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A Survey on Different Image Retrieval Techniques

Nandkumar Sushen Admile[1]

[1]*Karmayogi Polytechnic College, Department of Electronics and Tele-Communication Engineering Shelve, Pandharpur*

Abstract – *Identification of images from an image database is an important research area in image processing. For the image retrieval number of techniques are developed. In earlier research the text based image retrieval is used, but due to the number of problems content based image retrieval technique is proposed. This Paper represents the various image retrieval techniques. The content based image retrieval is the most effective technique for image retrieval. In this the word content refers to the various content of the image such as color, Shape and Textures. Now a day the block truncation coding technique is preferred for image retrieval. Out of this dot diffusion block truncation coding technique is employed in this paper. To retrieve image using dot diffusion block truncation two feature descriptor are extracted which are color histogram feature and bit pattern feature. The performance of image retrieval task is measured in terms of average precision rate and average recall rate.*

Key Words: **Image Retrieval, Content Based Image Retrieval, Block Truncation Coding, Dot Diffusion Block Truncation Coding, Average Precision Rate, Average Recall Rate.**

1. INTRODUCTION

Content-based Image Retrieval (CBIR) is also known as content-based visual information retrieval (CBVIR) or query by image content (QBIC). It is an application of computer vision technique to solve the problem of image retrieval. That is the problem of searching particular images from a vast image dataset. Content-based image retrieval is different from traditional concept-based techniques. The search of images based on the contents of images instead of metadata such as keywords, tags, or descriptions belonging to the images which is the exact meaning of "Content-based". The term "content" in this case refer to color, shape, texture, or any other information that can be obtained from the image. In most of the systems the search of image totally based on metadata hence CBIR is suitable for the image retrieval task. It is too difficult for humans to manually annotate images by entering keywords or metadata in a vast dataset. It also time consuming and may not capture the exact keywords to describe the image. The CBIR systems have lot of challenges to define the image retrieval task. Now a day's CBIR is the most attractive technique for image retrieval because of the limitations in metadata based systems, as well as the large range of possible uses for image retrieval. The information of textures associated with images can be easily identified using existing techniques, but this requires man power to manually describe each image in the dataset. It is not easy task for very large dataset or for images which are generated automatically, e.g. those from surveillance cameras. There is also chance to miss images which uses different synonyms for description .Systems based on classification of images in semantic classes like "rose" as a subclass of "flowers" can avoid the mismatching problem, but for this we need more effort by a user to find images that might be "rose", but are only classified as an "flowers". Number of techniques have been developed to categorize images, but all still having problem of scaling and miscategorization images. The basic CBIR systems were designed to search dataset based on image properties such as color, texture, and shape. Content-based image retrieval, uses the visible contents of an image such as color, texture, shape and spatial information to describe the images. In typical content-based image retrieval systems (Figure 1-1), the visual contents of the images in the dataset are obtained and described by multi-dimensional feature vectors. In order to retrieve images, user provides the retrieval system with example images. The system then changes these examples into its internal representation of feature vectors. Similarities between the feature vectors of the query images and those of the images in the dataset are calculated with the help of indexing scheme and retrieval is performed. The indexing scheme provides an effective way to search for the images from a vast dataset. Most of the recent retrieval systems have uses users' relevance feedback to modify the retrieval process in order to generate semantically and perceptually more accurate retrieval results.

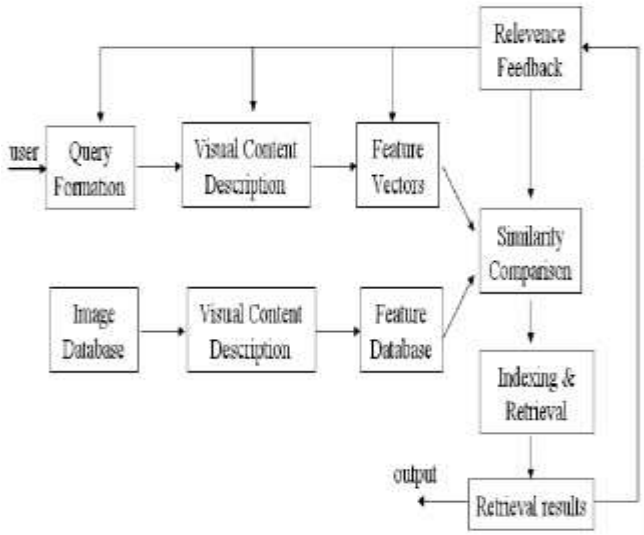

Figure 1-1. Diagram for content-based image retrieval system

The images consist of various attributes and information. The main attributes the image consist of following three things:

1.1 Visual content levels

Natural images consist of various attributes or information contents that can help to resolve the image retrieval problem. The information content that can be derived from an image is classified into three levels.

