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A Survey: Content Based Image Retrieval Based On Color, Texture, Shape & Neuro Fuzzy

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Abstract
In current technology the acquisition, transmission, storing, and manipulation are allowed on the large collections of images. With the increase in popularity of the network and development of multimedia technologies, users are not satisfied with the traditional information retrieval techniques. So nowadays, the content based image retrieval is becoming a source of exact and fast retrieval. Content Based Image Retrieval (CBIR) is a technique which uses visual features of image such as color, shape, texture, etc. to search user required image from large image database according to user's requests in the form of a query image. Images are retrieved on the basis of similarity in features where features of the query specification are compared with features from the image database to determine which images match similarly with given features. Feature extraction is a crucial part for any of such retrieval systems. So far, the only way of searching these collections was based on keyword indexing, or simply by browsing. Literature survey is most important for understanding and gaining much more knowledge about specific area of a subject. In this paper we survey some technical aspects of current content-based image retrieval systems and described the image segmentation in image processing and the features like neuro fuzzy technique, color histogram, texture, and shape for accurate and effective Content Based Image Retrieval System after doing the deep study of related works.
Keywords— Content-Based Image Retrieval (CBIR), Neuro Fuzzy, Color Histogram, Texture, HSV Color and Wavelet decomposition, Image Segmentation.

I. INTRODUCTION

With the development of the Internet, and the availability of image capturing devices such as digital cameras, image scanners, the size of digital image collection is increasing rapidly. Efficient image searching, browsing and retrieval tools are required by users from various domains, including remote sensing, fashion, crime prevention, publishing, medicine, architecture, etc. For this purpose, many general purpose image retrieval systems have been developed. There are two frameworks: text-based and content-based. The text-based approach can be tracked back to 1970s. In such systems, the images are manually annotated by text descriptors, which are then used by a database management system. (DBMS) to perform image retrieval. There are two disadvantages with this approach. The first is that a human labour at considerable level is required for manual annotation. The second is the inaccuracy in annotation due to the subjectivity of human perception. To overcome these disadvantages in text-based retrieval system, content-based image retrieval (CBIR) was introduced in the early 1980s. In CBIR, images are indexed by their visual content, such as color, texture, shapes. [1]The fundamental difference between content-based and text-based retrieval systems is that the human interaction is an essential part of the latter system.

1.1 Classification of Images

i) Intensity Images

It represents an image as a matrix where every element has a value corresponding to how bright/dark the pixel at the corresponding position should be colored. There are two ways to represent the number that represents the brightness of the pixel: The double class (or data type). This assigns a floating number ("a number with decimals") between 0 and 1 to each pixel. The other class is called uint8 which assigns an integer between 0 and 255 to represent the brightness of a pixel. [2, 3]

ii) Indexed Images

In an indexed image, the image matrix values do not determine the pixel colors directly. Instead, MATLAB uses the matrix values as indices for looking up colors in the figure's colormap. This is a practical way of representing color images. An indexed image stores an image as two matrices. The first matrix has the same size as the image and one number for each pixel. The second matrix is called the color map and its size may be different from the image. [2, 3]

iii) Scaled indexed images

A scaled indexed image uses matrix values.

The difference is that the matrix values are linearly scaled to form lookup table indices. To display a matrix as a scaled indexed image, use the MATLAB image display function imagesc. [2, 3]

iv) Binary Images

This image format also stores an image as a matrix but can only color a pixel black or white (and nothing in between). It assigns a 0 for black and a 1 for white. [2, 3]

1.2 Content Based Image Retrieval

The term Content-based image retrieval was originated in 1992, when it was used by T. Kato to describe experiments into automatic retrieval of images from a database, based on the colors and shapes present. Since then, this term has been used to describe the process of retrieving desired images from a large collection on the basis of syntactical image features. The techniques, tools and algorithms that are used originate from fields such as statistics, pattern recognition, signal processing, and computer vision. [4]

In content-based image retrieval (CBIR), the image databases are indexed with descriptors derived from the visual content of the images. Most of the CBIR systems are concerned with approximate queries where the aim is to find images visually similar to a specified target image. In most cases the aim of CBIR systems is to replicate human perception of image similarity as well as possible. [5]

The process of CBIR consists of the following stages:

(1) Image acquisition: to acquire a digital image.

- Image Database: It consists of the collection of n number of images depends on the user range and choice.

(2) Image preprocessing: to improve the image in ways that increases the chances for success of the other processes. The image is first processed in order to extract the features, which describe its contents. The processing involves filtering, normalization, segmentation, and object identification. Like, image segmentation is the process of dividing an image into multiple parts. The output of this stage is a set of significant regions and objects.

