A REVIEW OF LOW LEVEL FEATURES IN VARIOUS OF CONTENT BASED IMAGE RETREIVAL SYSTEMS OF QBIC, VIRAGE AND VisualSEEk

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Abstract

Content-based image retrieval (CBIR) is use visual content low-level features of images such as color, texture and shape to represent and to index images. This paper presents a review of three comparison systems based on CBIR. We have chosen three different systems of image retrieval which are QBIC, Virage and VisualSEEk. This paper discussed with the basic introduction to CBIR, then explain various image retrieval systems of CBIR proposed by different authors. We also survey color features extraction that focus on RGB color to extract the same images in image repository, based on user needs.

Keywords-CBIR, low level features, Image Retrieval Systems of QBIC, Virage and VisualSEEk.

I. INTRODUCTION

Two decades ago, few applications were developed for users to search for images using content analysis; and research in content-based image search has also been known since the 1990's. This technology has evolved from the searching by text to searching based on low levels features (Wang & Dong, 2009) and has now been expanded to searching using high level features. CBIR is a topic that will be discussed in this paper. It can be defined as "any technology that basically can organize digital photo archive by their visual content (Datta et al, 2008). After a decade of intensive research conducted, QBIC and Virage introduced as a commercial product for use in CBIR.

Image retrieval process is divided into two that are CBIR and Semantic Based Image Retrieval (Yasmin et al., 2013). Content Based Image Retrieval is an application of computer vision where digitally similar images are retrieved from the large database on the basis of their content. Content in this context refers to the Information that describes the image like color, texture, and shapes.

CBIR is known as low level features and Semantic Based Image Retrieval is known as high level features. This paper focuses on low level features of image retrieval systems such as QBIC, Virage and VisualSEEk for a class of spectral models on RGB images.

A. COLOR

Color is one of the important features that make possible the recognition of images by humans. In CBIR, colors are defined in three dimensional color spaces, there are ***RGB*** (Red, Green, and Blue), ***HSV*** (Hue, Saturation, and Value) and ***HSB*** (Hue, Saturation, and Brightness). According to (Smith & Chang, 1995; Wang & Suter, 2003), *HSV* has lots of benefit over *RGB* which hue is equal to another categories of shading, shadows and highlights. According to Sakhare & Nasre (2011), image format such as *JPEG*, *BMP* and *GIF* used to store information in RGB color space. A vector with three coordinates represent the colors in

this space. When all three coordinates are set to zero, visible color is black. When all three coordinates set to 1, colors seen are white. Other color space operate in a similar fashion but with different perceptions.

Swati et al. (2011) also said the color histograms can be divided into two types, there are Global Color Histograms (GCHs) and Local Color Histogram (LCHs). GCHs represent an overall image with a single color histogram while LCHs contains more information about the image, but is computationally expensive when comparing images. LCHs dividing the image into blocks of fixed and take the color histogram of each block. GCHs This is the traditional method for color-based image search. However, it has no information about the distribution of colors of the image.

B. SHAPE

The Shape features of the object image has many applications in CBIR system. It is an important visual features and a basic features to describe an image. Apart from the features of texture and color, shape characteristics can be calculated when the process is done in the image segments (Mojsilovic et al., 2000). Shape retrieval is using searching method based on search queries for all common objects in large image databases relevant to a query.

Basically, shape-based image retrieval consists of measuring the similarity between shapes represented by their features. Some simple geometric features can be used to describe shapes. Usually, the simple geometric features can only discriminate shapes with large differences; therefore, they are usually used as filters to eliminate false hits or combined with other shape descriptors to discriminate shapes. They are not suitable to stand alone shape descriptors. A shape can be described by different aspects (Zhang & Lu, 2004). These shape parameters are Mass, Center of gravity (Centroid), Mean, Variance, Dispersion, Axis of least inertia, Digital bending energy, Eccentricity, Circularity ratio, Elliptic variance, Rectangularity, Convexity, Solidity, Euler number, Profiles and Hole area ratio (Traina et al, 2004).

