ISSN:0975-9646

Fundamental of Content Based Image Retrieval

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Abstract -The aim of this paper is to review the present state of the art in content-based image retrieval (CBIR), a technique for retrieving images on the basis of automatically-derived features like color, texture and shape. Our findings are based both on a review of the relevant literature and on discussions with researchers in the field.

There is need to find a desired image from a collection is shared by many professional groups, including journalists, design engineers and art historians. During the requirements of image users can vary considerably, it can be useful to illustrate image queries into three levels of abstraction first is primitive features such as color or shape, second is logical features such as the identity of objects shown and last is abstract attributes such as the significance of the scenes depicted. While CBIR systems currently operate well only at the lowest of these levels, most users demand higher levels of retrieval.

1. INTRODUCTION

A typical CBIR system automatically extract visual attributes like color, shape, texture and spatial information of each image in the database based on its pixel values and stores them in to a dissimilar database within the system called feature database [3,5]. The feature data for each of the visual attributes of each image is very much smaller in size compared to the image data. The feature database contains an abstraction of the images in the image database; each image is represented by compact illustration of its contents like color, texture, shape and spatial information in the form of a fixed length real-valued multi-component feature vectors or signature. The users generally prepare query image and present to the system. The system automatically extract
the visual attributes of the query image in the same mode as it does for each database image and then identifies images in the database whose feature vectors match those of the query image, and sorts the best similar objects according to their similarity value. During operation the system processes less compact feature vectors rather than large size image data therefore giving CBIR its cheap, fast and efficient advantage over text-based retrieval. CBIR system can be used in one of two ways. First, exact image matching, that is matching two images, one an example image and the other, image in image database. Furthermore is approximate image matching, which is finding most closely match images to a query image [12].

CBIR involves the subsequent four parts in system realization [5], data collection, build up feature database, search in the database, arrange the order and deal with the results of the retrieval [1].

1) Data gathering:-By using Internet spider program that can collect webs automatically to interview Internet and do the gathering 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) Extract feature database:-Using index system program do analysis for the collected images and extract the feature information. At this time, the features that use widely involve low-level features such as color, texture and so on, the middle-level features such as shape.
3) Searching in the Database:-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 suitable feature from the database and calculate the similar distance, then find some related webs and images with the lowest similar distance.
4) Process and index the results:-Index the image obtained from searching due to the similarity of features, and then returns the retrieval images to the user and allow the user select. If the user is not pleased with the searching result, he can re-retrieval the image again, and searches database again.

2. FEATURES EXTRACTION

Feature extraction is the heart of the content based image retrieval. As we know that raw image data that can not used straightly in most computer vision tasks. Mainly two reason behind this first of all, the high dimensionality of the image makes it hard to use the whole image. Further reason is a lot of the information embedded in the image is redundant. Therefore instead of using the whole image, only an expressive representation of the most significant information should extract. The process of finding the expressive representation is known as feature extraction and the resulting representation is called the feature vector [11]. Feature extraction can be defined as the act of mapping the image from image space to the feature space. Now days, finding good features that well represent an image is still a difficult task. In this paper, a wide variety of features are used for image retrieval from the database. Image content

can distinguish between visual and semantic content. Features usually represent the visual content. Visual content can be further divided into general or domain specific. For example the features that can use for searching would be representing the general visual content like color, texture, and shape. Another side, the features that are used for searching human faces are domain-specific and may include domain knowledge. If we talk about the semantic content of an image is not simple to extract. Annotation and/or specialized inference procedures based on the visual content also help to some extent in obtaining the semantic content [2].

The main point for choosing the features to be extracted should be guided by the following concerns:The features should carry sufficient information about the image and should not require any domain specific knowledge and it should be easy to compute in order for the approach to be feasible for a large image collection and rapid retrieval.

Another thing is that it should relate well with the human perceptual characteristics since users will finally determine the suitability of the retrieved images

3. COLOR FEATURE

One of the most significant features of image that make possible the recognition of images by humans is color[9]. Color is a property that depends on the reflection of light to the eye and the processing of that information in the brain. We use color everyday to tell the distinction between objects, places, and the time of day .Images characterized by color features have many advantages:

Efficiency:-There is high percentage of relevance between the query image and extracted matching images.

Strength:-The color histogram is invariant to rotation of the image on the view axis and changes in small steps when rotated otherwise or scaled .It is also not sensitive to changes in image and histogram resolution and occlusion.

Simplicity:-The construction of the color histogram is a simple process, including scanning the image, the resolution of the histogram, assigning color values to, and building the histogram using color components as indices.

Low Storage Requirements: - The color histogram size is significantly smaller than the image itself, because of color quantization.

4. TEXTURE FEATURE

In the field of computer vision and image processing there is no exact definition of texture [4,8].Because available texture definitions are based on texture analysis methods and the features extracted from the image. Texture is a main component of human visual perception. Like colour, this also makes it an essential feature to consider when querying image databases. Everyone can recognise texture but, it is not easy to define. Unlike colour, texture occurs over a region rather than on a point. It is normally defined purely by grey levels and as such is orthogonal to colour. Texture has qualities like periodicity and scale; it can be described in terms of coarseness, direction, contrast. However texture can be considered as repeated patterns of pixels over a spatial domain, of which the addition of noise to the patterns and their repetition frequencies result in textures that can become visible to random and unstructured. Or in other word we can say that texture is that innate property of all surfaces that describes visual patterns, each having properties of homogeneity. It contains important information related to the structural arrangement of the surface, such as; clouds, leaves, bricks, fabric. It also describes the relationship of the surface to the surrounding environment [7].

Basically two primary issues in texture analysis during similar image retrieval.

