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An Enhanced Technique for Image Retrieval Using Texture Features

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Abstract--- Content-Based Image Retrieval (CBIR) uses the visual contents of an image such as color, shape, texture and spatial layout to represent and index the image. The CBIR is the process of retrieving images from a database or library of digital images according to the visual content of the images. Image retrieval is the most essential process in the real world web application where the most of the user attempting to retrieve the images by submitting the label keywords. The image retrieval process is enhanced to improve the retrieval accuracy by retrieving the contents based on visual information present in the images instead of the labelling information. Then feature extraction on image retrieval is to be accomplished. The segmentation is the process of partitioning an image into multiple images. Content based image retrieval is done efficiently by using the combination of the texture and the shape features. Gustafson-kessel algorithm is used for segmentation to improve the retrieval accuracy of the images. The texture features are extracted from the segmented images to calculate the Hausdroff distance for similarity measures. Based on the similarity value, the images in the data bases are retrieved and the performance is evaluated with Corel database of images. The high accuracy, precision and recall are compared with the existing models and are implemented with Mat lab.

Keywords-CBIR, TBIR, RBIR, SPCA, CAD, FCM.

I . INTRODUCTION

An image retrieval system is a computer system for browsing, searching and retrieving images from a large database of digital images. Most traditional and common methods of image retrieval utilize some method of adding metadata such as captioning', keywords or descriptions to the images so that retrieval can be performed over the annotation words. Manual image annotation is time-consuming, laborious and expensive to address a large amount of research done on automatic image annotation.

Text based image retrieval stores the text in the form of keywords together with the image. Some TBIR uses surrounding text of the image to search the keywords which are physically close to the image. Content based image retrieval system makes direct use of content of the image rather than relying on the human annotation of metadata with the keywords. At present the CBIR makes use of low level features like shapes, color and texture to retrieve desired image from database. To obtain efficient image retrieval, tools like pattern recognition and statistics are well used different implementation of CBIR makes use of different types of queries.

Region based image retrieval is an extension of content based image retrieval techniques. Region based image retrieval system provides new query types to search for objects embedded in an arbitrary environment. This system automatically segments images into a variable number of regions and uses a segmentation algorithm to extract a set of features for each region. Context Based Image Retrieval is a comparatively new approach of image retrieval. Context is any information that can be used to characterize the situation of an entity. Context is the where, who, what and when of an object.

Texture can define as the visual pattern that has properties of homogeneity not resulting from the presence of only a single color or intensity. Various techniques for texture analysis have been investigated in the field of computer vision and pattern recognition. The texture extraction techniques can be classified into two categories: They are statistical and structural. Statistical approaches use intensity distribution of image to extract statistical parameters representing texture of image. Commonly used statistical methods include Fourier power spectra, Co-occurrence matrices, Shift-invariant principal component analysis (SPCA), Tamura feature, Wold decomposition, Markov random field, Fractal model, and Multi-resolution filtering techniques such as Gabor and wavelet transform.

II. LITERATURE SURVEY

Nadia[1] developed a retrieving and distributing multimedia data becomes a frequent but still challenging task of retrieving data from large scale multimedia databases with satisfactory accuracy and performance rates. The advent of large scale multimedia databases has led to great challenges in content-based image retrieval (CBIR). In particular, it gives an overview of statistical methodologies and techniques employed for texture feature extraction using most popular spatial-frequency image transforms, namely discrete wavelets, Gabor wavelets, dual-tree complex wavelet and contour lets. It does not achieve high accuracy.

Gauri [2] Content Based Image Retrieval (CBIR) the term Content based means that the search will analyze the actual contents (features) of the image. In the image two types of features are present, Low Level Features and High Level Features. It is difficult to extract high level features like emotions or different activities present in that image. But they

give relatively more information about objects and scenes in the images that are perceived by human beings. The low level features to be used depend upon the applications. It does not consider shape feature for improve accuracy level.

Gode [3] described the content-based means that the search analyses the contents of the image other than the metadata. Metadata refers to keywords, tags or descriptions associated with the image. To apply the integration of the above combination, then cluster based on properties create the co-occurrence matrix. Co-occurrence matrix calculates the feature vector for texture. Canny algorithm is use for edge detection to calculate the feature vector for the shape. Invariant moments are then used to record the shape features. Optimal feature extraction is still investigated.