Usually, all formed objects of the images in the database have calculated the distance function to form a query. For example, when 3D objects are converted into 2D images, one-dimensional object information will be lost. The shape will extract only a part from an image that represent the projected object. Computer graphics or mathematics use effective shape representation which is impracticable in shape recognition and vice versa.

C. TEXTURE

In computer apparition, texture features are defined as a description of the characteristics of the shape and color or a more comprehensive it is defined as a structure and random (Tamura et al.,1978). Structural methods consist of graphical method which tends to be more effective when applied to the texture.

The structural technique involves graphical approach that has a tendency to be more efficient (Voorhees & Poggio, 1988). Randomness approaches features (Tamura et al., 1978), stayed composition, Markov random fields, change change, tree change and two complex contours allow. Texture can be represented by a gray-level Cooccurrence (Babu Rao et al., 2011). Texture is an important feature for universal images but its complete description is still in research.

II. CBIR SYSTEMS ARCHITECTURE

Figure 1 shows a typical architecture for CBIR system system Silva (Silva Torres & Falcao, 2006). There are two main functionalities in this system which are entering data and processing queries. Subsystem is responsible for entering data for the appropriate features from the image and stores it in the database images (see dashed modules and arrows). This

process is usually done offline. Query processing, in turn, is an organized interface that allows users to specify queries and to visualize the similar retrieved images. After that, the query processing module extracts the characteristic vector based on query pattern and apply a metric such as Euclidean distance to evaluate the similarity between the query input with the images in the database.

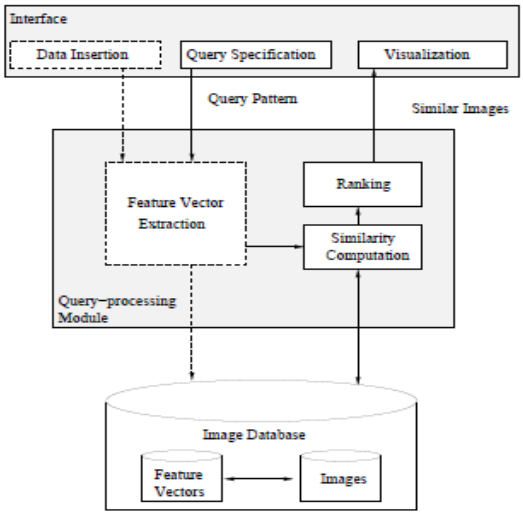

Figure 1: Typical architecture for CBIR system (Silva Torres & Falcao, 2006).

Next, the image database is ranked in descending order of similarity to the query input and the most similar images to the interface module (Silva Torres & Falcao, 2006). Image database is often indexed by feature vectors with the use of structures such as the M-tree (Ciaccia et al., 1997) or Slim-tree (Traina et al., 2002) to speed up the computation of similarities and automated retrieval. Typically, data entry and query functions use vector extraction module features (Silva Torres & Falcao, 2006).

III. COMPARISON IMAGE RETRIEVAL SYSTEMS OF CBIR

The main challenge in the development of image-based access is selection and choice and represention of the visual features. Currently, there are many CBIR systems that have been built, but the focus for this paper is on a system that uses low level features using QBIC, Virage and VisualSEEk. QBIC system use color, shape and texture to retrieve an image whereas Virage uses color, shape,texture and structure of an image. However, VisualSEEk uses global features such as mean color and color histogram to match spatial relationship between object and visual features together in order to get a powerful search result. A brief summary about QBIC, Virage and VisualSEEk applications will be discussed in this topic.

A. QBIC - Query By Image Content

QBIC was introduced by IBM that allows the user to compare the contents similarities visual image based on characteristics such as color percentages, color layout, and textures that are present in the image. Query can be a model for the image, where the sketches made by a user and painting or color and texture of selected patents (The QBIC website's) (Flickner et al., 1995). IBM has developed a QBIC technology based on the Multimedia Manager Product to retrieve visually similar images (Barber et al., 1994).

