix are maximally random entropy has its highest value. So, a homogeneous image has lower entropy than an inhomogeneous image. In fact, when energy gets higher, entropy should get lower. Third, the correlation feature measures the correlation between the elements of the matrix. When correlation is high the image will be more complex than when correlation is low. The fourth feature, the inverse difference moment, has a relatively high value when the high values of the matrix are near the main diagonal. [2,5,6]

$$Homogeneity = \sum_i \sum_j \frac{C(i,j)}{1+|i-j|} \qquad (1)$$

$$Entropy = -\sum_i \sum_j C(i,j) \log C(i,j)$$

(2)

$$Contrast = \sum_i \sum_j (i-j)^2 C(i,j)$$

(3)

$$Energy = \sum_i \sum_j C^2(i,j)$$

(4)

4. Methodology

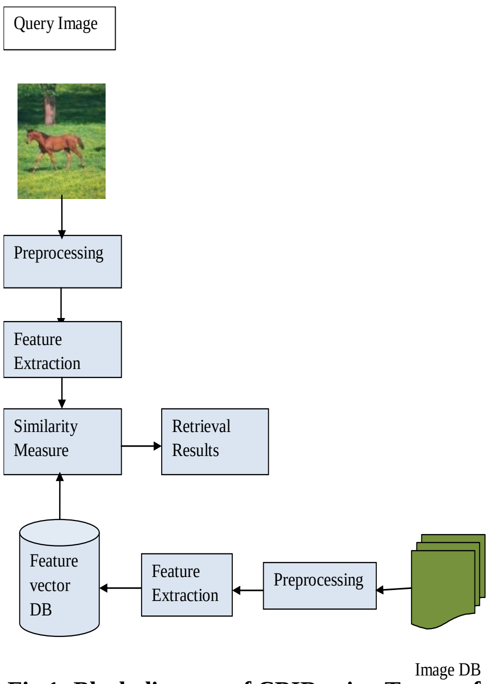

Fig 1: Block diagram of CBIR using Texture feature of an Image for extraction

4.1 Feature extraction

Feature extraction involves extracting the meaningful information from the images. So that it reduces the storage required and hence the system becomes faster and effective in CBIR. Once the features are extracted, they are stored in the database for future use. The degree to which a computer can extract meaningful information from the image is the most powerful key to the advancement of intelligent image interpreting systems. One of the biggest advantages of feature extraction is that, it significantly reduces the information to represent an image for understanding the content of that image. There has been tremendous work on different approaches to the detection of various kinds of features in images. The only low-level feature used for content description is texture. The issue of choosing the features to be extracted should be guided by the following concerns: the features should carry enough information about the image and should not require any domain-specific knowledge for their extraction. Also, they should be easy to compute in order for the approach to be feasible for a large image collection and rapid retrieval.

4.2 Feature Vector Database

The Images and its specified moment values like Homogeneity, Energy, Contrast can stored in a database file. We have saved the Homogeneity and Energy. This .mat file is a trained database file in which we store images and its specified values. First the database files are loaded for further processing.

4.3 Similarity Measure

During searching time, the user can either specify the desired proportion of each color it depends on the system to give that option or not(design and options), or submit an example image from which a color histogram is calculated. Matching process then retrieves those images whose homogeneity match those of the query most closely as described above in percentages.

4.4 Retrieved Results

The intermediate retrieval results are stored in a database file that can be in retrieved .The retrieved images will give a final relevant retrieval image set.

5. EXPERIMENTAL SETUP

5.1 Database

Almost 1000 images have been used for populating the database. The images are from SIMPLIcity database .In the SIMPLIcity database, these 1000 images are included in ten different categories(Table1).The SIMPLIcity database is a subset of the COREL database, formed by 10 image categories, each containing 100 pictures. As the focus of information from the content of an image for most research is on image database it is categorized into different categories as “People”, “Beaches”, “Landscape and buildings ”,“Buses”, “Dinosaurs” , “Horses” ,”Elephants”, “Flowers” ,”Scenery”, “Food” [4].The images in Database are all in RGB color space.

Table 1. Classes in SIMPLIcity database

Id	Category
1	People
2	Beaches
3	Landscape and buildings
4	Buses
5	Dinosaurs
6	Horses
7	Elephants
8	Flowers
9	Scenery
10	Food

For a horse image from the Image database these values can be computed

Homogeneity: 0.7954

Contrast: 0.4968

Energy: 0.1218

6. Result and analysis

We analyze the results by :Visual and Qualitative analysis. The visual retrieval is performed by visualizing the results displayed. The quantitative evaluation is performed based on precision and recall.

System Evaluation

To evaluate the performance of this image retrieval algorithm two traditional parameters are defined as follows:

Precision: Precision is the fraction of the relevant images which has been retrieved from all retrieved

Precision= Relevant retrieved images/All Retrieved images

Recall: Recall is the fraction of the relevant images which has been retrieved from all relevant images in the database.

Recall=Relevant retrieved images/All Relevant images in database

For a quantitative evaluation, the performance can be compared using average precision .A high precision value means that there are few false alarms. A retrieved image is considered a correct match if it is in the same category as the query image.

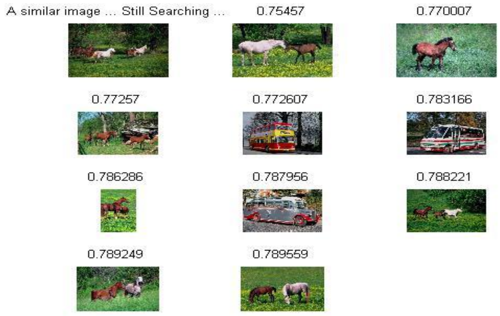

Fig 2: CBIR using texture Homogeneity

Fig 3: CBIR using texture energy

7. Conclusion

CBIR is an active research topic in image processing, pattern recognition and computer vision. In this paper a CBIR method has been proposed based on texture as a feature for extraction using GLCM. The experimental results showed that the proposed method yields higher precision and recall with reduced vector dimension. As further studies , the proposed method is to be evaluated for more various databases.

8. REFERENCES

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