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REVIEW PAPER ON CONTENT BASED IMAGE RETRIEVAL FOR DIGITAL IMAGES

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Abstract: - Image retrieval is a very important area of digital image processing. Image can be retrieved from a large database on the basis of text, color, structure or content. Content-based image retrieval uses the visual contents of an image such as texture, color, shape, and spatial layout to represent and index the image. In typical CBIR systems, the visual content of the images in the database are extracted and described by multi-dimensional feature vectors .The feature vector of the images in the database for a feature database. To retrieve the images, users provide the retrieval system with example images. The system then changes these examples into its internal representation of feature vectors. In this paper we present the review on various content based image retrieval techniques.

Keywords: CBIR, SVM, Content based Image Retrieval, Image Retrieval.

Introduction

Content based image retrieval is the important field of research. Content based image retrieval has gained much popularity in the last decade. CBIR system has also helped users to retrieve relevant images based on their content. It represents low level features like texture, color and shape [5]. There are two most relevant techniques. The first technique is to mine from huge amount of images alone and the second technique is to mine from the integrated collections of images and related alphanumeric data. Image Retrieval is in effect an extension of traditional information retrieval to include images. Image retrieval is the process of searching and retrieving images from a large database. As the images grow complex, retrieve the right images become a difficult problem. Content-Based Image Retrieval (CBIR), also known as query by image content (QBIC) is the process of retrieving images from a database on the basis of features that are extracted automatically from the images themselves. For the given a query image its feature vectors are computed. If the distance between features of the query image and images in the database is small, the corresponding image in the database is to be considered as a match to the query. The search is usually based on similarity rather than on exact match and the retrieval results are then ranked accordingly to a similarity index [5]. A CBIR consists of main component is feature extraction. Measures of image retrieval can be defined in terms of Precision and Recall.

Image Retrieval

The advent of the World Wide Web (WWW) and the development of highly economical devices for capturing, storing and transmitting images have led to the creation of huge image libraries. Thus, we are faced with the inevitable problem of having to retrieve useful information from these collections, both efficiently and effectively. This has led to a renewed interest in image retrieval and its practical applications.

Text Based Retrieval

Traditional image retrieval employed text as the primary means by which to represent and retrieve images from databases. Images were stored along with string attributes – keywords prepared by an annotator that reflected in a relatively broad manner the content of the image. Although text-based image retrieval took advantage of already well-established information retrieval algorithms. It disadvantages as an effective tool to retrieve images became readily apparent.

Content Based Retrieval

Content-based image retrieval utilizes representations of features that are automatically extracted from the images themselves. Almost all of the current CBIR systems allow for querying-by-example, a technique wherein an image (or part of an image) is selected by the user as the query. The system extracts the feature of the query image, searches the database for image with similar features, and exhibits relevant images to the user in order of similarity to the query. Content-based image retrieval systems attempt to exploit the visual information inherent in images, thus providing a more realistic perceptual representation of an image. In this context, content includes among other features, perceptual properties such as color, texture, shape, and spatial relationships.

Color Based Retrieval

There are various features extraction techniques but color is considered to be most dominant and distinguishing visual feature. The main reason is that it uses histogram to describe it. A color histogram is created which tells whole color distribution in an image and thus used in CBIR. Color histogram has various advantages such as high speed, use less memory space, and it is not sensitive with change in size and rotation of image so
gains maximum attention[4].

Texture based retrieval

Texture measures have an even larger variety than color measures. Some of the most common measures for capturing the texture of images are wavelets and Gabor filters .These texture measures try to capture the characteristics of the image or image parts with respect to changes in certain directions and the scale of the images. This is most useful for region or images with homogeneous texture[3].

Shape based retrieval

It represents visual content of an image. Every natural or man-made object has their own shape, so we easily recognize shape of an object . Different varieties of shapes are computed by many objects which are stored in database and at search time user can easily identify desired shape. There are two
types of shape features, Global Feature- aspect ratio, circularity and moment invariant, Local feature-Boundary segment. Shape feature queries apply for both example image and user drawn image.
Shape feature can be divided into 2 categories :

- Boundary based: Outer boundary of object is calculated.
- Region based: Entire region i.e. area covered by object [2].

