Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 4, Issue. 3, March 2015, pg.12 – 15

RESEARCH ARTICLE

Image Mining with CBIR

S.Chidambaranathan

Head, Department of MCA,
St.Xavier's College, Tirunelveli
Scharan2009@rediffmail.com

Abstract— Analyzing this huge amount of multimedia data to discover useful knowledge is a challenging task. It has opened up opportunities for research in Multimedia Data Mining (MDM). Multimedia Data Mining can be defined as the process of finding interesting patterns from media data such as audio, video, image and text that are not ordinarily accessible by basic queries and associated results. This paper mainly focuses on Image Mining techniques and how Content-based Image Retrieval can be helpful for Image mining.

Keywords— MDM, CBIR, Image Mining

I. INTRODUCTION

In today's world, image plays a vital role in every aspect. Useful information can be gained on analysing the images. However, there are certain difficulties to gather the images in a right way [1]. Due to incomplete data, the information gathered is not processed further for any conclusion.

Image retrieval is the fast growing and challenging research area with regard to both still and moving images. Many Content Based Image Retrieval (CBIR) system prototypes have been proposed and few are used as commercial systems.

CBIR aims at searching image databases for specific images that are similar to a given query image. It also focuses at developing new techniques that support effective searching and browsing of large digital image libraries based on automatically derived imagery features. It is a rapidly expanding research area situated at the intersection of databases, information retrieval, and computer vision. Although CBIR is still immature, there has been abundance of prior work. The CBIR focuses on Image 'features' to enable the query and have been the recent focus of studies of image databases. The features further can be classified as low-level and high-level features.

Users can query example images based on these features such as texture, colour, shape, region and others. By similarity comparison the target image from the image repository is retrieved. Meanwhile, the next important phase today is focused on clustering techniques. Clustering algorithms can offer superior organization of multidimensional data for effective retrieval. Clustering algorithms allow a nearest neighbour search to be efficiently performed. Hence, the image mining is rapidly gaining more attention among the researchers in the field of data mining, information retrieval and multimedia databases. Spatial Databases is the one of the concepts which plays a major role in Multimedia System. Researches can extract semantically meaningful information from image data are increasingly in demand.

II. PHASES OF IMAGE PROCESSING

A. *Preprocessing*

In image data, the spatial segmentation can be done at region and/or edge level based on the requirements of the application. It can be automatic or manual and should be approximate enough to yield features that can reasonably capture the image content.

B. *Feature Extraction and Transformation*

Color, edges, shape, and texture are the common image attributes that are used to extract features for mining. Feature extraction based on these attributes may be performed at the global or the local level. There are obvious trade-offs between global and local descriptors.

Global descriptors are generally easy to compute, provide a compact representation, and are less prone to segmentation errors; but they tend to integrate and, therefore, are often unable to discover subtle patterns or changes in shape. Local descriptors, on the other hand, tend to generate more elaborate representations and can yield useful results even when part of the underlying attribute.

III. IMAGE MINING USING CBIR CONCEPTS

This section mainly focuses on how low level features of image can be extracted and can be used effectively for Image mining purpose. In subsequent sections extraction techniques are discuss in details and how Indexing and Retrieval can be improved. To overcome the disadvantages inherent in a text-based retrieval system, content-based image retrieval (CBIR) was introduced in the early 1980s. Content-based image retrieval (CBIR) is the application of computer vision to the image retrieval problem and deals with the problem of searching for digital images in large databases. CBIR generally works on the basis of querying using an example image or a part of an image. Various types of algorithm are developed and these algorithms may vary depending on the application, but result images should all share common elements with the provided example. Content-based image retrieval uses the visual contents of an image such as color, shape, texture, and spatial layout to represent and index the image. In a Generalized CBIR system (Figure 3), the visual contents of the images in the database are extracted and described by multi-dimensional feature vectors. The feature vectors of the images in the database form a feature database. To retrieve images, users provide the retrieval system with example images or sketched figures. The system then changes these examples into its internal representation of feature vectors. The similarities distances between the feature vectors of the query example or sketch and those of the images in the database are then calculated and retrieval is performed with the aid of an indexing scheme. The indexing scheme provides an efficient way to search for the image database [9]. All the mathematical expressions defined in subsequent sections and their descriptions and nomenclature are taken from F. Long et al. [9].

