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Content Based Image Retrieval: A Review

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Abstract*—In field of image processing and analysis Content based image retrieval is a very important problem as there is rapid growth in storing and capturing multimedia data with digital devices. Although extensive studies, conducted and image finding is desired from multimedia databases and it is very challenging and open issue. This paper provides an review of evolutionary algorithms in in content based image retrieval (CBIR). Genetic algorithm is a branch of evolutionary algorithms which makes retrieval process more speedy do user can find their results from database as bettr as traditional ways. The paper covers the current achievements in relevance feedback, interactive genetic algorithm, neural network in CBIR, various relevance feedback techniques and applications of CBIR.

***Keywords*—CBIR; Image Retrieval**

I. INTRODUCTION

Content-based image retrieval (CBIR), also known as query by image content (QBIC) and the content based visual information retrieval application which belongs to computer vision techniques for image retrieval and main aim to search interested images from large database using visual content of image. Content Based means that search will analyze the actual content of image such as color, shapes, texture or any information that can be derived from image instead of mete-data (like keyword,tags, description of image).

II. CONTENT BASED IMAGE RETRIEVAL

The main unit of CBIR is an image retrieval technique that used to retrieve from the database the most similar images to the query image [9]. A typical content-based retrieval system is divided into off-line feature extraction and online image retrieval. In off-line stage, the system automatically extracts visual attributes at either a low-level (such as color, texture, and shape) or at a high-level (such as a color histogram), or both for each image in the database based on its pixel values and stores them in a different database within the system called a feature database [4]. The feature data (also known as image signature) for each of the visual attributes of each image is very much smaller in size compared to the image data, thus the feature database contains an abstraction (compact form) of the images in the image database. One advantage of a signature over the original pixel values is the significant compression of image representation, so CBIR is cheap, fast and efficient over image search methods. In on-line image retrieval, the user can submit a query example to the retrieval system to search for desired images. The system represents this example with a feature vector and the distances (i.e., similarities) between the feature vectors of the query example and those of the image in the feature database are then computed and ranked. Retrieval is conducted by applying an indexing scheme to provide an efficient way of searching the image database. Finally, the system ranks the search results and then returns the results that are most similar to the query examples [5]. If the user is not satisfied with the search results, he can provide relevance feedback to the retrieval system, which contains a mechanism to learn the user's information needs. In CBIR, each image that is stored in the database has its features extracted and compared to the features of the query image. It involves two steps.

Feature Extraction: The first step in the process is extracting image features to a distinguishable extent.

Matching: The second step involves matching these features to yield a result that is visually similar.

A. CBIR System

In typical content-based image retrieval systems, the visual contents of the images in the database are extracted and described by multi-dimensional feature vectors.[3]. The color content of an image (in the form of a histogram or probability distribution depicting the intensities of pixels in an image) is the most widely used feature for content-based image retrieval (CBIR), while texture and shape features are also used, albeit to a lesser degree. A single feature is not enough to discriminate among a homogeneous group of images. In such cases, either pairs of these features or all of them are used for the purpose of indexing and retrieval. Similarity matching, through metrics called similarity measures, is done to determine the degree of relevance of an image in a collection to a query. This is a key component of a content-based image retrieval (CBIR) system because finding a set of images similar to the image the user had in mind is its primary goal.

A general and simplified model of a query-by-example (QBE) content-based image retrieval (CBIR)
system is shown in Fig 1.

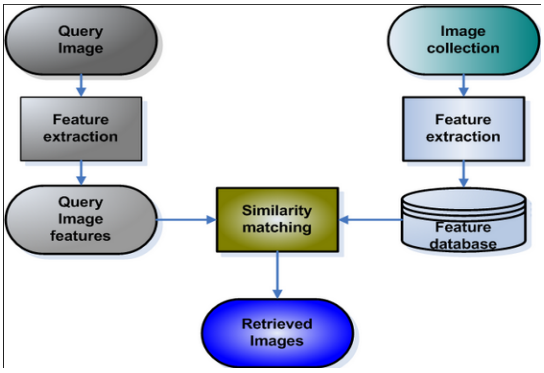

Fig. 1. General Content Based Image Retrieval System

CBIR involves the following four parts in system realization: data collection, build up feature database, search in the database, arrange the order and deal with the results of the retrieval.