(3) Feature Extraction: Features such as shape, texture, color, etc. are used to describe the content of the image. The features further can be classified as low-level and high-level features. In this step visual information is extracts from the image and saves them as features vectors in a features database .For each pixel, the image description is found in the form of feature value (or a set of value called a feature vector) by using the feature extraction .These feature vectors are used to compare the query with the other images and retrieval.

(4) Similarity Matching: The information about each image is stored in its feature vectors for computation process and these feature vectors are matched with the feature vectors of query image (the image to be search in the image database whether the same image is present or not or how many are similar kind images are exist or not) which helps in measuring the similarity. This step involves the matching of the above stated features to yield a result that is visually similar with the use of similarity measure method called as Distance method. Here is different distances method available such as Euclidean distance, City Block Distance, Canberra Distance.

(5) Resultant Retrieved images: It searches the previously maintained information to find the matched images from database. The output will be the similar images having same or very closest features as that of the query image. [6]

(6)User interface and feedback which governs the display of the outcomes, their ranking, the type of user interaction with possibility of refining the search through some automatic or manual preferences scheme etc.[7]

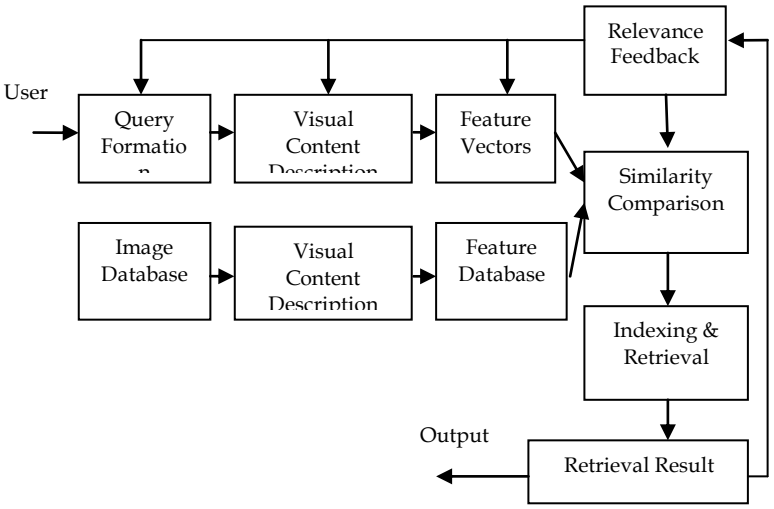

Fig 1.1 CBIR System and its various components

1.3 Application of CBIR systems

(1) The advantages of such systems range from simple users searching a particular image on the web.
(2) Various types of professionals like police force for picture recognition in crime prevention.
(3) Medicine diagnosis
(4) Architectural and engineering design
(5) Fashion and publishing
(6) Geographical information and remote sensing systems
(7) Home entertainment [8]

1.4 Main Challenges to CBIR systems

There could be many challenges faced by a CBIR system such as:

(1)The issue related to the Semantic gap where it means 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. The user wants to seek

semantic similarity, but the database can only provide similarity by data processing. [9]
(2) The expectation of users for huge amount of objects to search among. [8]
(3)Sometimes incompleteness of query specification seems to be a challenge.
(4)Incomplete image description is also a source of challenge to an efficient CBIR system.

1.5 Kinds of CBIR

i) General: In this type of model we try to match a query image to an arbitrary collection of images.
ii) Application specific: Here we try to match a query image to a collection of images of a specific type (e.g. Finger prints, X-ray images of specific organs). [9]

1.6 Feature Extraction

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. [7]

i) Color

Color is one of the most widely used low-level visual features and is invariant to image size and orientation.

➢ **Color Histogram**

One of the most popular features used in CBIR is the color histogram in the HSV color space, as used in MPEG-7 descriptor .The images are firstly converted to the HSV color space, and a 64-bin color histogram is generated by uniformly quantizing H, S, and V components into 16, 2, and 2 regions, respectively. [11]

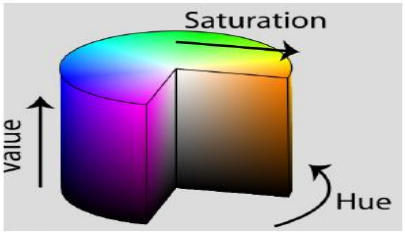

Fig. 1.2 The HSV space color [11]

➢ **Color Moments**

The mean μ, standard deviation σ, and skew g are extracted from the R, G, and B color spaces to form a 9-dimensional feature vector 1[10].

