STUDY BASED PERFORMANCE ANALYSIS OF CONTENT BASED IMAGE RETRIEVAL TECHNIQUES BASED ON VISUAL FEATURES

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ABSTRACT

The area of multimedia contents increases online day by day. Therefore image data availability search has become a feasible way of retrieving relevant images. Content-Based Image Retrieval has emerged as an important area in computer vision and multimedia computing. The objectives of this research are to give the various theoretical and practical side that are exist in the literature. This paper consists of detail knowledge of CBIR system with feature extraction methods and analysis with performance parameter of their pros & cons.

Keywords*: *CBIR, Color, Image retrieval,Feature Extraction,Performance parameter, Texture, Shape.

I. INTRODUCTION

A huge amount of work has been done on the capable field of multimedia and image retrieval systems. Image retrieval system has been popular so much from the past years. Many different systems are design for content based image retrieval (CBIR). A content-based retrieval is used to search query from database based on visual characteristic. CBIR system depends on important visual contents ie. Color, Texture, Shape, Size, Spatial details of an image.[4] These features can be extracted by using image processing tools and compared to the features of the query image. Combination of these features are achieve higher level of retrieval accuracy. Efficiency and accuracy are two important concepts in designing a content-based system. In this way, image retrieval can be characterized as the assignment of looking for images in a image database.CBIR systems look collection of images [3] in view of features that can be separated from the image files themselves without manual distinct. The target of CBIR systems is to backing image retrieval in light of substance e.g., figure, color, texture. The following figure(1) show the general block diagram of CBIR system.
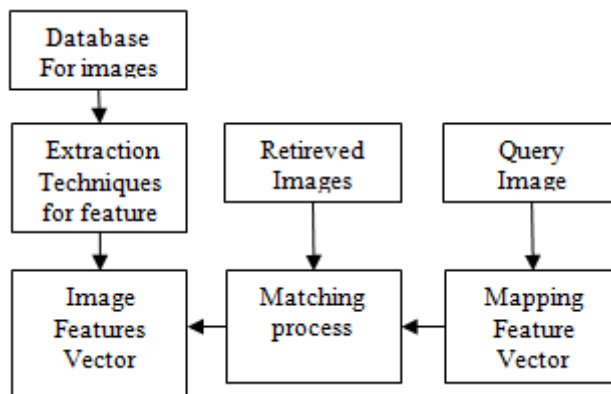
Fig 1 General block diagram of CBIR system.

A central issue of this approaches are the feature vector extraction. Grouping images into (semantically) meaningful categories using low-level visual features is a challenging and important problem in content-based image retrieval. Feature extraction is the methodology of creating elements to be utilized as a part of the selection and classification tasks. Feature selection declines the quantity of features gave to the classification task. Those features which are prone to help in inclination are chosen and utilized as a part of the classification task. Features which are not choose are discarded. The final consequence of the extraction assignment is an arrangement of components, regularly called an feature vector, which constitutes a representation of the image.Figure 1.2 show the classification of the Image retrieval system.
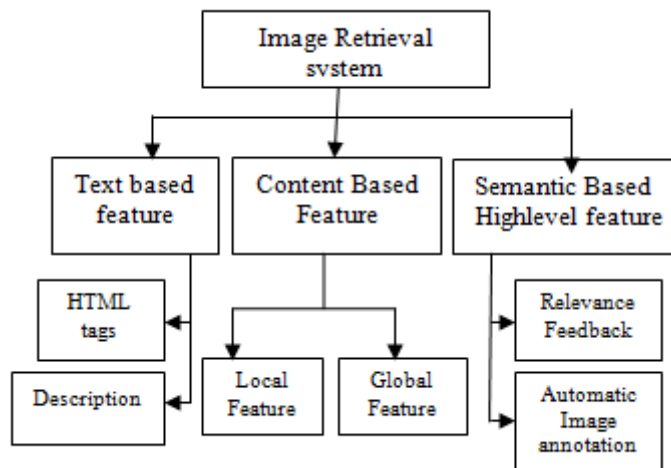

Figure 1.2 Image retrieval classification .

II. FEATURE EXTRACTION CATEGORIES

According to the existing literature the Visual contents can be categorise in two types: text based and visual contents based.Textual (text based) features are keywords, html tags,documents etc. Visual (visual based) image features are color, shape, texture etc. The visual features are again divided into general features and domain specific features. General features are color, texture, shape and domain specific features are application dependent for e.g. human faces and finger prints. Domain specific features are related to pattern

recognition.Content-based image retrieval, uses the visual contents of an image such as color, shape, texture, and spatial layout to represents and indexed the image. The low level visual features are-:

Color Feature Extraction-

The aim of finding color feature indexing is to retrieve all the images whose color configurations are related to the color configuration of the query image. The color content is widely used important feature for image representation. Color histrogram, color correlation, color space, color quatisation and relationship measurement are the key components of color feature extraction. Color feature is not conditional for shape and size of image. The color models can be classified such as RGB and LUV, HSV, YCBCR etc.