Figure 2 below show how QBIC works using color searching. For example, the Hermitage website for digital collections of Russian State Hermitage Museum was developed in collaboration with IBM Corporation using QBIC engine to achieve a digital archive of the world famous art. Archive Hermitage became a new virtual gallery of high-resolution images of works

of art using visual tools, for example by choosing colors from pallets or by sketching shape on canvas (IBM's Query by Image Content System Website's).

Usually, color can similarly use an easy surfing from a detailed category, for example prints and sculptures, sketch art paintings, weapons and armor, ceramics and porcelain and many more. QBIC help to improve search results by asking all works of art with the same visual attributes to be searched (IBM's Query by Image Content System Website's). **Figure 3** shows an interface in QBIC using the color searching.

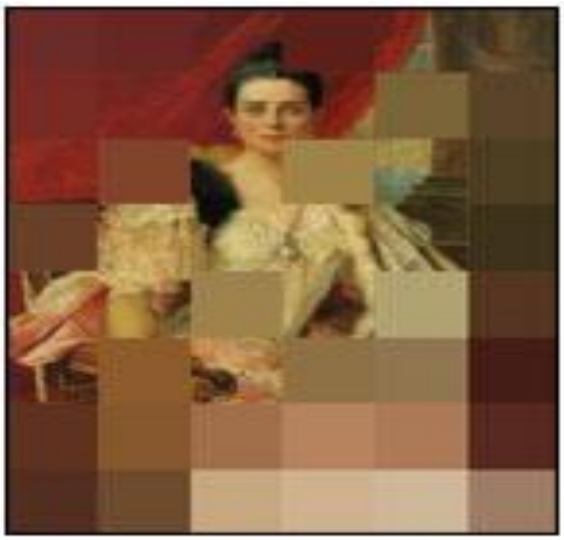

Figure 2: Hermitage website for digital collections of Russian State Hermitage Museum (Flickner et al., 1995).

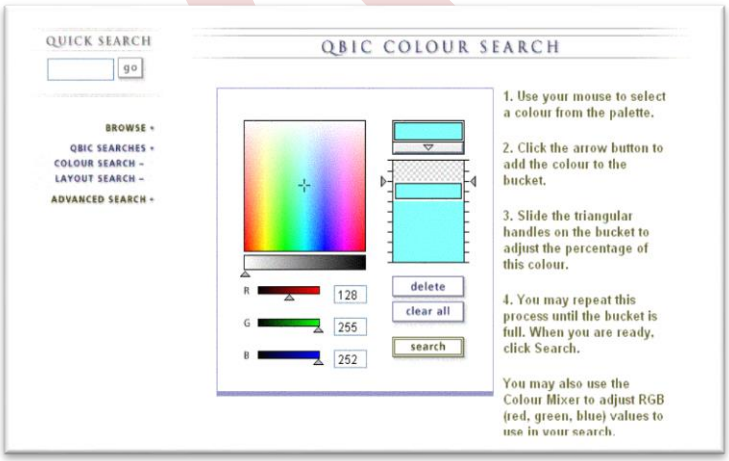

Figure 3: Color search interface in QBIC (Flickner et al., 1995).

Through the samples retreived from the database, there are 3 components such as the 3–component average colour vectors, 3-component texture vectors and 20-component shape vectors are being evaluated using weighted Euclidean distance with the inverse variances. Using a data searching, the preprocessing kept characteristics are evaluated with the specified query to control the image that matches the query.

The method of QBIC search has several advantages which has a speed searching, simple to implement and it is invariant to the small alterations in camera angle but sometimes it will happen to the large changes. However, there are some drawbacks using this application such as it is sensitive to illumination changes, sensitive to different level of gamma collection and QBIC application doesn't account for location of color.