RGB is the best known space color and is it commonly used for visualization. The acronym stands for Red Green Blue. This space color can be seen as a cube where the horizontal x-axis as red values increasing to the left, y-axis as blue increasing to the lower right and the vertical z-axis as green increasing towards the top, as in fig.4.2 [11]

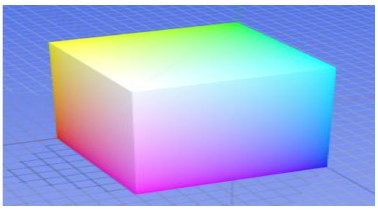

Fig.1.3 The RGB color model mapped to a cube. The origin, black, is hidden behind the cube. [11]

ii) Texture

A texture measure is also a larger variety feature used for image retrieval. Some of the most common measures for capturing the texture of images are wavelets and Gabor filters. These texture measures try to retrieve the image or image parts characteristics with reference to the changes in certain directions and the scale of the images. This is most useful for region or images with homogeneous texture. [9]

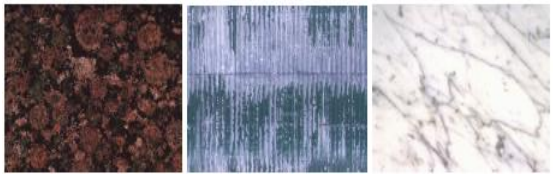

Fig.1.4 Example of textures [11]

iii) Shape

Shape 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. Shape representations can be generally divided into two categories:
(1)Boundary-based--- shape representation only uses the outer boundary of the shape. This is done by describing the considered region using its external characteristics; i.e., the pixels along the object boundary. [12]
(2)Region-based--- shape representation uses the entire shape region by describing the considered region using its internal characteristics; i.e., the pixels contained in that region.[12]
Methods used for edge detection as preprocessing are:

- Canny edge detection algorithm
- Sobel edge detection algorithm

✓ The Canny edge detection algorithm:

The Canny edge detection algorithm is popular as the optimal edge detector.
Here, an "optimal" edge detector means:

- ❖Good detection – the algorithm should mark as many real edges in the image as possible.
- ❖Good localization – edges marked should be as close as possible to the edge in the real image.

❖ Minimal response – a given edge in the image should only be marked once, and where possible, image noise should not create false edges. [12]

✓ Sobel Edge Detection Algorithm:

As designs become larger and more complicated, it has become necessary to describe a design at a high level. This high level description not only enables the designer to run simulations faster, it can also be used throughout the development process for verification. This resulting process allows developers to identify bugs early on and avoid costly bug discovery towards the end of development. This high-level design is usually done by system engineers. [12]

iv) The retrieval based on Neuro Fuzzy

The technique of the proposed neurofuzzy content based image retrieval system in two stages. 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. Fuzzy logic is used to define the query. [13]

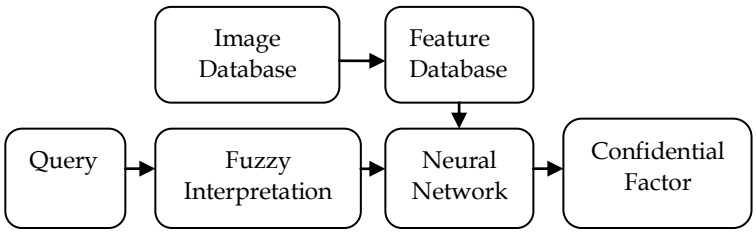

Fig.1.5 Block diagram of Neuro Fuzzy system [13]

1.7 CBIR with relevance feedback

A major task in the CBIR systems is the similarity matching between the query image and the retrieved images. Unfortunately, the gap between high-level concepts and low-level features, as well as the subjective perception for the visual content by the human beings, result a significant mismatch between the retrieval results judged manually and by the computers. To improve the retrieval precision, human interactions are usually involved. Relevance feedback is an interactive process which integrates 'users' evaluation of the retrieval results. Typically, the relevance feedback technique includes an interactive scoring system to evaluate the past retrieval results to improve the subsequent content retrieval. Various techniques, such as Radial Basis [10]

1.8 Wavelet Transformation

Wavelet analysis is an exciting new method for solving difficult problems in mathematics, physics, and engineering, with modern applications as diverse as wave propagation, data compression, signal processing, image processing, pattern recognition, computer graphics, the detection of aircraft and submarines and other medical image technology. The wavelet representation of a function is a new technique. Wavelet transform of a function is the improved version of Fourier transform. [14]

II. LITERATURE REVIEW

2.1 Existing Image Retrieval Systems

Since the early 1990s, content-based image retrieval has become a very active research area. Both commercial and research image retrieval systems, have been built. Most image retrieval systems support one or more of the following options [15]:

- random browsing
- search by example
- search by sketch
- search by text (including key word or speech)
- navigation with customized image categories.

