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A Survey On: Object Recognition for Image Retrieval Systems

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***Abstract*— As the network and development of multimedia technologies are becoming more popular, 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. With significantly huge image database it is difficult to mine that data and retrieve relevant images. Feature Based Image Retrieval is a very important research area in the field of image processing. This paper provides the survey of technical achievements in the research area of image retrieval. In this paper, a survey is done on the different methods of content based image retrieval for the classification of texture and color. For the classification of the extracted features we have used SVM. Classification using cascaded SVM is also used here for solving large-scale pattern classification problems. Cascaded SVM has advantages over conventional SVM.**

***Index Terms*—**Test image, Preprocessing, Feature Extraction, Database Training, Classification, Parameter analysis.

1. INTRODUCTION

Now days, CBIR(Content based image retrieval) is a hotspot of digital image processing techniques. CBIR research started in early 1990's and is likely to continue during the first two decades of 21st century [1].The growing demands for image retrieval in multimedia field such as crime prevention, Fashion and grapic design and biometrics has pushed application developers to search ways to manage and retrieve images more efficiently. Manual browsing the database to search for identical images would be impractical since it takes a lot of time and requires human intervention. A more practical way is to use Content based image retrieval (CBIR) technology.

There are two essential principles of CBIR Systems for retrieving the images and they are- feature extraction and matching. When we gave the image as input to the image retrieval system, then it extorts the features of image and these features were compared with the features of images which are already stored in the database. After that image retrieval system figure out the distance between input image and further images which are already stored in the database and then images are shortlisted based upon their distance. At this time we have a list of the images that have smaller distance with input image or image to be searched and these images are considered as outcome of the image retrieval system. This searching process is depends on most identical image that are already stored in the database, instead of exact match of a searched image [3].

CBIR operates on a totally different principle from keyword indexing and aimed at efficient retrieval of relevant image databases based on automatically derived imagery features. CBIR is still an emerging science. As image compression, digital image processing, and image feature extraction techniques come to be more developed, CBIR preserves a steady pace of development in the research field. Moreover, the progress of powerful processing power and faster and cheaper memories contribute deeply to CBIR development. This progress promises a vast range of future applications using CBIR. CBIR is used for automatic indexing and retrieval of images depending upon contents of images known as features.

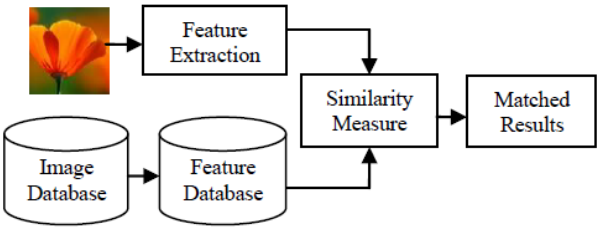

Figure 1. Content-based Image Retrieval System

Feature Based Image Retrieval (FBIR) or content based image retrieval is the retrieval of images based on their visual features such as color, texture and shape. The ultimate goal of a FBIR system is to avoid the use of textual descriptions for an image by the user. This kind of a textual-based image retrieval system always suffers from two problems: high priced manual annotation and inaccurate and inconsistent automated annotation. On the other hand, the cost associated with manual annotation is prohibitive with regards to a large-scale data set [4].As a result fbir which extract visual content of images like color, shape, texture, edge, layout and the desired images are retrieved from a large collection of images on the basis of features that can be automatically extracted. So the retrieval methods based on text or keywords for the digital multimedia apparently can't meet the demand that human being get multimedia information exactly. With more and more multimedia information appear on the Internet and other digital multimedia as well as human beings' thirst for exact and fast retrieval, based on contents multimedia information retrieval becoming the focus of the academe research as well as images retrieval of contents is one of the important study aspect of multimedia information retrieval.[32].

II. APPLICATIONS

1) The advantage of such systems ranges 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) Geographical information and remote sensing systems
4) Medicine Diagnosis
5) Architectural & Engineering Design
6) Fashion & Publishing
7) Home Entertainment
8) Retail Catalogues

III. CBIR: SURVEY

The various methods for modelling textures and extracting texture features can be applied in four broad categories of problems: texture segmentation, texture classification, texture synthesis, and shape from texture. We now review these four areas.