B. Virage

CBIR has also developed Virage Image Engine to support structure of the image, queries based on color, shape and texture. According to (Meduri et al., 2008), users will modify the weights associated with each feature by combining a query. Virage is a transportable structure for the diverse CBIR application and system design to support the "plug-in" modules for specific needs to solve a specific image management.

The Virage image search engine provides an open framework for building a system. The Virage engine state visual features as the image of the "Primitives." Primitives can be very general such as color, shape and texture or to specific domains such as face recognition, detection of cancer cells, and so on. Virage architecture was designed to support both static images and videos in an integrated paradigm. Infrastructure provided by Virage engine can also be used to address the problem of high-level, such as keywords automatically, without the supervision of an assignment or classification of images (Bach et al., 1996).

The main advantage of Virage engine is that it representsa concrete and practical tool in order to construct a new applications. It also has a broad horizontal capabilities to address diverse needs in imaging and visual management. Interface of Virage is flexible and extensible.

C. VisualSEEk

Meduri et al, (2008) said, VisualSEEk is content-based image and video query systems developed for advanced television image and laboratories of the University of Columbia (Smith and Chang 1996). It integrates image-based features by color index based method of spatial queries. This allows queries to various colour in the sketch image. Queries can be made to sketch the layout of the color, by providing the URL of a seed image, or by using an example game first. Figure 4 shows an overview of VisualSEEk system that has 4 parts that users and customers VisualSEEk, network and VisualSEEk server.

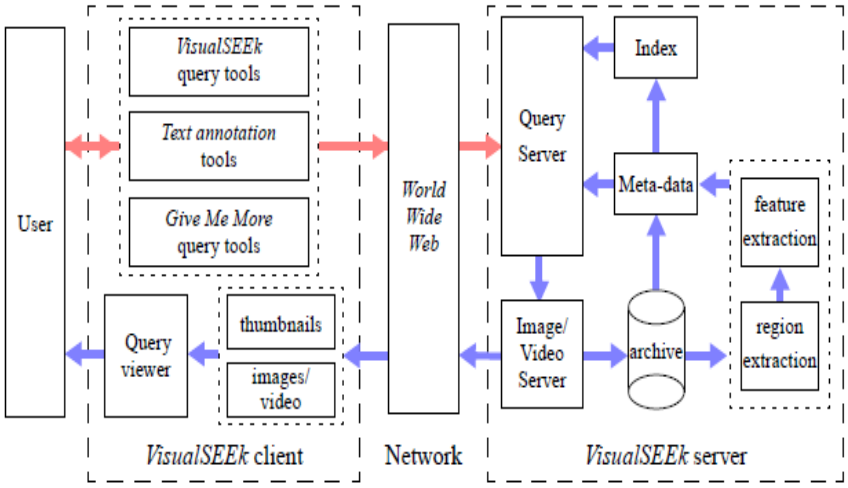

Figure 4: VisualSEEk system overview (Joint content-based Website's).

VisualSEEk client applications developed in the Java language platform to allow customers the freedom and accessibility on the World Wide Web. As shown in Figure 4, VisualSEEk system consists of several components, namely, the set of tools the user, the server queries, images and video servers, image and video archive, meta-data database and index. In reference to Venters & Cooper (1982), this system uses a novel approach for region extraction and representation based upon colour set back-projection where striking colour regions from images are automatically extracted.

Figure 5: A query example by Chang et al. (1997) using VisualSEEk

One advantages of VisualSEEk is that the system allows to search for images in a test-bed of 12; 000 color images. VisualSEEk has a tool that enables the transfer of application for browsing photo collections and videos from across the Web world over a million. VisualSEEk also supports a number of strategies to query that determines the color, size and layout of the color space, including spatial location of the absolute and relative. This image search system improves search capabilities with the integration of spatial queries such as those used in geographic information systems, and inquiries visual features. Users ask the system to search a picture or a video that covers an area with the desired characteristics and spatial relationships. **Figure 5** shows a query example by Chang et al. (1997), using VisualSEEk in which two spatially arranged color patches were issued to find images with open grass fields and blue sky.

