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Fundamental Approaches Implemented in Content Based Image Retrieval System

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Abstract – This paper presents a comprehensive study on different techniques and approaches implemented in the research area for image retrieval and especially in the field of content based image retrieval. Image retrieval has been an active area among researchers from past few years. Different techniques and approaches have been implemented in the image retrieval system so as to achieve higher efficiency and accuracy. The major concern of an image retrieval system is to retrieve a desired image as per the user query. The overall system performance is based on the accuracy and efficiency. In this paper a survey on different techniques and approaches implemented in the Content Based Image Retrieval System is proposed. Various Techniques like Color Coherence Vector (CCV), Extended Local Tetra Pattern, Color Histogram Processing, Wavelet Based Color Histogram, DCT & DCT wavelets, Gabor filtering and Haar Wavelet Transform and K-means Clustering algorithms have been implemented in the Image Retrieval system to achieve higher accuracy and efficiency of the system & its performance

Keywords*: Image retrieval, Content Based image retrieval, Color Coherence Vector, Extended Local Tetra Pattern.*

I. Introduction

A large amount of digital data in form of images is been generated by various areas like defense, weather forecasting department, civilians, satellites, bio-medical and government. Due to convenience and easy accessibility to the internet digital photography is one of the worldwide medium of obtaining and sharing information. This provides us unique image databases and videos which are easily available & accessible on the web. In the present scenario visual data is very common and the mass of digital images on the web is increasing per minute with very high rate. This huge amount of digital data i.e. being generated needs to be either annotated by keywords or captions so as to achieve a perfect retrieval system for the desired image. This causes many researchers to pay attention to develop efficient image retrieval techniques that give accurate result.

In the last two decades Image Retrieval (IR) has been an active research area. Research in image retrieval is broadly divided into two categories.

CBIR- In Content-based image retrieval system Image features i.e. visual contents of an image such as color, shape, spatial layout, and image texture are used to represent and index the image. Typically in content-based image retrieval systems the visual features are extracted from the images and described by multi-dimensional feature vectors from the database. The feature vectors that represent the images in the database form a feature database. To retrieve images, users provide a query image to the retrieval system. The system then changes the query images into its internal representation of feature vectors. The retrieval is performed with the help of indexing scheme in which the similarities or distance between the feature vectors of the query image or picture and those of the images in the database are then calculated and matched. This indexing scheme provides an efficient method of searching images from the image database. Recently users' relevance feedback has been incorporated in the retrieval systems to modify the retrieval process so as to achieve more efficient, effective, and fast retrieval of images.

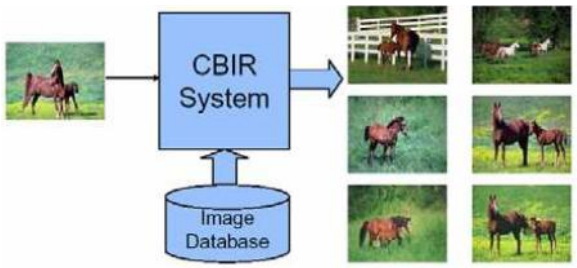


Fig: 1 Concept of Content Based Image Retrieval System.

I.1. A General Outline of Content Based Image Retrieval System:

A. Feature Extraction: - The most important part of content-based image retrieval is Feature (content) extraction. Broadly features in an image may include both text-based features like keywords, captions, or annotations and visual features may include shape, color, texture etc. Feature extraction is the heart of the content based image retrieval.

B. Color Feature: - Color is the most significant features of an image that makes possible the recognition of images by humans. Color is a property which depends on the reflection of the light from an object to the eye and the processing of that information in the brain. Color has been used every day to tell the distinction between objects, places, and the time of day.

C. Texture Feature:- There is no exact definition of texture in the field of computer vision and image processing. This is because the available texture descriptions are centered on texture analysis methods and the features extracted from the image.

D. Shape Feature:- Shape of an object is another major image feature i.e. contained in the image. Features of the Shape of an image may be explained as the typical surface arrangement of an object; an outline or contour. It allows an object so that it can be distinguished from its surroundings by its outline.

E. AIA: - Earlier techniques generally were not only based on visual features but on the textual annotation of images. In other words, firstly images are annotated with a text and then searching is done using a text-based approach from traditional database management systems. Image retrieval using text-based uses traditional database techniques to manage images. To facilitate easy navigation and browsing based on standard Boolean queries images can be organized by topical or semantic hierarchies through text descriptions. However, for a wide spectrum of images automatically generating descriptive texts is not feasible, manual annotation of images is required by most text-based image retrieval systems. Apparently, manually annotating images is a cumbersome and expensive task for large image databases, and it is often subjective, context-sensitive and is not complete. As a result, it is difficult for the traditional text-based methods to support a variety of task-dependent queries.

