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Content Based Image Retrieval Comparison between Techniques

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Abstract: ***Content Based Image Retrieval (CBIR) is the technique by which an image is searched for in a multimedia database based on its features not by its name or description. This technique is used in criminal investigation and medical diagnoses. In this paper we briefly review some of the different techniques that were employed by Content based image retrieval systems. We then give our opinion based on our findings and propose a system concept.***

Keywords: CBIR, QBIC, Multimedia Database, Image Retrieval.

1. Introduction

As the use of multimedia data such as images, videos and audio increases, the size of their storage also increases. This data needs to be stored in an organized manner so that we can make efficient use of it by being able to search and retrieve it. The solution to this problem is found in Multimedia Database Management Systems.

Multimedia database management systems can be viewed as storage and retrieval systems, in which large volumes of media objects are created, indexed, modified, searched and retrieved [1].

There are two types of retrievals: navigation through database to locate the desired data and database querying that finds the desired data associatively, attribute-based, or content-based [1].

In this paper, we will focus on content based retrieval for images, known as Content Based Image Retrieval (CBIR) or Querying by Image Content (QBIC) [2].

CBIR is the technology of analyzing an image, extracting the features, and retrieving images withsimilar features to the query image from the image database [3].

2. CBIR Overview

IBM introduced QBIC in the mid 1990'swhere they showed the importance of QBIC by stating, "picture yourself as a fashion designer needing images of fabrics with a particular mixture of colors"[15]. The common applications of CBIR include medical diagnosis by comparing X-ray images with old cases, or in criminal investigation by finding the faces of criminals from an image of a crowd [4].

CBIR operates using a simple principle: we have an imagethat we are searching for known as the query image, find an image that is similar to it and input it to the database of images. The database of images will return all the images with similar features to the inputted image [5]. In order to be able to find images with similar features as the query image, the features of the query image are extracted. These features normally include texture, color and shape. The texture of the image is the degree of contrast, coarseness, and directionality [5]. For example, a picture of a zebra would have high contrast, while a polar bear in a snowstorm would have low contrast. A tic-tac-toe board is coarser than a checkerboard, and a picket fence has more directionality than the leaves on a tree [5]. The color of the image consists of the values of Red Green and Blue. The shape of the image refers to the shape of a specific region in the image that is being extracted. They are usually determined by applying segmentation or edge detection to an image [8].

3. Related Work

An image retrieval system was implemented in [4] that dependedon the colors Red, Green and Blue (RGB). The histogram for each color of the imagesis computed by counting the numbers of pixels in it and is then stored in the database to be compared with the histogram of query image.

Multimedia databases were categorized by [6] into two types: Linked Multimedia Databases and Embedded Multimedia Databases.

Linked Multimedia Databases were described as an organized database of metadata, where the metadata is linked to the actual data which may be stored on a Hard Disc, CD-ROM, DVD or Online. Embedded Multimedia Databases are databases were the multimedia data are stored in the database itself.

In [7] a simple Content Based Image Retrieval system was implemented. This system was created with an aim of returning the user a group of images that share similarity with their query image in short amount of time. In this system Content Based Image Retrieval was

implementedusing a technique called Relevance Feedback. The input query image's regions and objects are detected and any redundant regions in the image are removed. The average values for each of the RGB colors are found for every region in the picture. The attributes found in the query image are compared with the attributes of the images in the database (target) images in order to find resemblance between them. The images are sorted by order of similarity and are returned to the user. This is known as Relevance Feedback.

A CBIR algorithm was proposed by [8] where the features or objects of the query image are first identified by a process they named content identification, and then the values of the features are computed. The query image is then compared with the images in the image database.

Instead of the texture, color and shape features each having their own values or having to choose one or two features, [9] implemented a CBIR technique consisting of fusing together the color features, texture features, and shape features to obtain what they called a feature vector. The feature vector is then used to categorize the images into classes and then form a feature database using the classes. The system then searches for the query image in the feature database not the original image database.