- High level – High level content of images includes impressions, emotions and meaning associated with the combination of perceptual features. Such as objects or scenes with emotional or religious significance.
- Middle level – The examples of middle level contents include presence or arrangement of specific types of objects, roles and scenes.
- Low level – Low level content of images includes visual features such as color, texture, shape, spatial information and motion.

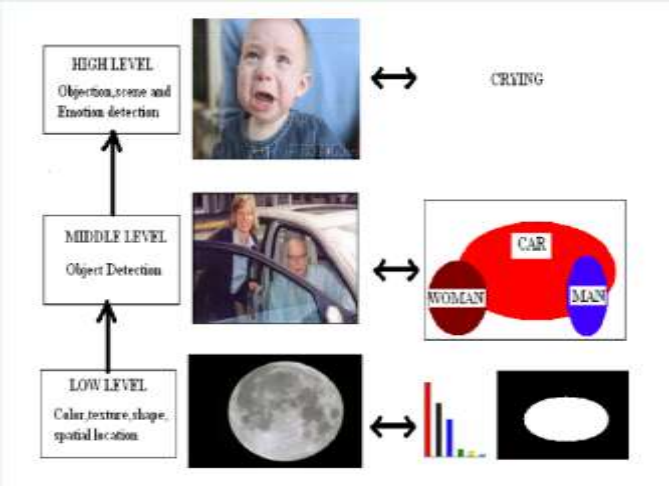

Fig.1.2.Visual content levels of Image

High level features goes beyond the collection of pixels. It identifies the impressions, meanings and emotions associated with the collection of pixels that make up the object. The middle level features are the features that can be extracted by collection of pixels that make up the image. At the low level, also called as primary level the features extracted (color, shape, texture, spatial information and motion) are called primitive features because they can only extracted from information obtained at the pixel level.

1.1.1 Color:

Computing distance measures based on color similarity is achieved by computing a color histogram for each image. Examining images based on the color is one of the most widely used techniques because it can be completed without regard to image size or orientation.

1.1.2 Texture

In the field of computer vision and image processing, there is no clear-cut definition of texture. This is because available texture definitions are based on texture analysis methods and the features extracted from the images. However, texture can be repeated patterns of pixels over a spatial domain. Texture properties are the visual patterns in an image that have properties of homogeneity that do not result from the presence of only a single color or intensity. The different texture properties as observed by the human eye for example, regularity, directionality, smoothness, and coarseness. In real world scenes, texture perception can be far more complicated. The various brightness intensities give rise to a blend of the different human perception of texture. Image textures have useful applications in image processing and computer vision. They include: recognition of image regions using texture properties, known as texture classification, recognition of texture boundaries using texture properties, known as texture segmentation, texture synthesis, and generation of texture images from known texture models. Since there is no accepted mathematical definition for texture, many different methods for computing texture features have been proposed over the years

1.1.3 Shape:

Shape feature provides the most important information about an image. Shape features are usually described using part or region of an image. The accuracy of shape features depends upon the segmentation used to divide an image with more meaningful objects. The shape descriptors are categorized into two classes: boundary based descriptor and region based descriptor. Some boundary based representative shape description techniques are chain codes, polygonal approximations, Fourier descriptor and finite element.

1.2 IMAGE RETRIEVAL METHODS

An image retrieval active research area which can be used for browsing, searching and retrieving images from a large dataset of digital images. In this paper following Image retrieval methods are mentioned.