Table 1. CBIR System with Low Level Features and Learning Algorithm

CBIR System	Low level features	Learning algorithm	Similarity matching
RETIN	1. Color 2. Texture	Color histogram Output of gabor transform	Weighted minkowski distance
KIWI	1. Color 2. Shape	Color histogram Gabor filters	Euclidean space
i PURE	1. Color 2. Texture 3. Shape 4. Spatial	average color in CIE's LUV space Wold decomposition Fourier descriptor location- centroid	Euclidean space

3.1 Color Histogram

The histogram of an image is a graph which contains the occurrence of each intensity value found in that image, obtained by counting all image pixels having that intensity value. For an 8-bit grayscale image there are 256 different possible intensities. So, the histogram will graphically display 256 grayscale values showing the distribution of pixels amongst those numbers. Histograms can also be taken of color images. A color histogram is the representation of the distribution of colors in an image. It is a standard statistical description of the color distribution in terms of the occurrence frequencies of the different regions in a color space (Imtnan-Ul-Haque et al., 2011). To create a color histogram, the color space has to be partitioned into regions. The 24 bit RGB color space has 224 different color regions. A histogram containing 224 bins is too large to be dealt. Hence the color space is quantized into a number of bins, where each bin represents a range of color values. The number of pixels in the image that falls in each of these ranges is counted to get the color histogram. The number of bins is decided based on the loss of precision tolerated and the memory requirement. Color histograms can be built in various color spaces (Deselaers T. et al., 2007, Neetu Sharma et al., 2011, Javad Kangarani Farahani et al., 2012).

3.2 Invariant Color Histogram

Theo Gevers et al., (2004) proposed a robust histogram from photometric color invariants (invariant to illumination, shading, highlights and inter reflections) for object recognition. The histograms are computed by the variable kernel density estimators. The variable kernel density estimator is given in equation (4) Here, kernel K is a function satisfying . The kernel centered on Xi, has its own scale parameter. For color images, the scale parameter is a function of the RGB-values and the color space transform. This histogram is invariant to illumination, shading, highlights and reflections.

3.3 Dominant Color

In region based image retrieval, the regions are segmented and the features are extracted for the regions. Due to the inaccuracy of the segmentation, the average color of a segmented region may be different from that of the original region. To obtain the dominant color of the image, first the histogram is obtained and then the bin with the maximum size is taken as the dominant color of the region. When the segmented region does not have a homogeneous color, then, the average color will not be a good choice for the color feature (Ying Liu, et al., 2008).

3.4 Texture Features

The identification of specific textures in an image is achieved primarily by modelling texture as a two-dimensional gray level variation. Textures are characterized by differences in brightness with high frequencies in the image spectrum. They are useful in distinguishing between areas of images with similar color (such as sky and sea, or water, grass). A variety of methods has been used for measuring texture similarity; the best- established depend on comparing values of what are well-known as second-order statistics estimated from query and stored images. Essentially these estimate the relative brightness of picked pairs of pixels from each image. From these it is possible to measures the image texture such as contrast, coarseness, directionality and regularity [3] or periodicity, directionality and randomness [4].

$$Contrast = \sum_i \sum_j |i-j|^2 \, p(i,j)$$

$$Correlation = \sum_i \sum_j \frac{(i-\mu_i)(j-\mu_j)p(i,j)}{\sigma_i \, \sigma_j}$$

$$Energy = \sum_i \sum_j p(i,j)^2$$

$$Homogeneity = \sum_i \sum_j \frac{p(i,j)}{1+|i-j|}$$

$$Entropy = \sum_i \sum_j p(i,j) \log\big(p(i,j)\big)$$

3.5 The retrieval based on shape feature

Shape information are extracted using histogram of edge detection. Techniques for shape feature extraction are elementary descriptor, Fourier descriptor, template matching, Quantized descriptors, Canny edge detection [5] etc. Shape features are less developed than their color and texture counterparts because of the inherent complexity of representing shapes. In particular, image regions occupied by an object have to be found in order to describe its shape, and a number of known segmentation techniques combine the detection of low-level color and texture feature with

region-growing or split-and-merge processes. But generally it is hardly possible to precisely segment an image into meaningful regions using low-level features due to the variety of possible projections of a 3D object into 2D shapes, the complexity of each individual object shape, the presence of shadows, occlusions, non-uniform illumination, varying surface reflectivity, and so on.[6]

