A Novel Approach of an effective image retrieval scheme using color, texture and shape features

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***Abstract*--** In this paper, we present a new and effective color image retrieval scheme for combining all the three i.e. color, texture and shape information, which achieved higher retrieval efficiency. Firstly, the image is predetermined by using fast color quantization algorithm with clusters merging, and then a small number of dominant colors and their percentages can be obtained. Secondly, the spatial texture features are extracted using a steerable filter decomposition, which offers an efficient and flexible approximation of early processing in the human visual system. Thirdly, the pseudo-Zernike moments of an image are used for shape descriptor, which have better features representation capabilities and are more robust to noise than other moment representations. Finally, the combination of the color, texture and shape features provide a robust feature set for image retrieval. Experimental results show that the proposed color image retrieval is more accurate and efficient in retrieving the user-interested images.

***Keywords*--** Image retrieval, Dynamic dominant color, Steerable filter, Pseudo-Zernike moments

I. Introduction

Nowadays, with increased digital images available on Internet, efficient indexing and searching becomes essential for large image archives. Traditional annotation heavily relies on manual labor to label images with keywords, which unfortunately can hardly describe the diversity and ambiguity of image contents. Hence, content-based image retrieval (CBIR) has drawn substantial research attention in the last decade. CBIR usually indexes images by low-level visual features such as color, texture and shape. The visual features cannot completely characterize semantic content, but they are easier to integrate into mathematical formulations. Extraction of good visual features which compactly represent a query image is one of the important tasks in CBIR.

Color is one of the most widely used low-level visual features and is invariant to image size and orientation. As conventional color features used in CBIR, there are color histogram, color correlogram, and dominant color descriptor (DCD). Color histogram is the most commonly used color representation, but it does not include any spatial information. presented a novel algorithm based on running sub blocks with different similarity weights for object-based image retrieval. By splitting the entire image into certain sub blocks, the color region information and similarity matrix analysis are used to retrieve images under the query of special object. Color correlogram describes the probability of finding color pairs at a fixed pixel distance and provides spatial information. Therefore color correlogram yields better retrieval accuracy in comparison to color histogram. Color auto correlogram is a subset of color correlogram, which captures the spatial correlation between identical colors only. Since it provides significant computational benefits over color correlogram, it is more suitable for image retrieval. DCD is MPEG-7 color descriptors. DCD describes the salient color distributions in an image or a region of interest, and provides an effective, compact, and intuitive representation of colors presented in an image. However, DCD similarity matching does not fit human perception very well, and it will cause incorrect ranks for images with similar color distribution, Yang presented a color quantization method for dominant color extraction, called the linear block algorithm (LBA), and it has been shown that LBA is efficient in color quantization and computation. For the purpose of effectively retrieving more similar images from the digital image databases (DBs) uses the color distributions, the mean value and the standard deviation, to represent the global characteristics of the image, and the image bitmap is used to represent the local characteristics of the image for increasing the accuracy of the retrieval system.

Texture is also an important visual feature that refers to innate surface properties of a n object and their relationship to the surrounding environment. M any object s i n 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.

In conventional texture features used for CBIR, there are statistic texture features using gray level co-occurrence matrix (GLCM), Markov random field (MRF) model, simultaneous auto-regressive (SAR) model, Wold decomposition model, edge histogram descriptor (EHD), and wavelet moments. Recently, BDIP (block difference of inverse probabilities and BVLC (block variation of local correlation coefficients) features have been proposed which effectively measure local brightness variations and local texture smoothness, respectively. These features are shown to yield better retrieval accuracy over the compared conventional features. In texture be modeled by the fusion of marginal densities of sub band image DCT coefficients. Following this approach, one can extract samples from the texture distribution by utilizings mall neighbourhood s o f scale- to -scale coefficients. Components of the multivariate texture-distributional vectors are formed using the spatially localized coefficients, at different image decomposition levels. Kokare designed a new set of 2D rotated wavelet by using Daubechies' eight tap coefficients to improve the image retrieval accuracy. The 2D rotated wavelet filters that are non-separable and oriented, improves characterization of diagonally oriented textures. Hang proposed a rotation-invariant and a scale-invariant Gabor representations, where each representation only requires few summations on the conventional Gabor filter impulse responses, and the texture features are then extracted from these new representations for conducting rotation-invariant or scale-invariant texture image retrieval. Object shape features can also provide powerful information for image retrieval, because humans can recognize objects solely from their shapes. Usually, the shape carries semantic information, and shape features are different from other elementary visual features, such as color or texture features. Basically, shape features can be categorized as boundary-based and region-based. The former extracts features based on the outer boundary of the region while the latter 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. Shape representation methods include Fourier descriptors, polygonal approximation, invariant moments, B-splines, deformable templates, and curvature scale space (CSS). Most of these techniques were developed for whole shape matching i.e.., closed planar curve matching. The CSS shape representation method has been selected for moving picture experts group (MPEG)-7 standardization .

