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IMAGE RETRIEVAL SYSTEM BASED ON FEATURE COMPUTATION – AN INTEGRATED APPROACH

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Abstract

The idea proposed in this paper utilizes an efficient image retrieval system that is based on computation and combination of grey level, shape and texture features. The proposed system calculates various grey level features which are used to extract attributes from an input image. Grey Level Co-occurrence Matrix is used to compute the texture feature of a given image while the Shape feature finds the shape of the specified object. Scale Invariant Feature Transform Algorithm is incorporated to extract the feature points of an image to detect the specific object among various kinds of image classes. The similarity of image objects is assessed by combining these features that are computed already. The "sample" database is constructed with different kinds of image classes such as car, bike etc.

***Keywords*-- Scale Invariant Feature Transform, Grey Level Co-occurrence Matrix, Image Retrieval.**

I. INTRODUCTION

Images are a fundamental part of our daily communication. The huge amount of pictures digitally available is not manageable by humans. A person searching for a picture in a database of 100 images will probably find what he searches for quite fast by just viewing the images or small versions of the images (thumbnails). If a thousand, ten thousand, or even more images are involved, the task becomes more tedious. However, Image Retrieval System performs well and it can be widely used in applications like Google Image Search, Medical Field and Crime Department.

Image Retrieval is the most important research area in computer society which aims at searching an image in a database, then find and retrieve specific image that are similar to the given 'query' image. Image Retrieval process is based on the features in the images.

II. RELATED WORK

Object reorganization for CBIR system implement some type of classification which is based on the edge detectors method [1]. Color image classification system has been developed by using the Texture feature [2]. Image Mining based retrieval system classify the images based on Histogram values [3].

Related systems used various algorithms and methods to classify the images. However, it provides a low level accuracy rate while compared to the proposed system.

2.1. Comparative Analysis

The proposed system classifies the images based on local features which include Texture Feature, Shape Feature and Grey level Feature. The existing system provides only 75% accuracy with any one or two class of images [4] [5].However this system yields 85% accuracy with 4 different types of classes.

2.2 Research Challenges

Image Classification is still a challenging task in the coming years where a large variety of system environments can exist. It has many challenges associated with it such as images placed in various environments such as image size (High Pixel, Low Pixel), similarity images (E.g. Boat, Fish) etc.

III. METHODOLOGIES

The proposed system computes local feature vector of all images in the database before the actual process of image retrieval. Local feature vector includes Grey Level Feature, Shape feature and Texture Feature [2] [3]. The system is aimed to classify the four classes of images in the ***"Sample"*** databases such as Car, Bike, Fish and Computer Monitor. The system retrieves similar images from the database.

Fig. 1 explains the stages of image retrieval process. The image features are pre-calculated and stored in a database and the features are combined as a Feature Vector. Finally, the system retrieves the similar image to the user on the screen.

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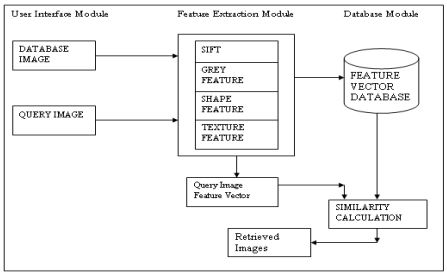

Fig.1 Image Retrieval Process

3.1 Local Features

The current Image Retrieval techniques assume certain mutual information between the similarity measure and the semantics of the images. Image retrieval in this regard is based on the integration of three prominent features called Texture, Shape and Grey features.

3.1.1 Texture Feature

Texture is a very interesting image feature that has been used for characterization of images with an application of image retrieval. GLCM is an important method for extracting the Texture features [1]. By using this method, Contrast, Energy, Entropy, Homogeneity, and Correlation of the Image [6] [7] are computed.

3.1.1.1 Contrast

Contrast measures the intensity contrast between a pixel and its neighbor and is defined as follows,

$$\sum_{i=1}^{k}\sum_{j=1}^{k}(i-j)^2 p_{ij} \qquad (1)$$

Where intensities i, j are the i^{th} and j^{th} element of the image of size M by N.