Image Retrieval using wavelet Decomposition

This wavelet transform identifies the core pixels of the image that actually make up the image at different levels. Each level gets the wavelet and the image gets on condensing to get the actual pixels of the image out. Perform Simple wavelet decomposition on the image and now consider each pass as a vector value. This brings the wavelet vector. After this features are extracted using wavelet decomposition After this step Color Correlogram is applied to identify similarity of the images by the spatial distribution of the color of the image and then k- means clustering is performed on the database and cluster the images based on the associated vectors to retrieve relevant images.

Image Retrieval using optimized hybrid clustering

This is the process in which the query image is compared with all the images present in the database on the basis of the similarity of their color feature space. The average RGB value of the images is calculated. The RGB value of the query image is compared with each RGB values of the database images. Then Images are hierarchically grouped based on their similarity levels. This results in random groups of images.

Related work

Following are the various existing algorithms:

Semi-Supervised active learning FSVM

1) For a given query image, the system performs search by K-NN using the Euclidean distance for similarity matching. The top n most similar images are returned to the user for feedback.
2) The user labels the n images as either relevant or irrelevant.
3) Train an initial SVM classifier Based on the n labelled images.
4) The SVM active learning is employed by selecting m unlabeled images that are closest to the current SVM separating hyper-plane for the user to label.
5) Add the m images to the labelled training set.
6) Use Bayes Classifier to select unlabeled images, assign a label and evaluate the relevance membership of each label in its class.
7) Train a FSVM using a hybrid of the user labelled and automatic labelled images.
8) Repeat steps 4)-7) until the user is satisfied with the retrieval results.

The steps involved in the FCM algorithm

Step 1: Initialize the cluster number c = K, where K is the number of semantic classes, choose the parameters of the FCM and the initialization (i.e., the termination criterion and the weighting exponents m). Set the iteration loop index t =1.
Step 2: Select the cluster centres as $v^{(0)}_j = \mu_j$
for j = 1, 2,...,c(t =0), where μ_j is the mean vector of semantic cluster j in eigenspace.
Step 3: Select N feature vectors z_i for i =1,...,N from the DB, where |DB| = N and compute the initial membership degrees of $W^{(0)}$ as

$$w_{ji} = = 1 + \frac{dist(zi,vj)^{-2/(m-1)}}{\sum_{k=1}^{c} dist(zi-vk)^{-2/(m-1)}}$$

Step 4 : Update all the new cluster centres $v_j^{(t)}$ for j= 1,2,……c using

$$v_j^{(t)} = \frac{\sum_{i=0}^{N} Wji Zi}{(x+a)^n = \sum_{i=1}^{N} Wji}$$

Step 5: update W(t) based on new similarity
measure of z_i | I = 1, . . .N with respect to the new cluster centres $v_j^{(t)}$ | j = 1, ...,c
Step 6 : if | $v_j^{(t)} - v_j^{(t-1)}$| <€ , for all j then stop; otherwise, set t=t+1 and go to step 4.
Steps of CBIR:

1. Load the image as a input.
2. Pre-process (Convert to grey scale, binary form).
3. Extract the features using Image Histogram.

4. Matching and recognition using SURF feature, SVM and NN.
5. Display the results and obtained the average accuracy.

Feature extraction algorithm

The main steps of feature extraction algorithm are as follow [1].

Step 1: Convert input R C B image (I) of size M X N into YCbCr colour space.

Step 2: Apply Canny Edge Detector on extracted Y matrix of the image.

Step 3: Combine edge map as obtained in step 2 with unmodified Cb and Cr to make single RCB image.

