Review on Reverse Image Search Engines and Retrieval Techniques

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Abstract. Reverse image search is content-based image retrieval (CBIR) query technique which involves providing the CBIR system with a sample query image then it will base its search upon. Reverse image search can be used to search either data related to the query image or the images related to that image or similar images or exact images. In this study, different features like color, texture, shape, and neuro fuzzy and different techniques like compact composite descriptor, fractal image processing, and genetic algorithm have been reviewed. Different World Wide Web reverse image search engines (Google, Bing, Tineye) that are available and well-known today are also reviewed.

Keywords. Content based image retrieval (CBIR), fractal image processing, compact composite descriptor (CCD), World Wide Web image search engines.

1 Introduction

The World Wide Web contains a huge quantity of information. The World Wide Web has grown very considerably in size, and is increasing enormously. Due to this enormous information retrieving the information of interest becomes very difficult. An image retrieval system is a computer system for browsing, searching and retrieving images from a large database of digital images. A lots of search engines are available for retrieving this information. This information can be the use of the text, images or visual information. Traditional character based search engines are unable to provide the capabilities needed for searching image data. To fill the need, image search engine system design allows users to input and search imagery. In addition to imagery, it can also search traditional data. These kinds of search engine system design are well known as content based image retrieval (CBIR) system.

Today search engines serve the needs for image search only by inputting the file name of an image. They use the image filename as an index; users input the desired image name for the query. The search engine will search all image filenames in the database, and return the results. This type of image search engines however searches the images based visual feature. They are based on the concept that the pictures speak a lot than thousands of words. For this, these engines are to be provided with a query image rather than keywords. This image search engines retrieves the images based on the query image. For searching the images based on query image many algorithms have been proposed [13]. We will consider several classes of features that are used to specify queries: color, texture, shape, spatial layout, and faces. Color features are often easily obtained directly from the pixel intensities, e.g. color histograms over the whole image, over a fixed sub-image, or over a segmented region are often used. Although a precise definition of texture has been allusive, the notion of texture generally refers to the presence of a spatial pattern that has some properties o homogeneity.

2 Content Based Image Retrieval

Information on the internet is shifting from text-based to multimedia based with a large amount of visual and audio data. The development of tools such as digital cameras and scanners, which convert analog data into digital data, has accelerated the increase in multimedia information on the internet, and widened internet bandwidth has dramatically improved access. These changes have demonstrated the need for current internet search systems to improve their search engines to include multimedia data such as images, music, and videos [16]. The main unit of content based image retrieval is an image retrieval technique that used to retrieve from the database the most similar images to the query image [9].

Content based image retrieval inherited its early methodological focus from the by then already mature field of text retrieval. A content based image retrieval system is required to effectively harness information from these image repositories. Content-based retrieval is characterized by the ability of the system to retrieve relevant images based on the visual and semantic contents of images.

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 [4]. 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.

One of the main tasks for CBIR systems is similarity comparison; extracting feature signatures of every image based on its pixel values and defining rules for comparing images. These features become the image representation for measuring similarity with other images in the database. An image is compared to other images by calculating the similarities (or differences) between their corresponding features [17].

Advantages:

One of the main advantages of the CBIR approach is the possibility of an automatic retrieval process, instead of the traditional keyword-based approach, which usually requires very laborious and time-consuming previous annotation of database images. The CBIR technology has been used in several applications such as fingerprint identification, biodiversity information systems, digital libraries, crime prevention, medicine, historical research, among others.

Limitation:

High feature similarity may not always correspond to semantic similarity.

3 Features Extraction

The description of the content by image features should serve that goal primarily. In general, a feature with a very wide class of invariance loses the power to discriminate among object differences. The aim is to select the tightest set of invariants suited for the expected set of non-constant conditions. Feature extraction is the basis of content based image retrieval. Typically two types of visual feature in CBIR: (1) Primitive features which include color, texture and shape. (2) Domain specific which are application specific and may include, for example human faces and finger prints.

3.1 Color-based extraction

Color represents one of the most widely used visual features in CBIR systems. Color is one of the most widely used low-level visual features and is invariant to image size and orientation. Color feature is the most intuitive and obvious feature of the image, and generally adopt histograms to describe it. Color makes the image take values in a color vector space. The choice of a color system is of great importance for the purpose of proper image retrieval. It induces the equivalent classes to the actual retrieval algorithm.