A.Text Base Image Retrieval

B. Content based Image retrieval

C. Query techniques:

D. Semantic retrieval:

E. Relevance Feedback (Human Interaction):

F. Iterative/Machine Learning:

G. Other query methods:

Text-based retrieval and Content-based retrieval

An image retrieval system is a computer based system for browsing, searching and retrieving image from a image dataset. Text-based and content-based are the two techniques designed to search and retrieve image from dataset.

In text-based retrieval, images are indexed using keywords, subject headings or classification codes, which used as retrieval keys during search and retrieval. Text-based

retrieval is less effective because different users use different keywords to describe images. Text descriptions are sometimes subjective and incomplete because it cannot describe complicated image features. Examples are texture images that cannot be described by text. In text retrieval, humans are required to describe each image in the dataset, so for a large image dataset the technique is less effective, expensive and labor-intensive. Content-based image retrieval (CBIR) technique uses content of images to search and retrieve digital images. Content-based image retrieval system was developed to overcome the limitations of text-based image retrieval. However, text-based and content-based image retrieval techniques are complement of each other. Text-based techniques can capture high-level feature representation. It is easy to solve text queries but text-based techniques cannot accept picture based image queries. On the other hand, content-based techniques can capture low-level image features and accept pictorial queries.

Query techniques:

Different implementations of CBIR make use of different types of user queries. Query by example is a query technique which provides the CBIR system with an example images. The search algorithm may vary depending on the application, but result images should all share common elements with the provided example. Options for providing example images to the system include: A preexisting image may be supplied by the user or chosen from a random set. The user makes an approximation of the image that they are looking for, for example image with color or general shapes. This query technique removes the difficulties that can existed when trying to describe images with words.

Semantic retrieval:

Semantic retrieval is nothing but the user making request like "find pictures of Abraham Lincoln". This type of task is very difficult for computers to perform image retrieval. Because Lincoln may not always be facing the camera or in the same pose. Many CBIR systems therefore generally make use of lower-level features like texture, color, and shape. These features are either used in combination with interfaces that allow easier input or with dataset that have already been trained to match features (such as faces, fingerprints, or shape matching). However, in general, image retrieval requires human feedback in order to identify higher-level concepts.

Relevance Feedback (Human Interaction):

Combining CBIR techniques is an very difficult task with the wide range of potential users. In order to make the CBIR successful depends entirely on the ability of users understanding. CBIR systems can make use of relevance feedback, where the user makes the search images in the results as "relevant", "not relevant", or "neutral" to the search query, then repeating the search with the new information.

Iterative/Machine Learning:

Machine learning and application of iterative techniques are becoming more common in CBIR.

Other query methods:

Along with above mentioned techniques Other query techniques include browsing for example images, navigating customized/hierarchical categories, querying by image region (rather than the entire image), querying by multiple example images, querying by visual sketch, querying by direct specification of image features, and multimodal queries (e.g. combining touch, voice, etc.)

LITERATURE REVIEW ON BLOCK TRUNCATION CODING BASED TECHNIQUE

In 1979 Delp and Mitchell develops the Block Truncation Coding (BTC) which is for compression of images [1].The block truncation coding method split the image into noncontiguous image block. From each block high and low mean values are calculated. By performing thresholding low mean values bitmap image is derived. In [3] and [5] author obtains better accuracy using block truncation coding based image retrieval. In this paper author uses RGB color space to extract the several of image features. In [6] instead of RGB color space author uses the different color space to extract the image features. The author obtains the improved results. In [2],[4] and [7] BCCM and BPH features are derived to obtain the sameness between images. In [7] author uses gray scale image to perform the image retrieval task which proves it achieves better image quality and efficiency as compared to ODBTC [8] and EDBTC [9] .In [10] and [11] author uses DDBTC technique to perform the image retrieval task.

This paper describes the Dot Diffusion Block Truncation Coding (DDBTC) method for image retrieval. Color Histogram Features and Bit Pattern Features are extracted and calculate the results.

Dot Diffusion Block Truncation Coding

In the DDBTC technique a color image is divided into number of non-overlapping image blocks. The DDBTC encoder generates two quantizes (minimum and maximum) from the RGB color space (12).