However, based on the curvature zero-crossing, the CSS method is more suitable for shapes with distinct curvature variations, such as leaf shapes than for smooth shapes with subtle curvature variations. Fourier descriptor has proven to be more efficient and robust than is the CSS in a review of shape representation and description techniques. But, as mentioned in Fourier descriptor was not suitable for partial shape matching presented an innovative partial shape matching (PSM) technique using dynamic programming (DP) for the retrieval of spine X-ray images. ,Wei proposed a novel content-based trademark retrieval system with a feasible set of feature descriptors, which is capable of depicting global shapes and interior/local features of the trademarks.

Most of the early studies on CBIR have used only a single feature among various color, texture, and shape features. However, it is hard to attain satisfactory retrieval results by using a single feature because, in general, an image contains various visual characteristics. Recently, active researches in image retrieval using a combination of visual features have been performed two-dimensional or one-dimensional histograms of the CIE Lab chromaticity coordinates are chosen as color features, and variances extracted by discrete wavelet frames analysis are chosen as texture features. In the color histogram is used as a color feature and Haar or Daubechies' wavelet moment is used as a texture feature. In these methods, their feature vector dimension is not considered as an important factor in combining multiple features. It is shown that such a combination of features without increase of feature vector dimension does not always guarantee better retrieval accuracy. Chun proposed a CBIR method which uses the combination of color auto correlograms of hue and saturation component images and
BDIP and BVLC moments of value component image in the wave let transf or m domain. In Hiremath presents a novel retrieval framework for combining color, texture and shape information. The image is partitioned into non- overlapping tiles of equal size. The color moments and moments on Gabor filter responses of these tiles serve as local descriptors of color and texture respectively. Shape information is captured in terms of edge images computed using gradient vector flow fields. Invariant moments are then used to record the shape features. Accordingly, for an advanced CBIR, it is necessaryto choose efficient features that are complementary to each other so as to yield an improved retrieval performance and to combine chosen features effectively without increase of feature vector dimension. In this paper, we propose a new and effective color image retrieval scheme which uses the combination of dynamic dominant color, steerable filter texture feature, and pseudo-Zernike moments shape descriptor. The rest of this paper is organized as follows. Section 2 presents dynamic dominant color extraction. Section 3describes the steerable filter decomposition and texture representation. In Section 4, the pseudo -Zernike moments based shape descriptor i s given . Section 5 contains the description of similarity measure for image retrieval. Simulation results in Section 6will show the performance of
our scheme. Finally, Section 7concludes this presentation.2. Color feature representation In general, color is one of the most dominant and distinguishable low-level visual features in describing image. Many CBIR systems employ color to retrieve images, such as QBIC system and Visual SEEK.

In theory, it will lead to minimum error by extracting color feature for retrieval using real color image directly, but the problem is that the computation cost and storage required will expand rapidly. So it goes against practical application. In fact, for a given color image, the number of actual colors only occupies a small proportion of the total number of colors in the whole color space, and further observation shows that some dominant colors cover a major ity of pixels .

Consequently, it won't influence the understanding of image content though reducing the quality of image if we use these dominant colors to represent image.

In the MPEG-7 Final Committee Draft, several color descriptors have been approved including number of histogram descriptors and am dominant color descriptor (DCD). DCD contains two main components: representative colors and the percentage of each color. DCD can provide an effective, compact, and intuitive salient color representation, and describe the color distribution in an image or a region of interesting. But, for the DCD in MPEG-7, the representative colors depend on the color distribution, and the greater part of representative colors will be located in the higher color distribution range with smaller color distance. It is may be not consistent with human perception because human eyes cannot exactly distinguish the colors with close distance. Moreover, DCD similarity matching does not fit human perception very well, and it will cause incorrect ranks for images with similar color distribution. We will adopt a new and efficient dominant color extraction scheme to address the above problems..

