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Feature Extraction Approach for Content Based Image Retrieval

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***Abstract* — Recently people are interested in using digital images. Hence developing an efficient technique for finding the images has become a great need. Content Based Image Retrieval (CBIR) is a significant and increasingly popular approach that helps in the retrieval of image data from a huge collection. Image representation based on certain features helps in retrieval process. Three important visual features of an image include Color, Texture and Shape. In this paper, we propose an efficient image retrieval technique which uses dynamic dominant color, texture and shape features of an image. Using that technique, as a first step an image can be uniformly divided into coarse partitions. The centroid of each partition will be selected as its dominant color after the above coarse partition. A texture representation for image retrieval based on GLCM (Gray Level Co-occurrence Matrix) can be used. Although a precise definition of texture is untraceable, the notion of texture generally refers to the presence of a spatial pattern that has some properties of homogeneity. In particular, the homogeneity cannot result from the presence of only a single color in the regions, but requires interaction of various colors. There is no universal definition of what shape is either. Impressions of shape can be conveyed by color or intensity patterns, or texture, from which a geometrical representation can be derived. We will consider shape as something geometrical. Therefore, we can consider edge orientation over all pixels as texture, but edge orientation at only region contours as shape information.**

***Keywords* — Content Based Image Retrieval, Gray Level Co-occurrence Matrix, Advanced Multimedia Oriented Retrieval Engine, Berkeley Digital Library Project, Comparison Algorithm for Navigating Digital Image Databases, Flexible Image Database System.**

I. INTRODUCTION

As the propagation of video and image data in digital form has increased, Content Based Image Retrieval (CBIR) has become a prominent research topic. Therefore an important problem that needs to be addressed is fast retrieval of images from large databases. To find images that are perceptually similar to a query image, image retrieval systems attempt to search through a database. CBIR can greatly enhance the accuracy of the information being returned and is an important alternative and complement to traditional text-based image searching. For describing image content, color, texture and shape features have been used. Color is one of the most extensively used low-level visual features and is invariant to image size and orientation [1]. There are color histogram, color correlogram as conventional color features used in CBIR. Without any other information, many objects in an image can be distinguished solely by their textures. Texture may describe the structural arrangement of a region and the relationship of the surrounding regions and may also consist of some basic primitives. Shape feature has been extensively used for retrieval systems. We will implement CBIR system that is based on dominant color and texture and shape.

CBIR is enviable because a large amount of network based image search engines depend solely on metadata and this produces a bunch of junk in the results. In addition, having humans manually enter keywords for images in a large database can be incompetent, expensive and may not confine each keyword that describes the image. Thus a system that can sort out images based on their content would provide better indexing and return more precise results.

A color space is defined as a model, for representing color in terms of intensity values. One of the dimensions for that is color component or a color channel. In an additive fashion to be able to reproduce other colors, the RGB model uses three primary colors, red, green and blue. This model has the advantage of being easy to extract as this is the basis of most computer displays today. Each pixel will have a red, green and blue value ranging from 0 to 255 in a true-color image.

Texture is a major constituent of human illustration perception. This makes it an essential feature to consider like color, when querying image databases.

Everyone can recognize texture, but it is more difficult to define. Texture occurs over a region rather than at a point, unlike color. It is orthogonal to color and is normally perceived by intensity levels. Texture can be described in terms of direction, coarseness, contrast and so on [4]. It has traits such as periodicity and range. It is this that makes texture a particularly interesting aspect of images and results in a surplus of customs of extracting texture features [8].

These features, which describe a spatial collection of texture components, assist to distinguish the preferred texture types, e.g. fine or coarse, close or loose, plain or twilled or ribbed textile fabrics. It is complicated to use human differentiations as a basis for formal definitions of image textures, because there is no evident ways of associating these features, easily supposed by human vision, with computational models that have the aim to depict the textures.

Since humans can distinguish objects exclusively from their shapes, object shape features can also make available powerful information for image retrieval [2]. Generally, the shape carries semantic information and shape features are different from other elementary visual features, such as color or texture features.

In core, shape features can be categorized as boundary-based and region-based. The earlier extracts features based on the outer boundary of the region while the final extracts features based on the entire region. Shape matching is a well-explored research area with many shape representation and similarity measurement techniques found in the literature.

For retrieval systems, shape feature has been extensively used. Shape is the most obvious requirement at the primitive level. Shape is a precise concept and there is significant indication that natural objects are chiefly acknowledged by their shape [3]. We will propose CBIR system that is based on color, texture and shape.

The remainder of this paper is organized as follows. Section II presents problem analysis and objectives for implementing CBIR. Section III outlines the related work. In Section IV, we have described the proposed work for CBIR. Section V presents our implications.