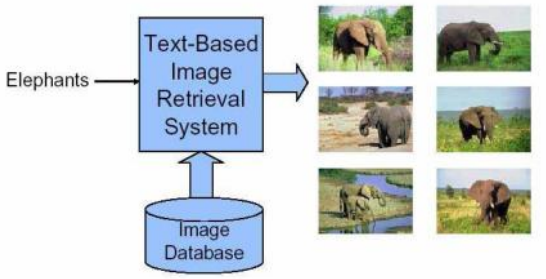


Fig: 2 Show the general outline of automatic image

I.2. Annotation in which it includes the following steps:

A. Segmentation: Segmentation is a step where an image is divided into group of pixels which are non-heterogeneous in nature. Then it extracts the visual features of the images which can be combined or split in order to build objects which are of our concern and on which we want to perform our image analysis and interpretation.

B. Feature Extraction: It is process in which low level visual information of the segmented image are being extracted in which various feature descriptors are used like color, texture, shape. Color and texture are among those visual features of the images which are most commonly extracted.

C. Feature Selection: Feature Selection is a process in which feature spaces of high dimensional images are reduced to low dimensional feature spaces using statistical techniques such as Principal Component Analysis and Particle Swarm Optimization Algorithm.

D. Clustering/Classification: Clustering is a step in which we group of feature vectors is formed. The feature vector depends on some of the efficient clustering techniques which are k means and fuzzy clustering. Clustering partitions the group of feature vector which are based on certain identified common feature and several other similarity measures for image retrieval.

E. Annotation Model: In this step annotation of image is done on the annotation model which are chosen such that the keywords are transferred from training to test images which are based on the annotation model are used for the annotation of the image.

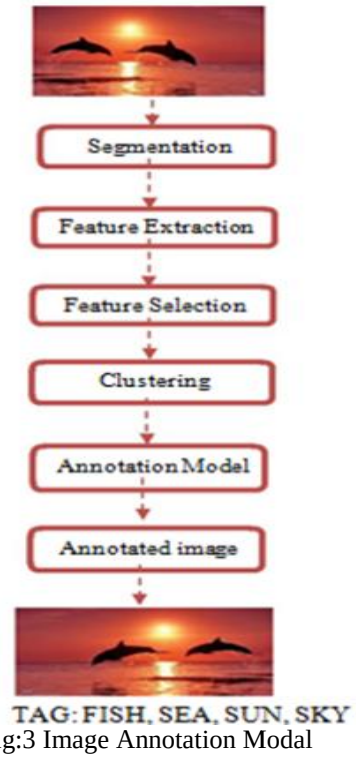


Fig:3 Image Annotation Modal

This paper is organized as follows. In Section II we include literature review related to content based image retrieval. Section III describes different techniques of content based image retrieval. Finally Section IV concludes our paper.

II. Literature Survey

Gulfishan Firdose Ahmed, Raju Barskar[1]"A Study on Different Image Retrieval Techniques in Image Processing" In this paper, the basic components of content-based image retrieval system is introduced. Based on color, texture, shape and semantic image are discussed, analyzed and compared as Image retrieval methods. The semantic-based image retrieval is an efficient way to solve the "semantic gap" problem, so this paper mainly aims on the semantic-based image retrieval method. Relevance feedback and performance evaluation related techniques are conversed. Problems and challenges are proposed as the conclusion.

Manimala Singh, K.Hemachandran [2] "Content Based Image Retrieval using Color and Texture Signal & Image Processing". The paper proposed the concept of content based image retrieval, using features like texture and color, called WBCHIR (Wavelet Based Color Histogram Image Retrieval).The Wavelet transformation and Color Histogram is used to extract the texture and color features from an image and the combination of these features is robust for scaling and translation of objects in an image. The suggested method has confirmed a favorable and quicker retrieval method on a WANG image database containing 1000 general-purpose color images in the conclusion.

Ritendra Datta [3] "Image retrieval: Ideas, influences, and trends of the new age". The paper discusses several key contributions in the present decade associated with the image retrieval and automated image annotation, covering 120 references. Some of the key challenges that have involved in the adaptation of current image retrieval methods are to build suitable systems that can handle real-world data. The conclusion of the paper is the trends in the column and impact of publications in the field with respect to venues/journals and sub-topics.