3.1.1.2 Energy

Energy is a measure of uniformity (the sum of squared range of GLCM) ranges from (0, 1). It returns a measure of the intensity contrast between a pixel and its neighbor over the whole image and it is defined as follows,

$$\sum_{i=1}^{k}\sum_{j=1}^{k} p_{ij}^2 \qquad \textbf{(2)}$$

Where intensities i, j are the i^{th} and j^{th} element of the image of M by N.

3.1.1.3 Correlation

Correlation measures how a pixel is correlated to its neighbor over the entire image and its range lies between 1 and -1 which is defined as follows,

$$\sum_{i=1}^{k}\sum_{j=1}^{k}\frac{(i-m_r)(j-m_c)p_{ij}}{\sigma_r\sigma_c} \qquad (3)$$

$\sigma_r \neq 0; \sigma_c \neq 0$

Where intensities i, j are the i^{th} and j^{th} element of the image of size M by N.

3.1.1.4 Homogeneity

Homogeneity measures the spatial closeness of the distribution of elements in the co-occurrence matrix to the diagonal, its range lies between [0, 1] and it is defined as follows,

$$\sum_{i=1}^{k}\sum_{j=1}^{k}\frac{p_{ij}}{1+|i-j|} \qquad \textbf{(4)}$$

Where intensities i, j are the i^{th} and j^{th} element of the image of size M by N.

3.1.1.5 Entropy

Entropy converts any class other than logical to uint8 for the histogram count calculation so that the pixel values are discrete and directly correspond to a bin value. Entropy is defined as follows,

Entropy = -sum (p.*log2 (p)) **(5)**

Where 'p' contains the histogram counts returned from *imhist*(). By default, entropy uses two bins for logical arrays and 256 bins for uint8, uint16, or double arrays.

3.1.2 Shape Feature

Image morphological operations are used to extract the Shape Feature vector. The Morphological operations produce an output image in which each pixel is based on the comparison of the input image and its neighborhood.

There are two basic types of the morphological operations on query image. They are: 1) Erosion 2) Dilation

The Dilation operation adds pixels to the boundaries of the objects while the Erosion operation removes pixels from the object boundaries.

Area, Perimeter and Metric are the values to be calculated using the morphological operation.

3.1.3 Grey Feature

Grey Feature calculates the following values from query images.

a) RMS (Root Mean Square)
b) Standard Deviation (SD)
c) Mean

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3.1.4 Similarity Computations

The similarity between the gray levels feature vector of the query image with those of the images in the database is calculated by the following formula:

$$Sim_{gr}(QI, DBI) = \sqrt{\sum_{n=1}^{16} (QI_n - DBI_n)^2} \quad (6)$$

QI is the query image and DBI is the database image.

Similarly, Shape and Texture feature vector similarities are calculated as Sim_{shape} and sim_{tex}. Then, the image retrieval process is performed. The entire similarity values are integrated using the following equation:

$$Sim\,(QI, DBI) = W_{gl} * Sim_{gl} + W_{tex} * Sim_{tex} + W_{shape} * Sim_{shape} \quad (7)$$

$W_{gl}+W_{tex}+W_{Shape} =1$, W_{gl} is the weight of grey level similarity, W_{tex} is the weight of texture similarity, W_{shape} is the weight of shape similarity.

IV. Results And Discussion

The proposed work is done in MATLAB 7. Two modules named as solitary and Combi module are created. The Solitary menu has three sub menus named as Grey Feature, Texture Feature, Shape Feature. The query image was converted from RGB to grey level image for extract the specified portion of the query (car) image. The Fig.2 (a) shows the grey view of a car image and Fig.2 (b) shows the extracted portion of query (Car) image.