II. PROBLEM ANALYSIS AND OBJECTIVES FOR IMPLEMENTING CBIR

Content Based Image Retrieval (CBIR) has become a major research area. To search for and browse through video and image databases located at remote sites, increased bandwidth availability will allow the users to access the internet in the near future. Therefore an important problem that needs to be addressed is fast retrieval of images from large databases. Image retrieval systems attempt to search through a database to find images that are perceptually similar to a query image. CBIR can greatly enhance the accuracy of the information being returned and is an important alternative and complement to traditional text-based image searching. It aims to develop an efficient visual content-based technique to search, browse and retrieve relevant images from large-scale digital image collections [5]. Color, texture and shape features have been used for describing image content.

Research and development issues in CBIR cover a range of topics, many shared with mainstream image processing and information retrieval. Some of the objective can be:

Extracting color, texture and shape features from images, providing compact storage for large image databases, matching query and stored images in a way that reflects human similarity judgments.

Tool used: MATLAB, Data Source: Bunch of Images

III. RELATED WORK

In [10], a number of Content Based Image Retrieval systems are described in alphabetical order, which are mentioned below. If no querying, indexing data structure, matching, features or result presentation is mentioned, then it is not relevant to the system (e.g. there is no relevance feedback), or no such information is known to us (e.g. often no information is specified about indexing data structures).

A. AMORE (Advanced Multimedia Oriented Retrieval Engine)

Developer: C & C Research Laboratories NEC USA, Inc.

Matching: Initially an association among regions in the query and target image is found. Regions associated to the same regions in the other image are fused. The shape resemblance among two regions is based on the number of pixels of overlap, a type of pattern matching. The distance in HLS space between the uniform region colors act as the color similarity between two regions.

Result presentation: Without an explicit order, the retrieved images are revealed like thumbnails. Result images were displayed as a scatter plot, with shape and color similarity values at the axes, or on a perspective wall in a research version of the system.

B. BDLP (Berkeley Digital Library Project)

Developer: University of California, Berkeley.

Matching: **T**ext strings are used as storage medium for image features. For instance, a representation of a sky with clouds might have little large white regions, and a large amount of blue, and would have a feature text string "mostly blue large white few". Matching is done by substring matching, e.g. with query string "large white%".

Result presentation: The retrieved photos are presented unordered, with id-number, photographer, and collection keys.

C. CANDID (Comparison Algorithm for Navigating Digital Image Databases)

Developer: Computer Research and Applications Group, Los Alamos National Laboratory, USA.

Matching: On the normalized Euclidean distance or the inner product of two signatures, the distinction among two image signatures is based.

Result presentation: Each related Gaussian division makes some involvement to the distinction measure and each pixel is assigned to one cluster. Each pixel is tinted depending on the contribution made to the resemblance measure so as to illustrate which parts of the images contribute to the match.

D. Diogenes

Developer: Department of EECS, University of Illinois at Chicago.
Matching: String matched with names in the system index built off-line by a web crawler is the query name. A number of distance values were yielded as an image taken from the web is compared to the training images. To situate person names and to decide their degree of involvement with the face image, the text of the web page is analyzed. To a classifier, the distance values and degrees of association are key in, which combines them with a Dempster-Shafer theory of evidence, a generalization of Bayesian theory of subjective probability.
Result presentation: Without any explicit order, the images in the database associated with the query name are shown.

E. FIDS (Flexible Image Database System)

Developer: Department of Computer Science and Engineering, University of Washington, Seattle, WA, USA.
Matching: The L_1 distance are the distances between the histograms. Some weighted difference is the distance between wavelet coefficients. By taking the weighted sum, maximum, or minimum of the individual feature distances, which conserve metric properties, an overall distance can be composed.
Result presentation: No accurate distances among query and images require to be considered as the images can be ordered on their lower bound. On the other hand, the user can select of how many of those the true distance must be calculated.

F. Picasso

Developer: Visual Information Processing Lab, University of Florence, Italy.
Matching: After a fast selection of the database images that contain all the colors of the query, the pyramidal structure of each candidate image is analyzed from top to bottom to find the best matching region for each query region in a query by color regions. By a weighted sum of distances between the computed region attributes (color, region centroid's position, area and shape), the matching score between a query region and a candidate image region is given. By summing all the scores of the matched query regions, the similarity score between the query image and a candidate image is obtained. First images are filtered according to the spatial relationships and positions of the delimited MERs, based on the 2D string representation in a shape based query. To the images that have passed this filtering step, 1D elastic matching is applied. The systems warps each contour over the candidate image's shape located in the same relative position as the query contour, if the sketch contains k contours. Both the match between the deformed contour and the edge image and the amount of elastic energy used to warp the query contour is taken into account by the similarity score between the deformed contour and the image object. In minimizing E – M, a gradient descent technique is used.
Result presentation: In decreasing similarity order, the query results are presented to user.

IV. PROPOSED WORK

To describe image from the different aspects for more detailed information in order to obtain better search results and to express more image information, we consider the dominant color, texture and shape features combined. The proposed method is based on dominant color, texture and shape features of image.