Ritika Hirwane [4]"Fundamental of Content Based Image Retrieval". The paper focuses to review the present trends in content-based image retrieval (CBIR), which is a system for retrieving of the images which is based on the basis of automatically-derived image features like color, texture and shape. Based on the relevant literature and researchers in the field this paper proposed more efficient, effective, fast retrieval scheme.

Dr. Fuhui Long [5]"Fundamentals Of Content-Based Image Retrieval". This paper introduces some fundamental theories for content-based image retrieval. The paper looks forward at the development of content-based image retrieval techniques based on efficiency of no. of images retrieve. Some widely used methods for visual content are been described. The paper briefly addresses similarity/distances measures between visual features, the indexing schemes, query formation, relevance feedback, and system performance evaluation. Details of these techniques are discussed in subsequently. Finally, the paper concludes based on the techniques applied.

Ms. Apurva N. Ganar [6] "Enhancement of image retrieval by using color, texture and shape features". This paper provides a simplified way to use the primitive features to retrieve the desired image. The technique by which the required image is obtained is CBIR. The Color Histogram and Texture features are obtained by quantifying the HSV color space and using these components a feature matrix is formed. This matrix is then mapped with the characteristic of local and global color histogram, and are analyzed and compared. For the co-occurrence matrix between the query image and the images that are in the database to retrieve the image. Gradient method is used here for extracting the features of shape. The conclusion is based on this principle, CBIR system uses shape, texture, and color features to retrieve desired image from the large database and hence it offers more efficiency and enhancement in image retrieval than the single feature retrieval system which means better image retrieval results.

Yong Rui and Thomas S. Huang[7]"Image Retrieval: Current Techniques, Promising Directions and Open Issues". The paper is a comprehensive study on the technical achievements that are done in the research areas of image retrieval, particularly in the field of content-based image retrieval, an area that has been so active from last few years. The survey made in this paper includes almost 100+ papers that cover the research aspects of image feature like image representation, feature extraction and multidimensional indexing, and system design, three of the fundamental bases of content-based image retrieval. The conclusion is a vast study and future hopeful work that can be implemented so as to enhance the modern image retrieval system.

Reshma Chaudhari, A. M. Patil [8] "Content Based Image Retrieval Using Color and Shape Features". This paper proposes an algorithm which incorporates the advantages of various other algorithms so as to improve the accuracy and the performance of retrieval system. The accuracy of color histogram based matching can be

improved by implementing the Color Coherence Vector (CCV) for successive refinement. The speed of shape based retrieval can be improved by considering approximate shape rather than the exact shape. In addition to this a combination of color and shape based retrieval is also included to improve the accuracy of the result is concluded.

Neetu Sharma [9] "Efficient CBIR Using Color Histogram Processing Signal & Image Processing". This paper focuses to compare various global descriptor attributes and to make CBIR system more efficient. It was found that further modifications were needed to produce better performance in searching images. The paper concludes the use of color histogram for image retrieval.

Junaid Khan [10] "Implementation of Content Base Image Retrieval Using Clustering Technique". This report explained a description of the primitive features of an image; texture, color, and shape. These features are extracted and used as the basis for a similarity check between images using the clustering technique. The paper concludes with algorithms used to calculate the similarity between extracted features, are then explained.

H. B. Kekre [11] "Retrieval of Images Using DCT and DCT Wavelet over Image Blocks". This paper introduces a new CBIR system based on two different approaches to achieve the retrieval efficiency and accuracy. Color and texture information is extracted and used in this work to form the feature vector. To do the texture feature extraction this system uses DCT and DCT Wavelet transform to generate the feature vectors of the query and database images. Color information extraction process includes separation of image into R, G and B planes. The paper concludes with the comparison between DCT and DCWT.

Arnold W.M. Smeulders [12] "Content Based Image Retrieval at the End of the Early Years". This paper presents a review of 200 references in content-based image retrieval. The paper starts with discussing the working conditions of content-based retrieval: pattern of use, types of pictures, the role of semantics, and the sensory gap. The paper conclusion is based on the survey of the CBIR system.

Remco C. Veltkamp[13]"Features In Content-Based Image retrieval Systems: A Survey "This paper presents the detailed framework of CBIR system in terms of technical aspects like: querying, relevance feedback, result presentation, features, and matching. The paper concludes the overview of CBIR system.