Color histograms method has the advantages of speediness, low demand of memory space and not sensitive with the images' changes of the size and rotation, it wins extensive attention consequently. In color indexing, given a query image, the goal is to retrieve all the images whose color compositions are similar to the color composition of the query image. Typically, the color content is characterized by color histograms, which are compared using the histogram intersection distance measure.

3.2 Texture-based extraction

Texture is another important property of images. It refers to the visual patterns that have property of homogeneity or arrangement that do not result from the presence of only a single color or intensity. Various texture representations have been investigated in both pattern recognition and computer vision. When it refers to the description of the image's texture, we usually adopt texture's statistic feature and structure feature as well as the features that based on spatial domain are changed into frequency domain. The elements can be placed more or less regularly or randomly. They can be almost identical or subject to large variations in their appearance and pose. In the context of image retrieval, research is mostly directed towards statistical or generative methods for the characterization of patches.

Two classes of texture representation method can be distinguished: (1) Structural methods which deal with the arrangement of image primitives, presence of parallel or regularly spaced objects and (2) Statistical methods which include the popular co-occurrence matrix, Fourier power spectra, Shift invariant principal component analysis (SPCA), Tamura feature, Multi-resolution filtering technique, characterize the texture by statistical distribution of the image intensity.

3.3 Shape-based extraction

Shape may be defined as the characteristic surface configuration of an object; an outline or contour. Shape usually related to the specifically object in the image, so shape's semantic feature is stronger than texture. It permits an object to be distinguished from its surroundings by its outline. Shape representations can be generally divided into two categories: (1) Boundary-based which uses only the outer boundary of the shape and (2) Region-based which uses the entire shape regions.

Combining shape and color both in invariant fashion is a powerful combination as described by where the colors inside and outside affine curvature maximums in color edges a restored to identify objects.

3.4 Neuro Fuzzy based extraction

The query to retrieve the images from database is prepared in terms of natural language such as mostly content, any content and few content of some specific color. Fuzzy logic is used to define the query. As the stage 1: the query to retrieve the images from database is prepared in terms of natural language such as mostly content, many content and few content of some specific color.

4 Reverse Image Search Techniques

4.1 Compact Composite Descriptors (CCD)

They are global image features capturing both, color and texture characteristics, at the same time they are very useful in a very compact representation which is suitable for large image databases. This system will take an input image as a query image by browsing the image database folder. Once the image is selected, the applying algorithm is selected by which the system should retrieve the similar images. This applying algorithm includes color and edge directivity descriptor (CEDD), fuzzy color and text histogram (FCTH), color layout descriptor (CLD), edge histogram descriptor (EHD) etc [13].

4.2 Fractal Image Processing

The method is best suited for textures and natural images, relying on the fact that parts of an image often resemble other parts of the same image. This technique can reduce data space by only retrieving the eigen values of the image by applying fractal image processing of the image in the spatial domain, and store the results in the image eigenvalue database [8].

4.3 Genetic Algorithm (GA)

GA searches for better solutions by genetic operations, including selection operation, crossover operation and mutation operation. Similarity score fusion method using genetic algorithm. With genetic algorithm the weights of color feature similarity score and texture feature similarity score are assigned optimally. Images are normalized in terms of size and color. For retrieving the fractal eigenvalue, in order to avoid consuming a lot of time, “the improvement of fractal gain” is used [2].

5 Reverse Image Search Engines

5.1 Google

Google Search is the most-used search engine and comprehensive *image search* on the web on the World Wide Web, receiving several hundred million queries each day through its various services. Google Search was originally developed by Larry Page and Sergey Brin in 1997. Google’s first search-by-image tool was started in 2009. It is now the most comprehensive image search on the web. Google analyzes the image, creating a mathematical model based on shapes, lines, proportions, colors and other elements. It then matches the model against images already in Google’s index. Google then does page analysis to take a text-based guess at what the image is part of the process of identifying the image and returning similar results. Search by Image looks for similar content on the web, so unique or never-before-seen images won’t work well. Search by Image is available now at images.google.com or via the “Images” tab in the left-side menu on Google.com.