Texture Feature Extraction-

Texture is used to get the multiresolution attributes of an image. It refers to innate surface properties of an object and their relationship to the surrounding environment. Texture feature arises where regularity and coarseness is presents. Texture feature describes spectral features which are taken using wavelet transform, statistical features, tamura texture features etc. Tamura explored the texture representation from a different viewpoint. [6]Texture and color queries can be formulated in similar way, by selecting desired textures or by supplying an query image.

Shape Feature Extraction-

Shape is one of the important features and contains the most attractive visual information for human perception. Basically shape refer to the information that can be deduced directly from images shape extracted from the image only in part represents the projected object. It creates problem even more difficult, shape is often degraded with noise, arbitrary distortion and occlusion. Shape features is categories into two types contour based and region based. Contour based shape features uses only boundary of the shape whereas region-based shape features uses entire shape region[5].

Shape features are known as geometric features. shape feature are commonly used – global features such as aspect ratio, circularity and moment invariants and local features[7].

III. RELATED REVIEWS

Based on the reviews of the various existin contents based image retrival techniques it can be categorise In three different types.

1. Retrieval is based upon the color contents.

2. Retrieval is based upon the texture contents.

3 Retrieval is based upon the shapecontents.

4. Retrieval is based upon Mixed contents.

3.1 Color contents based

Shrivastav,Tygi et. al. gave "An Efficient Techniques For Image Retrival Of Color Images In Large Data Base" Elsevier Nov. 2014.This paper presents a new image retrieval technique which retrieves similar images in three stages. A fixed number of images firstly retrieved based on their color feature similarity. The relevance of the retrieved images is further improved by matching their texture and shape features. This eliminates the need of fusion and normalization techniques, which are commonly used to calculate final similarity scores. This reduces the computation time and increases the overall accuracy of the system[13].

Kinnareea, Pattanasethanonb, Boonthoa Thanaputtiwirota, et. al. provides "RGB Color Correlation Index for Image Retrieval" Elsevier 2011. The main focus of this paper is on an image retrieval scheme that is based on the concept of maximum RGB color correlation index between images. The proposed method retrieves the images on the basis of maximum color correlation so that the images with more similarities and, hence, exhibiting maximum correlation with each image is the index for retrieved accordingly. The RGB correlation index method has a maximum precision and recall rate. The propose image retrieval system has a high detection rate with RGB correlation index [20].

Kousalya,Thanamani, et al. provides the "Image Color Extraction And Retrieval Using Classification Techniques" 2013. This paper provides color features concepts for retrieving similar images. CBIR aim at measuring color for specific images that are similar to a given query color. This approaches include color features are usually represented as a histograms of intensity of the pixel colors. The Objective is to extracting color from specific images and retrieving the similar pixels using Euclidean distance measures[15].

3.2 Texture Content Based

K.P, Mary, Vasuki, et al. gave "An Image Retrival Techniques Based On Texture Feature Using Semantic Properties" IEEE pattern Recogntion 2013. The main focus of this paper is on the semantic based image retrieval system based on the texture feature. GLMC method is used for texture feature extraction which gives semantic interpretation of images .The paper works for reducing the semantic gap between the low level feature and high level feature. The extracted features are assigned into semantics [14].

Divakar Singh Anju Singh provide "A New Frame Work For Texure Based Image Content With Comparative Analysis of Clustering Techniques" IEEE 2012. The paper show the comparative study of two clustering algorithm for image retrival system . for this comparison the more appropriate feature of image is texture visual feature for improving the retrieval efficiency.[17]

3.3 Shape Content Based

Sheikh, Mansor,.Lye,Fauzi, et al. give the "Content Based Image Retrival System For Marine Life Images Using Gradient Vector Flow" IEEE 2013.This paper focus on marine life images and also emphasis on shape matching.The aim of this research is to recognize marine species without huge amount of man power in malaysia. The objective of this work is to compare automated segmentation and manual segmentation with without segmentation. It uses two feature   extraction techniques color & shape for indexing and recognition[16].

Acharya, Devi, et al. focuese on "Image Retrieval Based on Visual attention Model" Elsevier 2012. It proposes a new technique of incorporating visual attention model to segment and extract the ROI from an image and then use the result for image retrieval purposes. The main advantage of this concept lies in the improvement of the performance of the retrieval scheme in terms of two parameters Precision and Recall[19].

3.4 Mixed(combination of color, texture, shape) Content Based

Kannan,Mohan,Anbazhagan, et al.   focuses on "Image Clustering and Retrieval using Image Mining Techniques" 2010. This paper proposed a combined approach of image mining and content based image retrieval and a new clustering technique also has been added to increase the speed of the image retrieval

system. The objective of this approach is to reduce loss of information in images and extracting meaningful features [21].

