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Automated Content based Image Retrieval using Wavelets

A. Irfan, P., Sumari

Abstract— Automated image retrieval from large databases using content-based image retrieval (CBIR) is in great demand nowadays as many areas such as medical and journalism rely on CBIR systems to perform their job. The ever increasing storage space needed to handle these large volumes of images call for an efficient way to compress and retrieve images from databases. CBIR systems available today, uses color, textual, shape or a combination of few features to retrieve image. Among all those features, color and texture seems to be the main feature used in ost CBIR systems. Color query can use different methods to trieve images from database but color histogram is the common method used in CBIR because they are not sensitive to viewpoint changes and easily computed [2]. Texture information can also be extracted after being decomposed using Wavelet transform. In this paper, we shall present techniques used to extract color and texture information from images using wavelet transform.

Keywords— Content-based Image Retrieval, Wavelets, subband, color, texture, RGB histogram.

I. Introduction

CBIR has grown to be a popular area of research. Many research areas has worked on how to find the best way to retrieve multimedia data and utilize storage space efficiently. Existing content-based image retrieval system such as QBIC [4], VisualSEEK [3] and BlobWorld uses color, texture and ape to retrieve images. The storage and manipulation of ..ese data in their raw form is very expansive. Therefore, systems that are designed to handle data in the large database must be able to search and retrieve data effectively and efficiently [5]. The two main features used in CBIR systems are color and texture as shape tends to be computationally expansive. considered are to minimize the size of the images using wavelet compression technique and to design a retrieval system based on the content of the data itself using color.

In this paper, we shall extract color and texture directly from the decomposed image during the compression process itself. By doing so, the processing time of storing images is much faster, because content is extracted directly during the compression time. After the process is done, the compressed form and it's information is stored into the image and feature database respectively. The organization of this extended abstract is as follows. We shall begin with the overview of the proposed color and texture retrieval of Wavelet-Based Compressed Image system followed by a brief explanation on Wavelet Transform and Color, texture Retrieval technique used.

II. Content-Based Retrieval of Images

A. Color Retrieval

In this paper, we propose a technique to retrieve Wavelet-based compressed image by using color information of the compressed image itself. The proposed color retrieval system is made up of two main components, the preprocessing component and the query component (Figure 1). The preprocessing component will prepare images before they are stored into the database. Within this component the image will be compressed, color information extracted and stored into the database.

First, the images will be decomposed using wavelet transform. The decomposed image will yield 4 subbands signals (LL, LH, HL, and HH). The LL_{n-1} component will be further decomposed until LL_0, depending on the level of decomposition, *n*. After the decomposition is done, the LL_0 component will be used to extract color information. Color information will be stored in the feature database in RGB histogram form and shall be used for histogram matching later in the query component.

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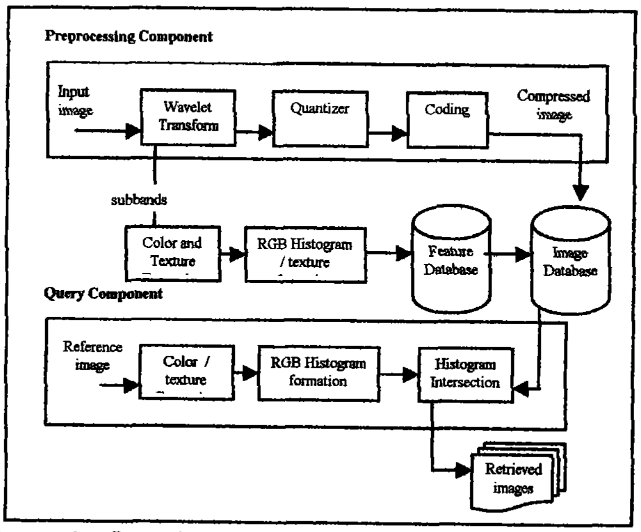

Figure 1: Overview of the Color Retrieval of Wavelet Based Compressed Image System.

In the query component, the user is presented with an interface to query the system. The user gives a sample image to the system. Color information from the query image is then extracted and stored into RGB histograms. These histograms are then sent to the matching process to search for possible outputs in the feature database. In the matching process, Histogram Intersection technique will be used. The similarities between the histograms of the query image and those in the database are then measured. The system will rank the most similar compressed image to the candidate image according to similarity measure. After the matching process, a set of images with highest similarity are retrieved. The user is then presented with a set of thumbnail images (low-resolution version). After the user has selected the desired image, the image will be decompressed and the high-resolution version will be presented.

B. *Texture Retrieval*

Texture is that innate property of all surfaces that describes isual patterns, each having properties of homogeneity. It contains important information about the structural arrangement of the surface, such as; clouds, leaves, bricks, fabric, etc. Texture also describes the relationship of the surface to the surrounding environment [17]. It is a feature that describes the distinctive physical composition of a surface.