A conceptual architecture for content based image retrieval was proposed in [10]. In this architecture, a ranking technique was introduced in which the search results are ranked by the system according to their relevancy to the user's desired query and the top result is sent to the user.

[11] Employed the materialized views for Content Based Image Retrieval. A Materialized View is a database object, which contain the result of a query. It can be a local copy of data located remotely or it can be a summary table based on aggregations of table's data [11]. After the features are extracted from the query image, the images are then classified according to their features and a materialized view is created for each classification, where the images are then inserted.

Faster image retrieval can be achieved by categorizing images according to [12]. The images are first decomposed by mathematical functions, then their featured are extracted also using functions. They are then divided into different categories according to their features. The image is then filtered through three phases before being returned to the user. In the first phase the query image is found from the database. In the second phase high level and low level frequency components are dealt with. In the third step similar images are retrieved from the database.

In [13] an image mining technique for image retrieval was implemented. The main objective of the image mining is reducing data loss and extracting the meaningful potential information to the humans' expected needs [13].This system computes the RGB value to classify the image according to it, calculates the texture distribution of image and then compares the results with query image after applying the same procedures mentioned above.

A content based image retrieval technique based on a Genetic Algorithm was employed by [14]. A Genetic Algorithm (GA) is a search algorithm based on the idea of evolution and genetics of living organisms that works to find the optimal solution to a problem by applying the techniques inspired by natural selection. In their technique which they named GA-based similarity measure, chromosomes are first created. The genes of these chromosomes are the indices of the database images. The number of images in the queried database determines the values of the genes. The extracted features of each image are grouped as the GA algorithm generates a number of chromosomes (images) which are the most relevant to the given query image. This process is repeated until the number of specified similar images is obtained. The optimal chromosome (image) is then selected and retrieved.

4. Discussion

The color histogram system [4] has the advantage of being fast, because the color histogram for the images in the image database is calculated in advance in order to save time, so only the color histogram for the query is calculated when retrieving an image.

IBM QBIC [5] also depends greatly on color histogram and even records the positions of different colors in an image, allowing color layout queries. The drawback of this approach however, is that irrelevant images may be categorized together in the distribution processalthough they might be semantically different.Another drawback is that histograms are affected byexternal factors such as noisewhich can lead to inaccurate image results.

[12] Mentions that fast image retrieval can be achieved through a categorized system. This system can be efficient in terms of accuracy because the images are retrieved by using three filtering processes first. However, the drawback of this system is that it is time consuming because the results are filtered three times after categorizing, and the image is decomposed first.

Image mining was proposed by [13] in order to reduce data loss. This system focused on feature extraction a great deal, which was necessary since the system was going to be applied in medical transcription for comparing pictures of diseases; so accuracy was very important.

In our opinion The Genetic Algorithm [14] is very slow and too complex for the image retrieval process. We believe thereis no need to repeat the search process until the optimal image is found because it is time consuming.

In our opinion the fastest technique was that of the materialized views employed by [11], because the data is stored in a view not in the database like the other techniques, so the image is searched for in the materialized views not in the database. They mentioned that feature extraction needs a lot of attention; however, they did not focus on the precision of their extraction process because they only used texture and shape for the features.

5. Proposed Concept

After reviewing many techniques, we came up with the idea of using materialized views [11]sincethey allow fast retrievalbutwe would like to enhance the feature extraction process by including searching by color as one of the features.

6. Conclusions

Image retrieval is an important technique that has not yet been introduced to the real world. It provides the ability of being able to show the computer an image and have it return all the similar images in your computer instead of trying to remember what you named that picture or having it display all images. The need for more accurate feature retrieval techniques is still an issue. IBM QBIC [5] suggests combining text-based search with content-based makes QBIC more powerful. A scenario to illustrate this can be given by imagining a shopping website where you are able to eliminate the items by price, category and then by pattern.

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