1. **Data collection:** Using the Internet spider program that can collect webs automatically to interview Internet and do the collection of the images on the web site, then it will go over all the other webs through the URL, repeating this process and collecting all the images it has reviewed into the server.
2. **Build up feature database** using index system program do analysis for the collected images and extract the feature information. Currently, the features that use widely involve low level features such as color, tex ture and so on, the middle level features such as shape etc.
3. **Search the Database:** The system extract the feature of image that waits for search when user input the image sample that need search, then the search engine will search the suited feature from the database and calculate the similar distance, then find several related webs and images with the minimum similar distance.
4. **Process and index the results:** after researching Index the image obtained from searching due to the similarity of features, then return the retrieval images to the user and let the user select. If the user is not satisfied with the searching result, he can retrieval the image again, and searches database again.

III. DIFFRENT TECHHICHES

The retrieval of content based image involves following techniques.

- **Color based retrieval:**

Colors is an intuitive features and plays an important role in image matching. The extraction of color features from digital image depends on the understanding of theory of color and representation of color in image. In this technique comparing the color content of a query image to that of database images is that of comparing color histograms. The methodology relies on the fact that images are generally represented as a series of pixel values, each corresponding to a visible color. Color histograms is one of most widely used color features representation in image retrieval and it is computed for each image so as to identify relative proportions of pixels within certain values. The original idea to use histogram for retrieval comes from Swain and Ballard [27], who realized the power to identify an object using color is much larger than that of a gray scale.

- **Texture based retrieval:**

Texture is a local neighborhood property of image regions and When it refers to the description of the image's texture which look for visual patterns in images and how they are spatially defined. Textures are represented by texels which are then placed into a number of sets, depending on how many textures are detected in the image. Texture is a difficult concept to represent. The identification of specific textures in an image is achieved primarily by modeling texture as a two-dimensional gray level variation. The relative brightness of pairs of pixels is computed such that degree of contrast, regularity, coarseness and directionality may be estimated. The problem is in identifying patterns of co-pixel variation and associating them with particular classes of textures such as *silky*, or *rough*. The selection of scale directly impacts the precision of texture representation.

- **Shape based retrieval:**

The shape of on abject is binary image representation the extent of the object. Human perception and understanding of objects and visual forms relies heavily on the shape properties. Shape features can be divided into two categories, boundary based and region based. Shapes often be determined first applying segmentation or edge detection to image. Shape descriptors may also need to be invariant to translation, rotation, and scale.

- **Clustering:**

Clustering is the task of grouping a set of objects in such a way that objects in the same group or cluster is more similar to each other than to those in other groups or clusters. It is a main task of exploratory and a common technique for image analysis. Cluster analysis itself is not a specific algorithm, but the task is to be solved. It can be achieved by various algorithms that differ significantly in their notion of what constitutes a cluster and how to efficiently find them. Cluster analysis as such is not an automatic task, but an iterative process of knowledge discovery or interactive multi-objective optimization that involves trial and failure. It will often be necessary to modify data pr e-processing and model parameters until the result achieves the desired properties.

Some of the most popular clustering algorithms, such as k - means or the hierarchical agglomerative clustering.

IV. Related Work

A lot of work has been done in the field of content based image retrieval. Color is common and important feature in image retrieval system.

A.W.M.Smeulders has provided the steps carried out in content based image retrieval process. The features used for retrieval are also spoken here. The disadvantages like need for databases, role of similarity and problems of evaluation are also discussed [4].

Tai X.Y in his paper has given the use of content based image retrieval systems in the Medical field and it provides more knowledge about how the CBIR can be used in real time medical application [5].