Texture properties include:

- Coarseness
- Contrast
- Directionality
- Line-likeness
- Regularity
- Roughness

Texture is one of the most important defining features of an image. It is characterized by the spatial distribution of gray levels in a neighborhood [16]. In order to capture the spatial dependence of gray-level values, which contribute to the perception of texture, a two-dimensional dependence texture analysis matrix is taken into consideration. This two-dimensional matrix is obtained by decoding the image file; jpeg, bmp, etc.

III RETRIEVAL TECHNIQUES

A. *Color*

As mentioned before, color is one of the most extensively used visual features in content-based image retrieval. This approach enables user to present an image example to search for the image from the database.

Color histogram [8][3] is a technique used to store color information in an image database. An image is actually made up of several components. As in the case of RGB image (*truecolor*), there are 3 components or *masks* that lay on top of each other to achieve the resulting image (Red, Green, Blue, component) (figure 4).

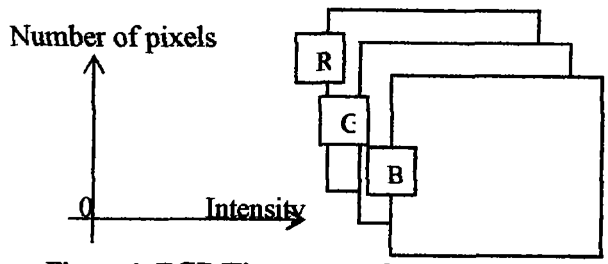

Figure 4: RGB Histogram and color space

B. *Histogram Intersection*

Color histogram is a very popular method for characterizing images in image retrieval systems using color feature. A color histogram is constructed by counting the numbers of pixels for each bin. RGB Histograms uses RGB color space to analyze images. RGB color space is widely used in most of the existing content-based image retrieval systems. It contains three color components which are red, green and blue. Each color is represented by a different wavelength. Each of this histogram uses the same concept as gray scale. A histogram is composed of multiple bins and each bin corresponds to a certain range of values

During the construction of the histogram, every pixel in the image is analyzed to get the intensity level of color components based on the RGB space. These pixels will then be stored into bins corresponding to specific intensity levels and color component (red, green blue). Then, the number of pixel in each bins are calculated and stored. The number of pixels and the intensity level are used to plot the histogram for each color component.

In the proposed system, color information will be extracted from the LL component right after the wavelet transform. There are many ways to store color information. Color could be stored into 3 separate histograms each corresponding to Red, Green and Blue channels. Another way is to store all the color information into one single histogram. We used the later approach as it is much easier and faster to compute. The compressed image and its corresponding RGB histogram will then be stored into the database.

C. *Texture*

A method called the pyramid-structured wavelet transform was used for texture classification. The pyramid-structure recursively decomposes sub signals in the low frequency channels. It is mostly significant for textures with dominant frequency channels. For this reason, it is mostly suitable for signals consisting of components with information concentrated in lower frequency channels [17]. Due to the innate image properties that allows for most information to xist in lower sub-bands, the pyramid-structured wavelet ransform is highly sufficient.

As the case of the color decomposition, the pyramid-structured wavelet transform, the texture image is decomposed into four sub images, in LL, LH, HL and HH sub-bands. At this point, the energy level of each sub-band is calculated. This is first level decomposition. Using the low-low sub-band for further decomposition, we reached fifth level decomposition. The reason for this is the basic assumption that the energy of an image is concentrated in the LL band. For this reason the wavelet function used is the Daubechies wavelet.

The Euclidean distance is calculated between the query image and every image in the database. This process is repeated until all the images in the database have been compared with the query image. Upon completion of the Euclidean distance algorithm, we have an array of Euclidean stances, which is then sorted. The five topmost images are en displayed as a result of the texture search.

III. Conclusion

In this paper, we have shown that the LL (low resolution) component of the decomposed image is almost similar to the original image and could be used for retrieval process. Using this system, the complexity of extracting color information has been reduced. This is because; only the LL component of the decomposed image is used. Therefore less color is used to descript the image. Using the LL component has also reduced size and noise compared to using the original image.

However, the proposed system also has it drawbacks. During the query process, in few cases, matching could not be done efficiently. This is because the compressed image uses low resolution image to extract color. In the future work, a better algorithm for histogram matching should be devised to correct this problem.

Appendix

Appendixes, if needed, appear before the acknowledgment.

Acknowledgment

The preferred spelling of the word "acknowledgment" in American English is without an "e" after the "g." Use the singular heading even if you have many acknowledgments. Avoid expressions such as "One of us (S.B.A.) would like to thank ... ." Instead, write "F. A. Author thanks ... ." **Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page.**

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