Today, there is the provision of a rich set of search options, but in practical applications which involves actual users still need systematic studies to explore the trade-offs among the different options mentioned above. Here, we will select a few representative systems and highlight their distinct characteristics. [15]

Some of the existing CBIR systems [15] are:

- ✓ QBIC or Query by Image Content It is the first commercial content based retrieval system. This system allows users to graphically pose and refine queries based on multiple visual properties such as color, texture and shape. It supports queries based on input images, user-constructed sketches, and selected colour and texture patterns.
- ✓ VisualSEEK and WebSEEK VisualSEEk is a visual feature search engine and WebSEEk is a World Wide Web oriented text/image search engine, both of which are developed at Columbia University.
- ✓ Virage Virage is content based image search engine developed at Virage Inc.It supports color and spatial location matching as well as texture matching.
- ✓ NeTra This system uses color, shape, spatial layout and texture matching, as well as image segmentation.
- ✓ MARS or Multimedia Analysis and Retrieval System This system makes use of colour, spatial layout, texture and shape matching.
- ✓ Viper or Visual Information Processing for Enhanced Retrieval .This system retrieves images based on color and texture matching.
- ✓ The img (Anaktisi) The img (Anaktisi) is a CBIR system on the web based on various descriptors which includes powerful color and texture features. The img (Anaktisi) provides different ways to search and retrieve them.

2.2 Related Work

Jaiswal, Kaul [8] concluded that content based image retrieval is not a replacement of, but rather a complementary component to text based image retrieval. Only the integration of the two can result in satisfactory retrieval performance. In this paper they reviewed the main components of a content based image retrieval system, including image feature representation, indexing, and system design, while highlighting the past and current technical achievement.

Ivan Lee, et.al. (1996) [10] have present the analysis of the CBIR system with the human controlled and the machine controlled relevance feedback, over different network topologies including centralized, clustered, and distributed content search. In their experiment for the interactive relevance feedback using RBF, they observe a higher retrieval precision by introducing the semi-supervision to the non-linear Gaussian-shaped RBF relevance feedback.

Verma, Mahajan, (2012) [13] have used canny and sobel edge detection algorithm for extracting the shape features for the images. After extracting the shape feature, the classified images are indexed and labeled for making easy for applying retrieval algorithm in order to retrieve the relevant images from the database. In their work, retrieval of the images from the huge image database as required by the user can get perfectly by using canny edge detection technique according to results.

Ryszard S. Chora´s (2007) [16] contributes their work for the identification of the problems existing in CBIR and Biometrics systems describing image content and image feature extraction. They have described a possible approach to mapping image content onto low-level features. Their paper investigated the use of a number of different color , texture and shape features for image retrieval in CBIR and Biometrics systems.

Pattanaik , Bhalke (2012) [17] has worked to prove that Content Based Image Retrieval has overcome all the limitation of Text Based Image Retrieval by considering the contents or features of image. A query image can be retrieved efficiently from a large database. A Database consists of different types of images has implemented on the system. Different Features such as histogram, color mean, Color structure descriptor texture is taken into consideration for extracting similar images from the database. From the experimental result it is seen that combined features can give better performance than the single feature. So selection of feature is one of the important issues in the image retrieval. The system is said to be efficient if semantic gap is minimum .The result can be improved in future by introducing feedback and user's choice in the system.

Zhao,Grosky (2002) [18] view that bridging the semantic gap between the low-level features and the high-level semantics is within the interface between the user and the system, other research direction is towards improving aspects of CBIR systems by finding the latent correlation between low-level visual features and high-level semantics and integrating them into a unified vector space model.

Peter Stanchev, et.al. [19] proposed that Several visual descriptors exist for representing the physical content of images, for instance color histograms, textures, shapes, regions, etc. Depending on the specific characteristics of a data set, some features can be more effective than others when performing similarity search. For instance, descriptors based on color representation might be effective with a data set containing mainly black and white images. Techniques based on statistical analysis of the data set and queries are useful.

From [20] a study conclude that a system based on the fuzzy c-means clustering algorithm, the CBIR system fuses color and texture features in image segmentation. A technique to form compound queries based on the combined features of different images is devised. This technique allows users to have a better control on the search criteria, thus a higher retrieval performance can be achieved.

III. CONCLUSION

From the literature survey it is concluded that a wide variety of CBIR algorithms have been proposed in different papers. The selection feature is one of the important aspects of Image Retrieval System to better capture user's intention. It will display the images from database which are the more interest to the user. The purpose of this survey is to provide an overview of the functionality of content based image retrieval systems. Most systems use color and texture features, few systems use shape feature, and still less use layout features. Fuzzy logic has been used extensively in various areas to improve the performance of the system and to achieve better results in different applications.

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