Step 4: Find R, C and B matrices of the image which obtained in step 3. Find histogram of each matrix separately. These three histograms H R, H G and H B contain 256 bins. This makes the overall length of the feature vector (f) equals to 768 (256 x 3). This is very large size of feature vector. Thus to reduce the size of the feature vector (f) and to improve the performance of the system, wavelet transform is taken of each of these histograms.

Step 5: Perform 2nd level discrete wavelet transform of HR histogram and consider only approximation coefficients at level 2. This reduces its size from 256 bins to 64 bins. Similarly perform 3rd level DWT of HG and HB and consider only approximation coefficients at level 3, which reduces size to 32 bins. Therefore, size of the total feature vector (f) is 128 bins (64 + 32 x 2 = 128).

Step 6: Calculate feature vector if) for each image in the database and arrange all these feature vectors in a database. The size of database is Number of images (Rows) x 128 (Columns)

Literature Survey

Agarval, et al in 2014[1] proposed that color is one of the most important low level features used in image retrieval and most content based image retrieval system use color as a image features. However, image retrieval using only color features often provide very unsatisfactory results because in many cases images with similar color do not have similar contents. As a solution to the problem this paper describe a novel algorithm for content based image retrieval based on color edge detection and Discrete Wavelet Transform .This method is different from existing histogram based methods. The proposed algorithm generates feature vector that combine both color and edge feature. This paper also use wavelet transform to reduce the size of feature vector.

Sonali jain [2] explains that image is a collection of row and column that is called pixel values. Extracting best matched image from large collection of database is emerging task. Image retrieval is mainly used in image processing, pattern recognition and computer vision. CBIR technique used in many areas such as medical, academic, art, fashion, entertainment. Generally image have color, texture, shape and size are relevant feature so extract all the relevant and irrelevant features of image. Color histogram of image formed by divided graph into levels and mean and standard deviation are calculated by pixel value of each level. After extracting all the feature of image applies SVM i.e. supervised learning algorithm get optimal result for image classification.

R.Senthil Kumar, in 2013 [3] proposed a Content-based visual information retrieval (CBVIR) or Content-based image retrieval (CBIR) has been one of the most vivid research areas in the field of computer vision over the last 10 years. In the medical field, especially digital images, are produced in ever increasing quantities and used for diagnostics and therapy. The Radiology Department of the university Hospital of Geneva alone produced more than 25,000 images a day in 2012, The cardiology is currently the second largest producer of digital images with digital imaging and communication in medical (DICOM), a standard for image communication has been set and patient information can be stored with the actual images. The main aim of this paper is to improve the overall CBIR system Performance using medical applications.

Neha Sharma ,in 2012 [4] In this paper Surf features along with the content properties of an image are used. Input will be one image file and software will search for the same images in database folder based on content properties

(i.e. shape, color or texture) encoded into feature vectors. Before storing the image in the database the key features from image are extracted.

Amanbir Sandhu, et. al in 2012 [5] Presents a technique for content based image retrieval using texture, color and shape for image analysis. In this paper they worked with the three features i.e. texture, color and shape and its different combinations. The GLCM is used for texture feature extraction, histogram for Color feature extraction and for shape different factors are found like area, Euler No., eccentricity and Filled Area.

The FCM algorithm and hence they suggested a fuzzy-c mean algorithm.

Ray-I Chang, et. al in 2012 [6] Proposed a novel content based image retrieval system using K-means/KNN with feature extraction. This paper first combines segmentation and feature extraction module, grid module, K-means clustering and neighborhood module to build the CBIR system. The problem with this technique is that the system architecture and modules proposed in this paper are not optimized properly.

Conclusion

As discussed in this paper, we present a general method of image retrieval system. Various approaches for image retrieval have been discussed in detail. It is concluded that a lot of work is required to be done in this area. Presented techniques shows very low accuracy hence cannot be used in the real world applications. Existing techniques shows good results only on small dataset but accuracy decreases considerably on large dataset. In future a system should be developed so that it can retrieve the images from a large data set efficiently in minimum amount of time.

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