5.2 Yahoo

In January 1994, Yang and Filo were electrical engineering graduate students at Stanford University when they created a website named “Jerry’s guide to the World Wide Web”. In March 1994, “David and Jerry’s Guide to the World Wide Web” was renamed “Yahoo!” The “yahoo.com” domain was created on January 18, 1995. The word “yahoo” is an acronym for “Yet another Hierarchical Officious Oracle”. The Yahoo API is nicely setup and well documented, is easy to use, and includes image thumbnails which look like the best candidate so far. The only problem is many of the images in the results are no longer on the web. Search by Image is available now at https://images.search.yahoo.com.

5.3 Bing

Microsoft's search engine has the ability to perform more complex image searches than before. From the Images tab in Bing, the button at the bottom of the screen can be clicked to search Image Match. By either uploading an image from your computer or pasting a URL, you can search using the visual properties of the image to find any other versions. This is useful if you are looking for the same image in another size, but more important for photographers who want to find out if their work has been posted elsewhere online without their permission.

5.4 Tineye

TinEye is an image search engine launched on May 2008. TinEye is an innovative product from Idée Inc. that is not just an ordinary image search engine. Rather it has been developed to search duplicates of an image, its source on the Internet. TinEye regularly crawls the web for new images, and we also accept contributions of complete online image collections. To date, TinEye has indexed 11,179,230,386 images from the web to help users find what they're looking for. This search engine employs image identification technology rather than keywords, watermark or metadata to search image. They can show cropped images, degraded images of the original images. This can be particularly useful for those who frequently come across ripped images, originally created by them.

5.5 Pixsy

Type in query and users can get what they are searching for amidst millions of images and videos. The web app looks into the RSS feed of variety of news sites and content providers like Yahoo and extracts the image previews. Clicking on the thumbnail preview takes users directly to the source. The source webpage opens in a two frame layout with a Pixsy brief on top and the source page below. The search can be filtered by *content type* (image or video), *category* and *source* (BBC, MSNBC, Rolling Stone, Webshots, Yahoo etc).

5.6 Virage

Virage image search engine provides an open framework for building such systems. The Virage engine expresses visual features as image 'primitives.' Primitives can be very general (such as color, shape, or texture) or quite domain specific (face recognition, cancer cell detection, etc.). In [12], Jeffrey et al. further proposed an open framework for image management. They classified the visual features (“primitive”) as general (such as color, shape, or texture) and domain specific (face recognition, cancer cell detection, etc.). Virage is intended as a portable framework for different CBIR applications. The Virage Image Engine has also been licensed into the AltaVista Photo & Media Finder.

5.7 MARS

MARS or Multimedia Analysis and Retrieval System (Huang et al. 1996) is an interdisciplinary research effort involving multiple research communities at the University of Illinois. The main focus of MARS is to develop methods to organize various features into adaptive retrieval architecture instead of finding the best representations for any particular application area.

5.8 WebSEEk

WebSEEk (Smith and Chang 1996a) is a WWW-oriented image search engine, developed at Columbia University along with the VisualSeek image query system. It uses both textual keywords, for example from the URL addresses and HTML tags, and color information to categorize images. Currently, WebSEEk has catalogued over 665,000 images and videos in the WWW.

5.9 NETRA

The used color indexing scheme for region-based image retrieval is presented in (Deng and Manju-nath 1999). The system incorporates an automated image segmentation algorithm that allows region-based search. Images are segmented into homogeneous regions at the time they are added to the database, and image attributes that represent each of these regions are computed.

5.10 Image Rover

ImageRover combines textual and visual statistics in a single index for content-based search of a WWW image database. Textual statistics are captured in vector form using latent semantic indexing (LSI) based on text in the containing HTML document. Used visual statistics include color and texture. To begin a search with ImageRover, the user first enters a few keywords describing the desired images.

6 CONCLUSION

This review provides an overview of the reverse image search engines, feature extraction in content based image retrieval system and some retrieval techniques. Most systems use color and texture features, few systems use shape feature, and still less use layout features. Fuzzy logic has been used extensively to improve the performance of the system and to achieve better results in different applications. The fuzzy inference integrates various features perfectly in content based image retrieval system and reflects the user’s subjective requirements, the experiments achieve good performance and demonstrate the efficiency and robustness of system.

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