IV. DISCUSSION OF PREVIOUS WORK IN CBIR SYSTEM

Table 1 below, shows a comparison between image retrieval systems based on keyword, color features and texture features. Search by keyword means user needs to key in the data by text based. All the search engines use text based retrieval techniques to search document. CBIR systems also need a keyword as a text based search to retrieve the relevant images. On the other hand, search by color is divided by five components which are dominant color, fixed subimage histogram, average color vector, global histogram and others. For image retrieval systems based on texture features, it is based on atomic texture features, wavelet or fourier transform, aged statistic, random fields and others.

Table 1 : Comparison between image retrieval system used in QBIC, Virage and VisualSEEk for color features (Abdul Fatah, 1996).

	Key word	Colour					Texture				
		Dominant Colour	Fixed Subimage Histogram	Average Colour Vector	Global Histogram	Other	Atomic Texture Feature	Wavelet/ Fourier	Transform Edge Statistics	Random Fields	Other
QBIC	√	-	-	√	√	-	√	-	-	-	-
Virage	√	-	-	-	-	√	-	-	-	-	√
VisualSEEk	-	√	-	-	-	-	-	-	-	-	-

Based on **Table 2**, the result of comparative experiment between QBIC, Virage and VisualSEEk is shown. Through this table, there are three types of image retreival system has

been used by the author in various fields. QBIC system is an active research compared Virage and VisualsEEk system.

Some authors have proposed new systems or algorithms (K. Karthika & C. Arunachalaperumal, 2012**;** Chadha et al, 2012; Shelly & Jindal, 2013; Chaudhari & Patel, 2012) and improved the current system. Some of the authors use low level features based on color (Alex et al., 2014; Jaswal et al., 2012), texture and shape (Allombert et al., 2010).

Table 2: Result of comparative experiment for various retrieval image of CBIR system

Image Retrieval Systems used	Author	Color	Shape	Texture
QBIC	Sakhare & Nasre (2011)	√	√	√
	Karthika & Arunachalaperumal (2012)	√	-	√
	Chadha et al. (2012)	√	√	√
	Shelly & Jindal (2013)	√	√	√
	Komali et al. (2012)	√	√	√
	Guedri et al. (2011)	-	√	√
	Alex et al. (2014)	√	-	-
	Jaswal et al. (2012)	√	-	-
Virage	Allombert et al. (2010)	-	√	-
	Nareshkumar S. & Vijayarajan V. (2013)	√	√	√
VisualSEEk	The QBIC Website's	√	-	-
	Smith & Chang (1996)	√	-	√
	Smith et al. (1996)	√	-	-

From observation, it is found that some authors focus on the CBIR research using color only, shape only and texture only. Some authors use combination of various components. The best results of the experiment is to use a combination of techniques such as color and texture (Sakhare & Nasre, 2011; Karthika & Arunachalaperumal, 2012) or color and shape.

V. CONCLUSION AND FEATURE WORKS

CBIR system is a good tool for a variety of applications to obtain visual information in various fields. The dramatic increase in the size of the database image retrieval system has led to the development of effective and efficient. As image compression, digital image processing and image feature extraction techniques become more advanced, CBIR maintains stable price development in the field of research. This paper presents the review of low level features in various of CBIR systems of QBIC, VIRAGE and VisualSEEk. Most of the organizations, companies and researchers have been using low level features in QBIC system in order to retrieve the images. Moreover this system has many functions that have been implemented such as the fastest retrieval of the images between the other images retrieval systems that we have chosen to compare. This system is invariant to the small changes in camera angle as well.

For future work, applying the system in a general purpose image search engine will be considered. Different assignments of weights of color and texture features will be explored for different image categories or properties. Moreover, extra experiments will be conducted on larger databases for comparison with similar systems to identify and quantify the strengths and weakness of the proposed techniques.

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