Consider f (i, j) be the image block at position (i, j). Where i = 1, 2.....M/m and j = 1,2.....N/n.
Let f_R (x, y), f_G (x, y) and f_B (x, y) are the RGB pixel values in the image block (i,j) where x = 1,2.....m and y = 1,2.....n.

$$Q_{min} = \{\min f_R(x, y), \min f_G(x, y), \min f_B(x, y)\} \quad (1)$$

$$Q_{max} = \{\max f_R(x, y), \max f_G(x, y) \text{ and } \max f_B(x, y)\} \quad (2)$$

R, G and B represents the Red, Green and blue color space. The gray scale image is obtained using:

$$f^{\wedge}(x,y) = 1/3\,[f_R(x, y) + f_G(x, y) + f_B(x, y)] \quad (3)$$

From the gray scale image Bitmap image is obtained as:

bm = 1; if f^ (x,y) ≥ f (i,j) (4)

0; if f^ (x,y) < f (i,j)

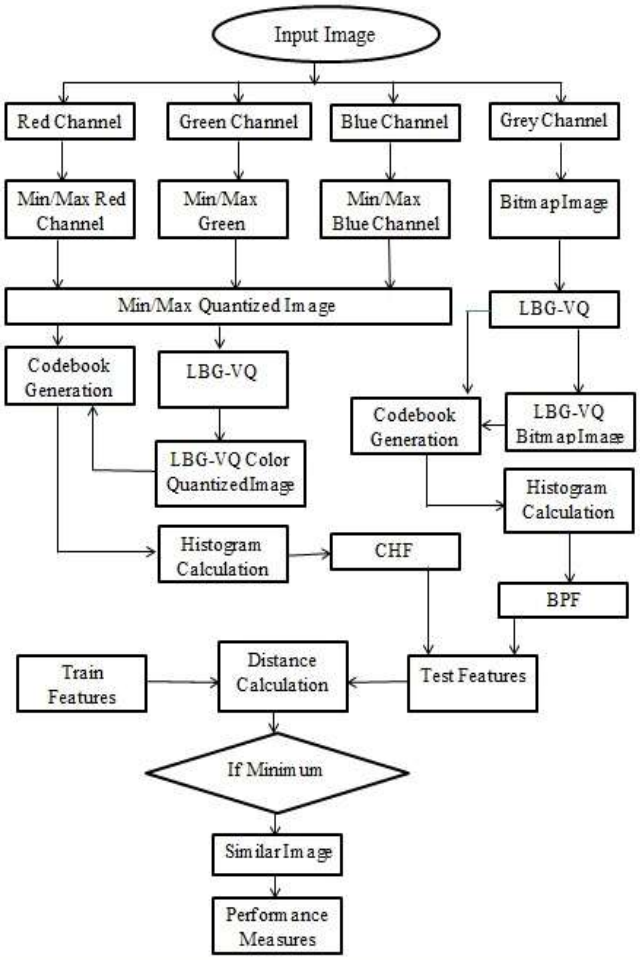

Fig.1.3 Flow of DDBTC Technique

2. Color Histogram Feature (CHF) :

Using minimum and maximum quantizers Color Histogram Feature is extracted The CHF feature is similar to the color codebook size Nc.

Let C = {C_1, C_2.... C_{Nc}} be the color codebook. Nc the VQ indexes the DDBTC minimum and maximum quantizers using the symbol I and j.

$$\tilde{\imath}_{min}(i,j) = \arg \min_{k=1,2,\dots N_c} \left\| q_{min}(i,j), c_k^{min} \right\|_2^2 \quad (5)$$

$$\tilde{\imath}_{max}(i,j) = \arg \max_{k=1,2,\dots N_c} \left\| q_{max}(i,j), c_k^{max} \right\|_2^2 \quad (6)$$

i=1,2,...M/m; j=1,2,....N/n

CHF_{min} and CHF_{max} can be calculated as:

$$CHF_{min}(k) = P_r\left\{\tilde{\imath}_{min}(i,j) = k \middle| i = 1,2,\dots,\frac{M}{m}; j = 1,2,\dots,\frac{N}{n}\right\} \quad (7)$$

Where k=1,2,.....N_{min}

$$CHF_{max}(k) = P_r\left\{\tilde{\imath}_{max}(i,j) = k \middle| i = 1,2,\dots,\frac{M}{m}; j = 1,2,\dots,\frac{N}{n}\right\} \quad (8)$$

k=1, 2 ...N_{max}

The Extraction of CHF is as shown in "Fig 2".