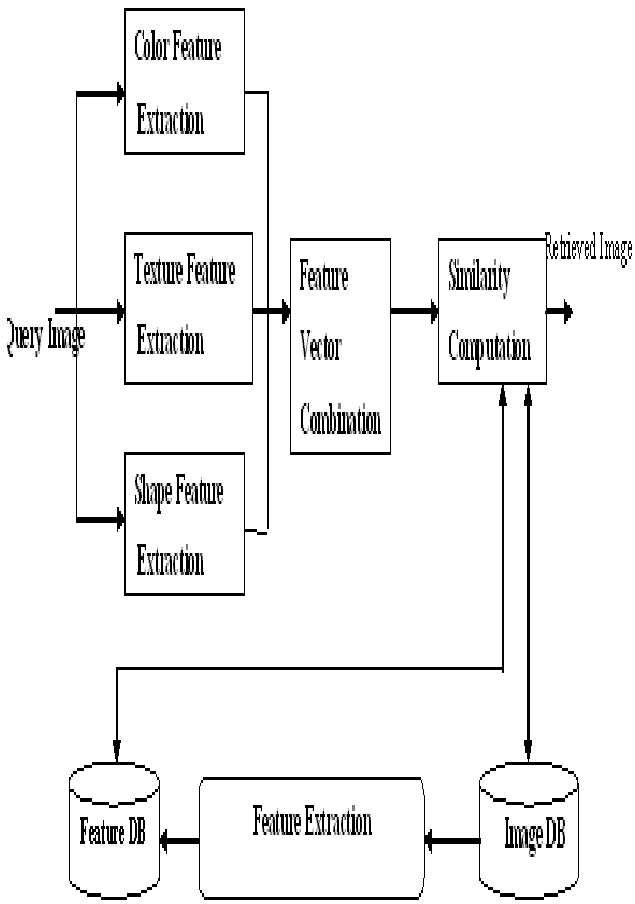

Fig.1 System Architecture

A. Extraction of dominant color of an image

Dominant color region in an image can be represented as a connected fragment of homogeneous

color pixels which is perceived by human vision. Image Indexing can be based on this concept of dominant color regions present in the image. The segmented out dominant regions along with their features can be used as an aid in the retrieval of similar images from the image database.
The procedure to extract dominant color of an image is as follows:

The RGB color space can be uniformly divided into 8 coarse partitions as shown in Fig.2. If there will be several colors located on the same partitioned block, they can be assumed to be similar. In [6], after the above coarse partition, the centroid of each partition can be selected as its quantized color.

B. Extraction of texture of an image

The notion of texture generally refers to the presence of a spatial pattern that has some properties of homogeneity [7]. A texture representation for image retrieval can be obtained using this notion. The ability to match on texture similarity can often be useful in distinguishing between areas of images with similar color (such as sky and sea, or leaves and grass).

A variety of techniques can be used for measuring texture similarity. The best established can be rely on comparing values of what are known as Second-order statistics calculated from query and stored images. Essentially, these can calculate the relative brightness of selected pairs of pixels from each image. From these, we can calculate measures of image texture. Alternative methods of texture analysis for retrieval can include the use of Gabor filters [9]. Texture queries/specifying can be formulated in a similar manner to color queries, by selecting examples of desired textures from a palette, or by supplying an example query image. The system then retrieves images with texture measures similar in value.

C. Extraction of shape of an image

We will consider shape as something geometrical. Impressions of shape can be conveyed by color or intensity patterns, or texture, from which a geometrical representation can be derived. Therefore, edge orientation at only region contours as shape information. Shape is the most obvious requirement at the primitive level. Unlike texture, shape is a fairly well-defined concept and there is considerable evidence that natural objects are primarily recognized by their shape.

A number of features characteristic of object shape can be computed for every object identified within each stored image. Queries can then be answered by computing the same set of features for the query image, and retrieving those stored images whose features most closely match those of the query.

V. CONCLUSION

In this paper, we will consider database comprising of various images and the feature set consisting of color, texture and shape descriptors computed for an image. We will implement a CBIR system which uses the combination of dominant color, texture and shape. Color is usually represented by the color histogram, color correlogram, color coherence vector, and color moment under a certain color space. Texture can be represented by Tamura feature, Wold decomposition, SAR (Simultaneous Auto Regressive) model, Gabor and Wavelet transformation. Shape can be represented by Moment invariants, Turning angles, Fourier descriptors, Circularity, Eccentricity, and Major axis orientation and Radon transform. An image will be uniformly divided into coarse partitions. The centroid of each partition will be selected as its dominant color. Texture of an image will be obtained by using the presence of a spatial pattern that has some properties of homogeneity. Impressions of shape can be conveyed by color or intensity patterns, or texture, from which a geometrical representation can be derived. The combination of the color and texture features of an image in conjunction with the shape features will provide a robust feature set for image retrieval. The similarity between query and target image will be measured from two types of characteristic features which includes dominant color and texture features.

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