3.6 The retrieval based on clustering techniques

Clustering techniques can be classified into supervised (including semi-supervised) and unsupervised schemes. The former consists of hierarchical approaches that demand human interaction to generate splitting criteria for clustering. In unsupervised classification, called clustering or exploratory data analysis, no labeled data are available [9],[10]. The goal of clustering is to separate a finite unlabeled data set into a finite and discrete set of "natural," hidden data structures, rather than provide an accurate characterization of unobserved samples generated from the same probability distribution [11], [12]. This paper critically reviews and summarizes different clustering techniques.

IV. CLASSIFICATION METHODS

Classification and clustering are important part of image mining. This machine learning technique is used to reduce semantic gap between low level image feature and high level semantic. Data classification is a twostep process, consisting of a learning step and a classification step [21]. Classification algorithm is applied to image database in which image is best described to classify it in classes. Classification is challenging task in various application domains, including biomedical imaging, biometry, video surveillance, vehicle navigation, industrial visual inspection, robot navigation, and remote sensing, handwritten letter reorganization [12].Image Classification have mainly three steps [1]:

a. Feature extraction – In this step features are extracted from sample images that are already labelled and establish feature description for each image.
b. Training – In this, the samples of each class are trained and model description for each class is established.
c. Classification – Use the model to classify and index images that are not labelled.

There is various ways to combined classification technique with feature extraction techniques. Sultan Aljahdali, Aasif Ansari has proposed method for feature based image retrieval process and it is applied with Gabor filter texture feature extraction technique [15]. They have experimented this method with Support Vector Machine Supervised Classification technique and without using it. Their result shows that great improvement in result by using SVM classification technique. But they have considered only texture feature which will not give best result for all type of images [15]. There are some comparison is also there with SVM classifier.

D. Jeyabharathi and Dr.A. Suruliandi have compared various feature extraction technique with different classification technique [16]. They have explored PCA, LDA and ICA for feature extraction techniques. On the basis of that features SVM and nearest neighbour classifier are compared. Their experiment result is evaluated based on reorganization rate and F score. Based on result they have concluded that PCA with SVM gives accurate result than nearest neighbour technique [16].Literature survey on various techniques to classify labelled and unlabelled images is available in [14].Like Svm, D-Em, RF, Active Learning, Transductive Learning techniques are explain. And they have given some recommendation for choosing fuzzy set theory or Rough set theory according to our application [14].

Apostolos Marakakis, Nikolaos Galatsanos, Aristidis Likas have proposed relevance feedback approach with SVM classification .They have used two feature selections method to train the database according to feedback given by user and for reducing the database dimensionality[20]. This method improves performance compare to existing feature selection methods.

V Parameter analysis:

The System saves and presents a sequence of images ranked in decreasing order of similarity or with the minimum distances is returned to the user.

To evaluate the efficiency of the proposed system precision and recall rates are to be calculated where,

$$\text{Precision} = (IR / IT) \quad (1)$$

IR=No Of Relevance Images Retrieved
IT=Total Number of Images Retrieved on the screen

$$\text{Recall} = IR / IRB \quad (2)$$

IR=No Of Relevance Images Retrieved
IRB=Total Number of relevant Images in the database

V. Conclusion

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, Most of the system use color and texture features. Few systems use shape feature and still less use layout feature. CBIR methods have been used extensively in various areas to improve the performance of system and achieve better results in different applications. The CBIR tools can be utilized in numerous applications such as digital libraries, photo sharing sites and crime prevention. And this paper helps in analyzing all the components of the CBIR framework

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