According to numerous experiments, the selection of color space is not a critical issue for DCD extraction. Therefore, for simplicity and without loss of generality, the RGB color space is used. Firstly, the RGB color space is uniformly divided into 8 coarse partitions, as shown in Fig. 1. If there are several colors located on the same partitioned block.

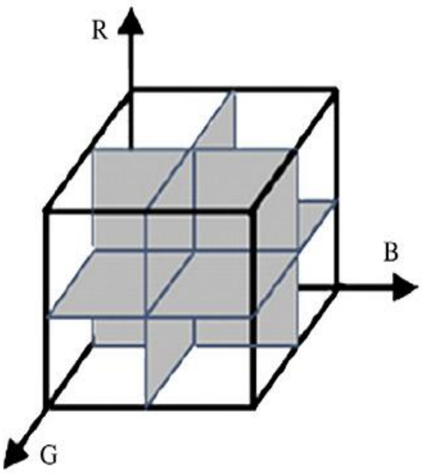


FIGURE 1: COARSE DIVISION OF RGB COLOR SPACE.

The average value of color distribution for each partition center can be calculated by

$$\overline{X}_i = \frac{\sum_{X \in C_i} X}{\sum_{X \in C_i} 1}$$

II. TWO-STAGE IMAGE RETRIEVAL SYSTEM:

In the proposed retrieval system, users describe the images they are looking for by using a set of local semantic concepts (e.g. 'sky', 'water', 'building', 'rocks', etc.) and the size of the image area to be covered by the particular concept. Thus, an exemplary query might be: "Search images with 20–40% of 'sky' ".The figure 2 depicts exemplary retrieval results for that query. Note that here, due to the semantic query mode, the concept 'sky' corresponds to very different occurrences of sky (e.g. clear sky, cloudy sky, overcast sky, etc.). The interval-based query mode might seem artificial at first sight. However, the user interval could also be mapped to descriptors such as "very little", "half of", "most of", etc. In addition, the combination of the search for several concepts in the same images leads to a powerful global image representation that can be used for scene categorization o retrieval as shown .The technical realization of the retrieval is split into two stages (see Fig. 1). In order to enable the use of concepts for querying, the system provides a set of so-called concept detectors. In Stage I of the system, the database images are analyzed by these concept detectors. They return a binary decision whether a particular image region contains the concept (positive patch) or not (negative patch). In the current implementation, each image is subdivided into a regular grid of patches each comprising 1% of the image. However, the system can be extended to arbitrary patch sizes. In Stage II, the patch-wise information of the concept detectors is pro-cessed according to the user interval to actually retrieve a set of images. The performance optimization affects the selection of the appropriate concept detector in Stage I and the setting of an internal parameter, the so-called system interval S =[S low %,S up%], in Stage II. Here, the main idea is to internally adapt the system interval in order to compensate for some of the concept detectors' errors and to thus optimize the system performance.

Performance prediction

The goal of the performance prediction is to make a for cast on the performance of the retrieval depending on certain parameters. We define the retrieval performance by precision, which is the percentage of the retrieved images that are also relevant, and recall, which is the percentage of the relevant images that are retrieve.