Texture classification is concerned with identifying a given textured region from a given set of texture classes. Each of these regions has unique texture quality. Basically Statistical methods are extensively used like GLCM, contrast, entropy, homogeneity. Another is texture segmentation is concerned with automatically determining the boundaries between various texture regions in an image.

5. SHAPE FEATURE

Another major image feature is the shape of the object contained in the image Shape feature of image may be defined as the characteristic surface configuration of an object; an outline or contour. It permits an object to be distinguished from its surroundings by its outline [6,10] Shape representations can be generally divided into two categories: Boundary-based, and Region-based. Boundary-based shape representation only uses the outer boundary of the shape. This is done by describing the considered region using its external characteristics, like the pixels along the object boundary. But the Region-based shape representation is totally dissimilar from the prior method .It uses the entire shape region by describing the considered region using its internal characteristics; i.e., the pixels contained in that region .The shape of an object is a binary image representing the extent of objects. In region-based considers the shape being composed of a set of two-dimensional regions, while the boundary based representation presents the shape by its outline. While in region-based feature vectors often result in shorter feature vectors and simpler matching algorithms. However, generally they fail to produce well-organized similarity retrieval. On the other hand, feature vectors extracted from boundary-based representations provide a richer description of the shape. This scheme has led to the development of the multi-resolution shape presentations, which proved very useful in similarity assessment.

6. SPATIAL ANALYSIS

Even though color and shape are the most important features of image, it is still possible that two images with totally different appearance might have the same color and shape information in the index file [11]. To distinguish two different images having similar color and shape information, we can apply spatial analysis. The images are partitioned into a number of regions. Then we apply the color and shape analysis in to each small region separately. The color and shape information of all the small regions together form the index of this image. The selection of the number of partitions is critical to the performance of image retrieval. More partitions need longer processing time and larger storage for the index file. If too many partitions are used, then the image retrieval result will be similar to exact matching and thus violate the principle of content-based retrieval methods. After trying many experiments, we have chosen to partition the image into 9 rectangular regions .

The most extensively used representation of spatial relationship is the 2D strings proposed by Chang et al.Spatial quad-tree, and symbolic image are also used for spatial information representation. Although, searching images based on spatial relationships of regions remains a difficult research problem in content-based image retrieval, because reliable segmentation of objects or regions is often not feasible except in very limited applications. Although a few systems simply divide the images into regular sub-blocks, only limited success has been achieved with such spatial division schemes since most natural images are not spatially constrained to regular sub-blocks. To solve this problem, a method based on the radon transform, which exploits the spatial distribution of visual features without a sophisticated segmentation?

7.RELEVANCE FEEDBACK

Relevance feedback (RF) is a commonly method to improve the effectiveness of retrieval systems . Basically, it is composed of mainly three steps first an initial search is made by the system for a user-supplied query pattern and returning a small number of image second is the user then indicates which of the retrieved images are useful or relevant then finally, the system automatically reformulates the original query based upon user's relevance judgments. This process can continue until the user is satisfied. RF strategies help to improve the semantic gap problem, because it allows the CBIR system to learn user's image Perceptions. RF strategies usually deal with small training samples normally less than 20 per round of interaction, asymmetry in training sample, and real time requirement (RF algorithms should be fast enough to Support real-time user interaction) . Another important matter is concerned with the design and implementation of learning mechanisms. The commonest method is use weight-based learning approaches , genetic algorithms , Bayesian probabilistic methods , and Support Vector Machines .

8. DISTANCE MEASURES

Instead of exact matching, content-based image retrieval calculates visual similarities between a query image and images in a database. Accordingly, the retrieval result is not a single image but a list of images ranked by their similarities with the query image. Many similarity measures has been developed for image retrieval based on empirical estimates of the distribution of features. Different similarity or distance measures will affect retrieval performances of an image retrieval system significantly. We denote D (I, J) as the distance measure between the query image I and the image J in the database; and fi(I) as the number of pixels in bin i of I .

9. PERFORMANCE MEASUREMENT

In the content-based retrieval, because there is variety of algorithm for retrieval, so it needs to estimate the retrieval results to compare their advantages and disadvantages. There are few approximation of response time of the system and the throughput rate, majority of estimates are put into the accuracy of the retrieval's results, mainly using the two indexes,precision and recall [1].

Recall=Number of relevant images retrieved / Number relevant images in collection

Precision= number of relevant images retrieved / total of images retrieved.

The higher recall and precision are, the more efficient retrieval algorithm is. Recall reflects the system's ability of retrieval related images, while the precision reflects the ability of rejecting the unrelated images.

10. CHALLENGES

The implementation of CBIR systems raises several research challenges, such as:

1)The semantic gap is the lack of coincidence between the information that one can Extract from the visual data and the interpretation that the same data have for a user in a given situation.

2)User seeks semantic similarity, but the database can only provide similarity by

3)How to represent visual content of images.What are "visual contents"? Colors, shapes, textures, objects, or meta-data (e.g., tags) derived from imagesWhich type of "visual content" should be used for representing image?Difficult to understand the information needs of an user from a query image.

4)Huge amount of objects to search among.

5)How to retrieve images efficiently.

6)Incomplete query specification.

7)Incomplete image description.

8)Maintaining and searching through database.

9)Evaluation of close result.

CONCLUSION

In this paper we have reviewed the various concepts and the applications of content based image retrieval. One of the main challenges is to find significant features that adequately represent an image, especially for the general purpose CBIR applications. Different feature of image and properties were discussed. The way the user communicates with the content based image retrieval system, the size of the databases , the features used and the speed of the retrieval
are the most important factors that judge the success of a CBIR system.

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