Aasish Sipani[14]"Content Based Image Retrieval Using Extended Local Tetra Patterns" .The paper aim to give a better image retrieval method by extending the Local Tetra Patterns (LTrP) for CBIR using texture classification by using additional features like Moment Invariants and Color moments. These features give additional information about the color and rotational invariance. So an improvement in the efficiency of image retrieval using CBIR is expected and is concluded as a result.

III. Different Techniques of Content Based Image Retrieval System

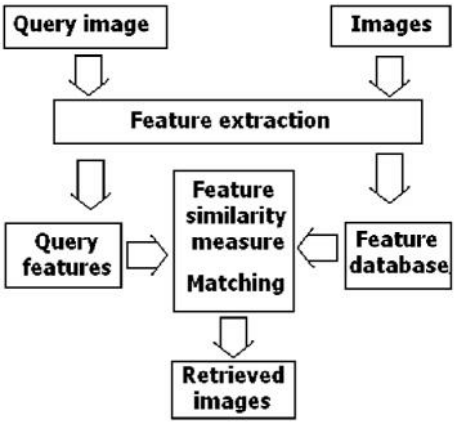
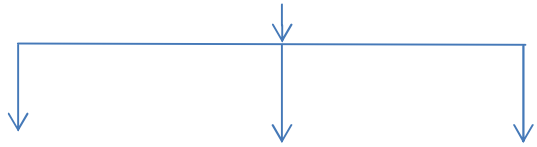


Fig.4 Diagram of the image retrieval process

Content based image retrieval technique is done by three basic methods i.e. through color, shape and texture. In CBIR, the HSV color space is first quantified so as to obtain the color histogram and texture features. Then a feature matrix is formed using these components. This matrix is mapped with the characteristic of global color histogram and local color histogram, which are analyzed and compared, for the co-occurrence matrix between the local image and the images in the database to retrieve the image. Using the gradient method shape features is extracted. Based on this principle, CBIR system uses color, texture and shape fused features to retrieve desired image from the large database and hence provides more efficiency or enhancement in image retrieval than the single feature retrieval system which means better image retrieval results.[6]

Content Based Image Retrieval System



Based on Color Based on Shape Based on Texture

A. Color Feature Extraction: Computing distance measures based on color similarity is achieved by computing a color histogram for each image that identifies the proportion of pixels within an image holding specific values. Examining images based on the colors they contain is one of the most widely used techniques because it can be completed without regard to image size or orientation. However, research has also attempted to segment color proportion by region and by spatial relationship among several color regions. The HSV color space is quantified to obtain the color histogram and texture features.

Using these components a feature matrix is formed. Then this matrix is mapped with the characteristic of global color histogram and local color histogram, which are analyzed and compared. For the co-occurrence matrix

between the local image and the images in the database to retrieve the image.

B. Shape Feature Extraction: Shape does not refer to the shape of an image but to the shape of a particular region that is being sought out. Shapes will often be determined first applying segmentation or edge detection to an image. Other methods use shape filters to identify given shapes of an image.[11] Shape descriptors may also need to be invariant to translation, rotation, and scale. Shape can be extracted using Fourier transform, Moment Invariant methods. For extracting shape feature gradient method is used here. Based on this principle, CBIR system uses color, texture and shape fused features to retrieve desired image from the large database and hence provides more efficiency or enhancement in image retrieval than the single feature retrieval system which means better image retrieval results.

C. Texture Feature Extraction: Texture measures look for visual patterns in images and how they are spatially defined. Textures are represented by texels which are then placed into a number of sets, depending on how many textures are detected in the image. These sets not only define the texture, but also where in the image the texture is located. Texture is a difficult concept to represent. The identification of specific textures in an image is achieved primarily by modeling texture as a two-dimensional gray level variation. The relative brightness of pairs of pixels is computed such that degree of contrast, regularity, coarseness and directionality may be estimated. The problem is in identifying patterns of co-pixel variation and associating them with particular classes of textures such as silky, or rough. Other methods of classifying textures include: Co-occurrence matrix, Laws texture energy, Wavelet Transform, Orthogonal Transforms (Discrete Tchebichef moments)

V. Conclusion

The paper presents a detail survey on various techniques implemented in CBIR system. The overall aim of this paper is to provide a brief review of various concepts used in the CBIR system to achieve high accuracy and efficiency. We believe that the field will experience various changes and implementation of various concepts in future, with the intent on being more on application-oriented, domain-specific work and accurate. The paper provides some ideas and approaches for building practical, real-world systems that we perceived during our own implementation experiences. The future of this field depends on the collective focus and overall progress in each aspect of image retrieval, and how much the ordinary individual stands to benefit from it.

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