A. *Image Content Descriptors:*

Image content may include both visual and semantic content. Visual content can be very general or domain specific. General visual content include color, texture, shape, spatial relationship etc. Domain specific visual content, such as human faces, is application dependent and may involve domain knowledge. Semantic content is obtained either by textual annotation or by complex inference procedures based on visual content. A visual content descriptor can be either global or local. A global descriptor uses the visual features of the whole image, whereas a local descriptor uses the visual features of regions or objects to describe the image content [9].

- *Color*

Color property is one of the most widely used visual features in content-based image retrieval (CBIR) systems. Researches in this field fall in three main subareas:

- definition of adequate color space for a given target application,
- proposal of appropriate extraction algorithms, and
- study/evaluation of similarity measures.

- *Color Histogram*

It is the most commonly used descriptor in image retrieval. The color histogram is easy to compute and effective in characterizing both the global and the local distribution of colors in an image. The color histogram extraction algorithm involves three steps: partition of the color space into cells, association of each cell to a histogram bin, and counting of the number of image pixels of each cell and storing this count in the corresponding histogram

bin. This descriptor is invariant to translation and rotation. The similarity between two color histograms can be performed by computing the L1, L2, or weighted Euclidean distances.

- *Color Moments*

Color moments have been successfully used in many retrieval systems such as QBIC. The first order (mean), the second order (variance) and the third order (skewness) color moments have been proved efficient in representing color distributions of images.

- *Texture*

Texture is the property of an image, characterized by the existence of basic primitives whose spatial distribution creates some visual patterns defined in terms of granularity, directionality, and repetitiveness. Generally, texture representation methods are classified into two main categories: structural and statistical. Structural methods, including morphological operator and adjacency graph, describe texture by identifying structural primaries and their rules. Statistical methods, including Tamura feature, shift-invariant principal component analysis (SPCA), Fourier power spectra, Wold decomposition, co-occurrence matrices, Markov random field, fractal model and multi-resolution filtering techniques such as Gabor and wavelet transform, define texture by the statistical distribution of the image intensity [9].

- *Shape*

Many content-based image retrieval systems use shape features of object or region. Shape features are usually described after images have been segmented into regions or objects as compared with color and texture features. The most frequently used methods for shape description can be boundary-based (rectilinear shapes, polygonal approximation, finite element models and Fourier-based shape descriptors) or region-based (statistical moments). A good shape representation feature for an object should be invariant to translation, rotation and scaling.

- *User Interaction*

For content-based image retrieval, user interaction with the retrieval system is very important because modification of queries can only be obtained by involving the user in the retrieval process. User interfaces in image retrieval systems typically consist of a query formulation part and a result presentation part. Specifying what kind of images a user wishes to retrieve from the database can be done in many ways. Commonly used query formations are: category browsing, query by concept, query by sketch, and query by example.

- *Relevance Feedback*

Human perception of image similarity is subjective, semantic, and task-dependent. Although content-based methods hold promises for image retrieval generally, retrieval results based on similarities of pure visual features may not always be meaningful in a perceptual or semantic way. Also, each type of visual feature tends to capture only one aspect of image property and it is usually hard for a user to specify clearly how different aspects are combined. To address this problem, interactive relevance feedback, a technique in traditional text-based information retrieval systems, was introduced. With relevance feedback, it is possible to establish a link between highlevel concepts and low-level features [9]. Relevance feedback is a supervised active learning technique used to improve the effectiveness of information systems. The main idea is to use positive and negative examples from the user to improve system performance. For a given query, the system first retrieves a list of ranked images according to a predefined similarity metrics. The user marks the retrieved images as relevant (positive examples) to the query or not relevant (negative examples). The system will refine the retrieval results based on the feedback and present a new list of images to the user. Thus the key issue in relevance feedback is how to incorporate positive and negative examples to refine the query and/or to adjust the similarity measure [9].

IV. CONCLUSION

With the advent of very large-scale images (e.g., Google and Yahoo!, Facebook, Linkedin, Flickr), and high resolution, high dimension biomedical and astronomical imagery, often captured at high throughput, image retrieval research faces an immediate challenge of incorporating the ability to make high resolution, high-dimension, and high-throughput images searchable by content. The future of CBIR will depend on the progress made in each aspect of image retrieval.

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