Ahonen.T presented a paper where content based image retrieval systems are used for facial recognition and texture. Classification in image retrieval. An operator called local binary pattern is used for image retrieval, where the LBP value is found for each pixel in Query image and compared with the LBP value of data base images and images are retrieved [6].

Huang.P.N has given a design of a two stage content based image retrieval system which mainly used the similarity measure, based on texture. Thus image retrieval technique is more enhanced.

Aigrain et al has discussed the main principles of automatic image similarity matching for database retrieval, emphasizing the difficulty of expressing this in terms of automatically generated features. They have reviewed a selection of current techniques for both still image retrieval and video data management, including video parsing, shot detection, key frame extraction and video skimming. The paper concludes that the field is expanding rapidly, but that many major research challenges remain, including the difficulty of expressing semantic information in terms of primitive image features, and the need for significantly improved user interfaces. CBIR techniques are likely to be of most use in restricted subject domains, and where synergies with other types of data can be exploited.

Color comparison between two images would however be time consuming and difficult problem to overcome this problem they introduced a method of reducing the amount of information. One way of doing this is by quantizing the color distribution into color histograms. Histogram refinement provides a set of features for proposed for Content Based Image Retrieval (CBIR) [2].

They used global histograms for image retrieval, because of their effectiveness and insensibility to minor changes, are broadly used for content based image retrieval. Using color histogram easier way for color distribution or they used histogram divide in to different classes for matching. Each pixel of the image can be represented as a point in a 3D color space. Commonly used color space for image retrieval include RGB, Munsell, CIE L*a*b*, CIE L*u*v*, HSV(or HSL, HSB). There is no agreement on which is the best. However, one of the desirable characteristics of an appropriate color space for image retrieval is its uniformity. Uniformity means that two color pairs that are equal in similarity distance in a color space are perceived as equal by viewers. In other words, the measured proximity among the colors must be directly related to the psychological similarity among them.

- RGB Color model

This model has primary colors like red, green, blue. Most of the CRT monitors and color raster graphics make use of the RGB color model. This model uses Cartesian coordinate system. The colors in this model are called “Additive primaries”, because desired colors can be produced by adding them together. RGB space is a widely used color space for image display. It is composed of three color components red, green, and blue. These components are called "additive primaries" since a color in RGB space is produced by adding them together. In contrast, CMY space is a color space primarily used for printing. The three color components are cyan, magenta,and yellow. These three components are called "subtractive primaries" since a color in CMY space is produced through light absorption. Both RGB and CMY space are device-dependent and perceptually non-uniform.

- HSV Color model:

This model offers a more intuitive representation of relationship between colors. Basically a color model is the specification of coordinate system and a subspace within that, where each color is represented in single point. In HSV (or HSL, or HSB) space is widely used in computer graphics and is a more intuitive way of describing color. The three color components are hue, saturation(lightness) and value (brightness). The hue is invariant to the changes in illumination and camera direction and hence more suited to object retrieval. RGB coordinates can be easily translated to the HSV (or HLS, or HSB) coordinates by a simple formula. K-means algorithm is one of the most widely used clustering algorithms in spatial clustering analysis [3]. It is easy and efficient. But is also having limitations: It is sensitive to the initialization. It doesn’t perform well in global searching and is easy to get into local optimization and the improved K-means is based on the classical method to make the process of optimization more dependent [4]. Many of image retrieval applications are based on color feature and shape feature. Estimating local texture based on pixels of the intensity image and a fuzzy index to point out the presence of major colors. It is based on the texture co-occurrence matrix.

The CIE L*a*b* and CIE L*u*v* spaces are device independent and considered to be perceptually uniform. They consist of a luminance or lightness component(L) and two chromatic components a and b or u and v. CIE L*a*b* is designed to deal with subtractive colorant mixtures, while CIE

L*u*v* is designed to deal with additive colorant mixtures. The transformation of RGB space to CIE L*u*v* or CIE L*a*b* space.