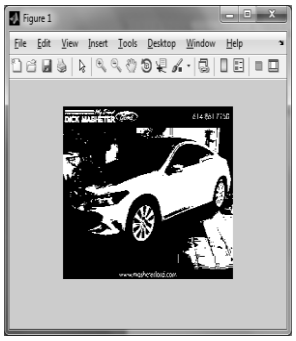

Fig. 2(a) Grey Image

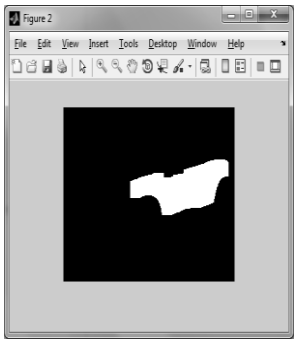

Fig.2 (b) Extracted Shape

The similarity between the query image and the database images are computed by the Euclidean distance formula in the Table 1 and the correlated value images are retrieved from the database. Fig.3 displays the process of retrieval in the fish class using three level feature vectors(Grey, Texture, Shape).

Image name	Value
'D:\ data\fish005.jpg'	0.0000356
'D:\ data\fish006.jpg'	1570.137149
'D:\ data\fish007.jpg'	2138.436327
'D:\ data\fishr008.jpg'	2357.606256
'D:\ data\fish009.jpg'	2368.47267

Table1 Similarity value

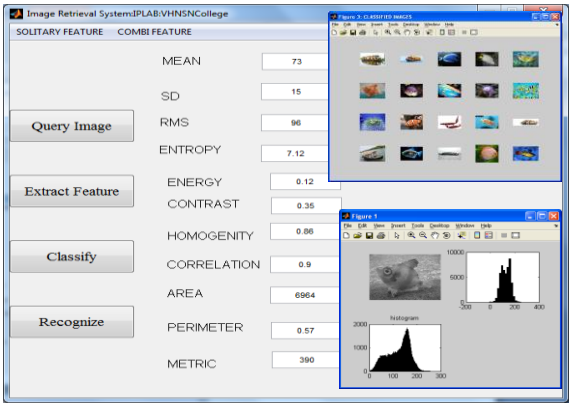

Fig.3 Image Retrieval

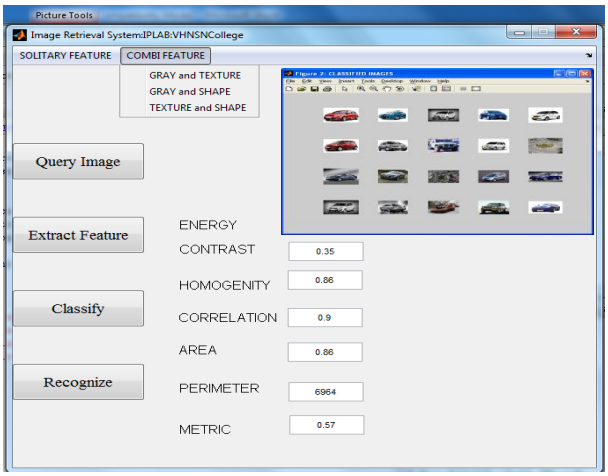

Fig.4 Image Retrieval using any two level feature vector (Grey and Shape)

Fig.4 displays the process of retrieval in the car class using two level feature vectors(Shape and Grey). Thus images are retrieved using any of the level feature vectors also.

Similarly, images will be retrieved using only one feature vector. However the system accuracy may vary and low.

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4.1. System Performance

The performance of the system is evaluated on the basis of relevant images retrieved from the image database.

CLASS TYPE	Retrieval Rate (%)
CAR	82
FISH	85
BIKE	84
MONITOR	83

Table.2 System performance

V. CONCLUSION

The system combines the Shape, Texture and Grey features. Shape feature detects the shape of object and Grey feature calculates the optimized bin level in the image and then Texture feature is derived from the Feature value from the image.

Then the system calculates the Euclidean distance of the input and database images and it gives the more relevant images to the user. The System accuracy will be high while integrating the three level feature vectors. However, the system accuracy will be very poor at single level feature vector.

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