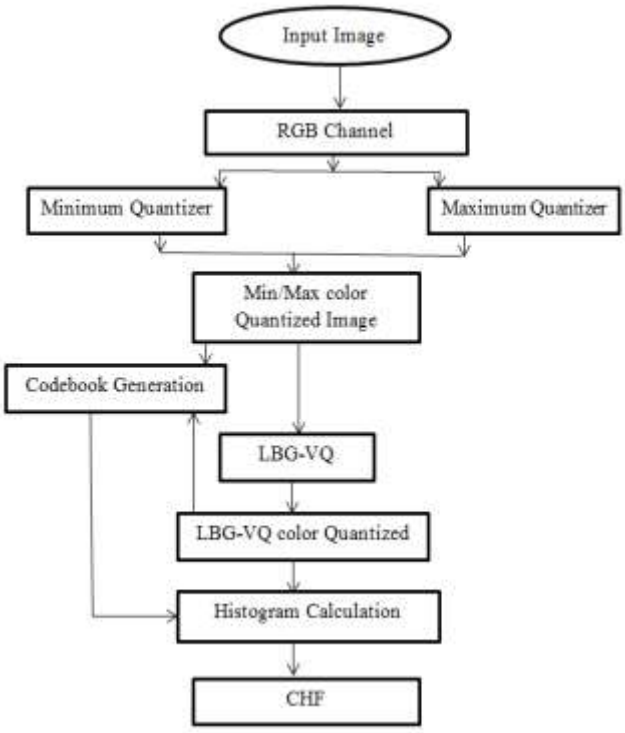

Fig.1.4 Extraction of CHF

3. Bitmap Pattern Feature (BPF):

The Extraction of CHF is as shown in "Fig.4".

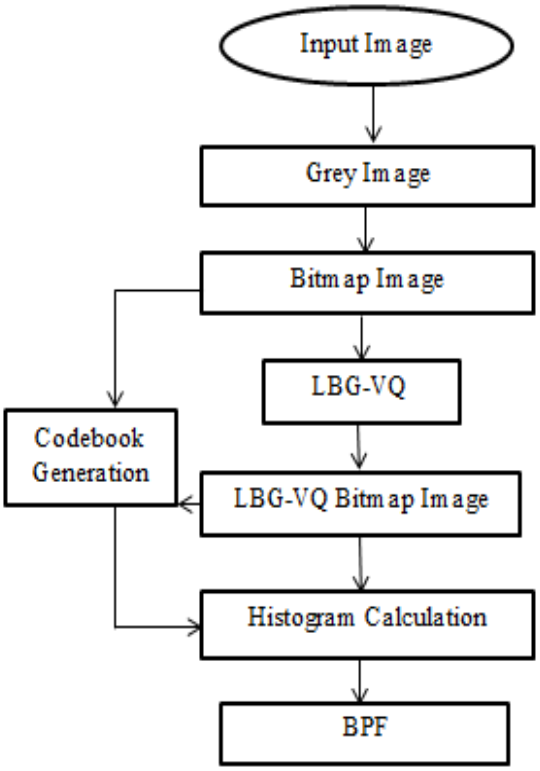

Fig.1.5 Extraction of BPF

Performance Measures:

The Average Precision rate (APR), Average Recall Rate (ARR) are measured by following equation.

$$APR = \frac{1}{Nt\ L}\sum_{q=1}^{Nt} Nq(L) \quad (12)$$

$$ARR = \frac{1}{Nt\ Nr}\sum_{q=1}^{Nt} Nq(Nr) \quad (13)$$

The Number of retrieved images is represented by L, total number of images in database are represented by Nt and number of relevant images of each class is represented by Nr The query image and correctly retrieved images is represented by q and Nq respectively.

3. CONCLUSION

In This paper different image retrieval techniques are studied. For this a 12 number of papers was studied and various image retrieval techniques and their types and methods are mentioned such as the text based and content based and the Semantic based image retrieval. Along with a DDBTC technique can also employed in this paper.

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