Figure 2: Two Stage Image retrieval System using Query Image

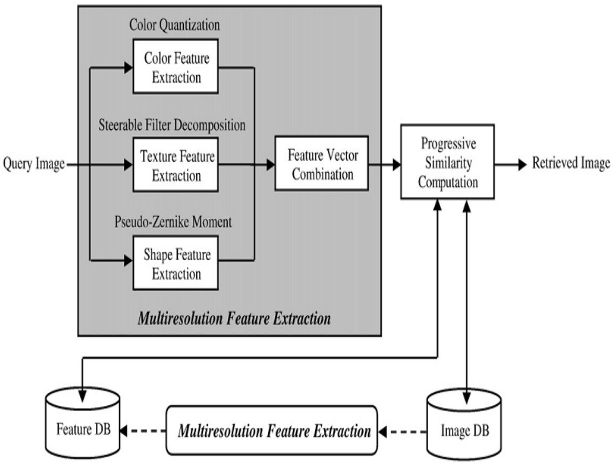
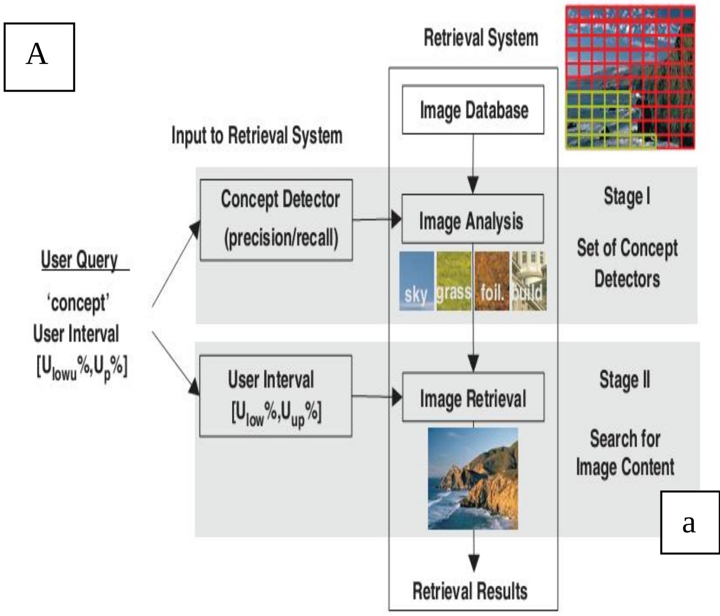


Figure 3: Block Diagram of Proposed System



III. CONCLUSION

CBIR is an active research topic in image processing, pattern recognition, and computer vision. In this paper, a CBIR method has been proposed which uses the combination of dynamic dominant color, Steerable filter texture feature, and pseudo-Zernike moments shape descriptor. Experimental results showed that the proposed method yielded higher retrieval accuracy than the other conventional methods with no greater feature vector dimension. It was all the more so for multi resolution image DBs. In addition, the proposed method almost always showed performance gain of average normal precision, average normal recall, and average retrieval time over the other methods. As further studies, the proposed retrieval method is to be evaluated for more various DBs and to be applied to video retrieval.

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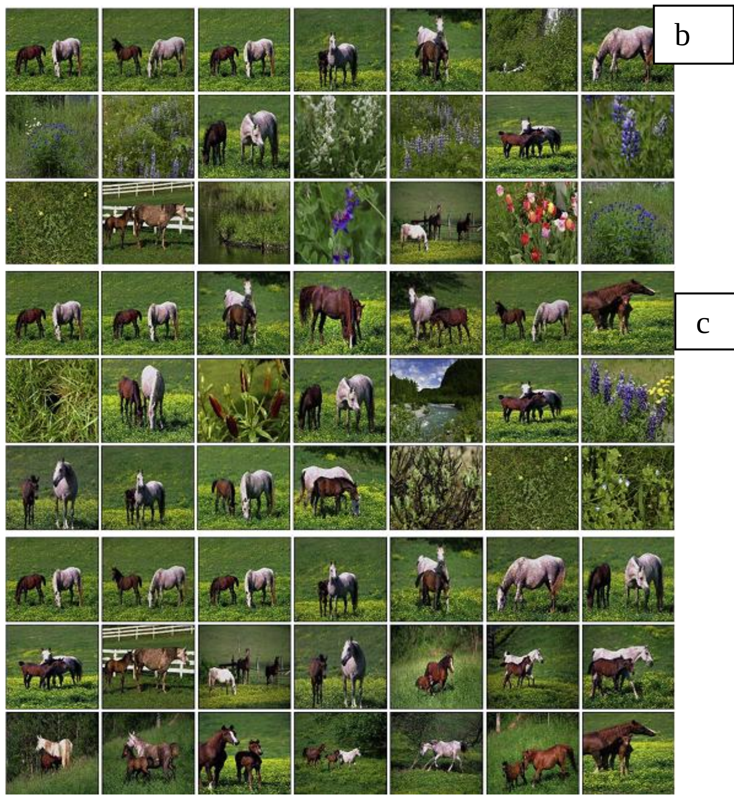

Figure 4: The image retrieval results (horses) using different schemes. (a) The retrieval based on traditional color histogram; (b) the retrieval based on color histogram of sub blocks [3]; (c) the proposed retrieval method.

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