Maheshwari, Silakari, Motwani, et al. focuses on "Image Clustering using Color and Texture" IEEE 2009. This paper is focuses on image clustering based on color and texture features. For extracting the information from the image dataset used Color moment and Gabor filter. For image data clustering used K-means and hierarchical data mining clustering algorithm of the image dataset. This approach provides a group of image data set into various clusters[22].

WangXing-yuan , ChenZhi-feng, YunJiao-jiao, "An effective method for color image retrieval based on texture", 2012. The paper presents a effective color image retrieval method based on texture, which uses the color co-occurrence matrix to extract the texture feature and measure the similarity of two color images. But proposed method is superior to the gray-level co-occurrence matrix method and color histogram method[18].

Datta, Joshi Li, Z. Wang, Acm "Image Retrieval: Ideas, Influences, and Trends of the New Age" Computing Surveys, April 2008. The article contribute the theoretical study and analysis related to image retrieval and automatic image annotation also discuss significant challenges involved in the Image retrieval system. The article show the concepts adaptation of existing image retrieval techniques to build new systems that can be useful in the real world. It also gives the future research aspects for image retrieval[23]

IV. COMPARISION ANALYSIS CHART BETWEEN LOW LEVEL FEATURES BASED TECHNIQUES :

Visual contents categories	Techniques	Accuracy	Benefits	Drawback
Color Feature	Color Moment	low	Overcome the quantization problem	Precision is low
	Fuzzy color histogram	High	Fast computation	More computation
	Color Correlogram	High	Provide spatial color information	Very slow computation
Texture Feature	Gabor Filter	High	Get maximum retrieval results	Computationally intensive
	Gabor Moment	Low	Lower Dimensionality	Low retrieval result compare to Gabor filter

	Gray level cooccurrence matrix	High	Texture classification	High Dimensionality
Shape Feature	Moment Invariant	High	Invariant to orientation and size,statistical feature	Limited recognition power
	Zernike moments	High	Shape analysis	Computational Complexity is High

Table 1. Comparison of the various features based techniqueS [9]

V. PERFORMANCE MEASUREMENT

5.1 Euclidean Distance

It is defined as the displacement of a pixel from the nearest background point. The equation[14] of Euclidean Distance is:

$$D = \sum (A_i - B_i)^2 \qquad (1)$$

5.2   Chi Square Distance

The ED between the components of profiles, on which weighting is defined (weight means the inverse of its frequency), is called the chi-square distance[14]. The equation is :

$$\chi^2 th = \sqrt{\sum_{j=1}^{p} \frac{1}{a+j}\left[\frac{a_{hj}}{ah+} - \frac{a_{ij}}{ai+}\right]^2} \qquad (2)$$

5.3 Weighted Euclidean Distance

Multiply squared differences by corresponding weights are known as Weighted Euclidean Distance. The formula of W.E.D is[14]

$$dx, y = \sqrt{\sum_{j=1}^{i} \frac{1}{S_j^2}(X_j - y_j)^2} \qquad (3)$$

VI. PERFORMANCE PARAMETER

Evaluation of retrieval process is a crucial problem in CBIR. Different methods are used for measuring performance of retrieval system. The most common performance parameters are Precision and Recall .

6.1 Precision

Precision rate is defined as a ratio of number of retrieve relevant images similar to the query to the total number of retrieved images in response to query[1][10[11].

$$Precision = \frac{Number of\ relevant\ images\ retrieved}{Total\ number\ of\ images\ retrieved}$$

6.2 Recall

Recall rate is defined as a ratio of number of retrieve relevant images similar to the query to the total number of relevant images available in the database[1][10][11].

$$Recall = \frac{The\ number of\ relevant\ images\ retrieved}{Total\ number\ of\ images\ in\ database}$$

VII. APPLICATION FIELDS OF IMAGE RETRIEVAL

system

The application fields of the image retrieval system are wide spread on the world wide web. Due to the improve techniques in the retrival system the applicability ratio is increased for the users and the professionals.following broad fields used the application of the image retrival.

1. Object/image recognition in crime prevention.
2. Disease Pattern findings for Medical diagnosis
3. Architectural and Structural design using shape based measure.
4. Commercial application like Fashion designing and publishing.
5. Geographical information and remote sensing system.

VIII. CONCLUSION

This paper focuses on various aspects regarding retrival system and their performance analysis perameters. The paper inclue the comparision with different color, texture and shape feature extraction methods that are most popularly used in image understanding studies.The comparison shows the considerable possibility of performance variability between the various feature extraction methods.This paper also gives the detailed mathematical expression for performance evaluation between input images and query images.

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