- Clustering:

Clustering is the task of grouping a set of objects in such a way that objects in the same group or cluster is more similar to each other than to those in other groups or clusters. It is a main task of exploratory and a common technique for image analysis. Cluster analysis itself is not a specific algorithm, but the task is to be solved. It can be achieved by various algorithms that differ significantly in their notion of what constitutes a cluster and how to efficiently find them. Cluster analysis as such is not an automatic task, but an iterative process of knowledge discovery or interactive multi-objective optimization that involves trial and failure. It will often be necessary to modify data pr e-processing and model parameters until the result achieves the desired properties. Some of the most popular clustering algorithms, such as k means or the hierarchical agglomerative clustering [9]. K-means clustering for the classification of feature set obtained from the histogram refinement method. Marakakis et .al, [7]introduced new relevance feedback (RF) approach for content-based image retrieval (CBIR), which uses Gaussian mixture (GM) models as image representations. The GM of each image is obtained as an adaptation of a universal GM which models the probability distribution of the features of the image database. In each RF round, the positive and negative examples provided by the user until the current round are used to train a support vector machine (SVM) to distinguish between the relevant and irrelevant images according to the preferences of the user.

Naresh Babu [8] showed that Content-based image retrieval (CBIR) is an important research area for manipulating large amount of image databases and archives. Extraction of invariant features is the basis of CBIR. The use HSI color information especially Hue value and CSS (Curvature Scale Space) as shape information. From a large image data base, an automatic shape & color Based retrieval technique can significantly increase the retrieval task. We are using three features for image retrieval like color, shape & texture Feature.

V. APPLICATIONS

CBIR systems have become a reliable tool for many image database applications and they were used in various fields and spheres of human activity. There is a growing interest in CBIR systems because of the limitations inherent in meta data based systems, as well as the large range of possible uses for efficient image retrieval systems. The CBIR technology has been used in a plethora of applications such as fingerprint identification, digital libraries, crime prevention, medical diagnosis, historical research, architectural and engineering design, publishing and advertising, art, education, fashion and graphic design, geographical information and remote sensing systems.

- **Medical Applications**

The use of CBIR can result in powerful services that can benefit biomedical information systems. Three large domains can instantly take advantage of CBIR techniques: teaching, research, and diagnostics [5]. Clinicians usually use similar cases for case-based reasoning in their clinical decision-making process. In the medical field, some ailments require the medical practitioner to search and review similar X-rays or scanned images of a patient before proffering a solution.

- **Digital Libraries**

There are several digital libraries that support services based on image content. One example is the digital museum of butterflie , aimed at building a digital collection of Taiwanese butterflies. This digital library includes a module responsible for content-based image retrieval based on color, texture, and patterns.

- **Crime Prevention**

One of the main jobs of police is to identify and arrest criminals in the country. However, to achieve that, the department of security investigation must identify the identity of criminals as fast as possible and with a high accuracy rate. Day after day, the crime rate is increasing so that the police must deal with a large number of criminals images that stored in a database. Once a new image is arrived, it must be compared with all of these images to classify it correctly. It is clear that, doing this job manually takes a long time so, the need for criminal recognition system is strongly highlighted here.

- **Web Searching**

The most important application, however, is the Web, as a big fraction of it is devoted to images,and searching for a specific image is indeed a daunting task. Numerous commercial and experimental CBIR systems are now available, and many web search engines are now equipped with CBIR facilities, as for example Alta Vista, Yahoo and Google.

CONLCUSION

In this paper we have given review of CBIR. Also we have discussed bout the different techniques of CBIR such as RGB, HSV, texture and shape & Clustering techniques. We had perform a comparative result analysis of RGB, HSV color model for classification of image classification We have discussed the different applications of CBIR. Image Classification also suffered from other feature such as texture and shape. for better image classification we also used all feature property of image data.

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