Usha [4] developed retrieval of an image is a more effective and efficient for managing extensive image database. In this proposed system, content based image retrieval is accomplished by features. The extracted feature vector of the query image is compared with extracted feature vectors of the database images to obtain the similar images. The main objective this work is classification of image using SVM algorithm. Support vector machine also known as SVM and is a supervised machine learning method that examine the data and identify the patterns, used for classification. The advantage of this algorithm is to classify the input query object depends on feature vectors and training samples. Optimal classification methods are required for improve precision and recall rate.

Srinivasa [5] enhanced shape of an object is a binary image representing the extent of the object. This system proposes a method to compute the exact values of the moments by mathematically integrating the Legendre polynomials over the corresponding intervals of the image pixels. Experimental results show that the values obtained match those calculated theoretically and the image reconstructed from these moments have lower error than that of the conventional methods for the same order. Support vector machine is only suitable for smaller data bases it does not suitable for large data base.

Mahantesh [6] discussed the content-based image retrieval is the application of computer vision techniques to the image retrieval problem, specifically the search for specific digital images in large databases. The evaluation of the proposed approach is carried out using the standard precision and recall measures. It achieves high retrieving accuracy.

Amit [7] revealed the technique which uses visual contents to search images to find a desired image from a collection of databases has wide applications. In this system present an algorithm for retrieving images with respect to a database consisting of engineering/computer-aided design (CAD) models. It does not suitable to investigate whether the proposed shape representation is useful in other application domains, such as protein search in molecular biology.

Mahdi [8] developed novel technique for content-based image retrieval based on tree matching. Image objects and their relations are some of the important features to match similar images. This new algorithm segments the image into some specific regions and then extracts their color, size, position, shape and object's relation. The proposed algorithm computes center of each segment and connects center of them to obtain the image graph. By obtaining minimum spanning tree and then tree matching, we compare the image that is being searched in the database against the sample image. The complicated texture image which may rarely cause some fails.

III. DRAWBACKS OF EXISTING SYSTEM

Content based retrieval is done with the consideration of the texture feature. Various techniques were adapted to retrieve the contents that are stored in the database in the accurate manner. Some of the limitations of the previous researches are given. In the previous research work only texture and color features are considered for calculating the similarity level between query image and the database stored images which might lead to less accurate retrieval of the images. The older version of classification methodologies are used for unifying the similar kind of images which might lead to the less accurate retrieval of contents. Tree matching process used in the existing work might also leads to the more time complexity.

IV. METHODOLOGY

The existing research methodology of this work is discussed in the detailed manner. In the existing system, content based retrieval is used for retrieve and gives the images for the users as per their requirements. Retrieving Images in the accurate manner might leads to the failure of contents downloads which needs to preserved with the concept. The K-means clustering and Fuzzy C-means clustering are used for segmenting the images. Here the texture and shape features are used for retrieval.

4.1 K-MEANS CLUSTERING

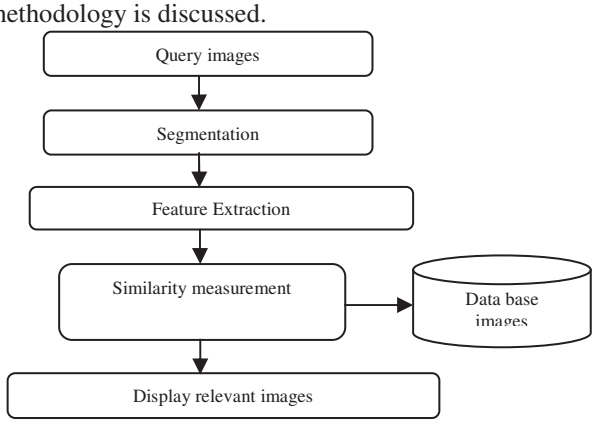
K-means clustering is a method of vector quantization, originally from signal processing, that is popular for cluster analysis in data mining. K-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. The problem is computationally difficult (NP-hard) however, there are efficient heuristic algorithms that are commonly employed and converge quickly to a local optimum. These are usually similar to the expectation-maximization algorithm for mixtures of Gaussian distributions via an iterative refinement approach employed by both algorithms. Additionally, they both use cluster centers to model the data; however, k-means clustering tends to find clusters of comparable spatial extent, while the expectation-maximization mechanism allows clusters to have different shapes.

4.2 FUZZY C-MEANS CLUSTERING

Fuzzy C-means clustering (FCM) is an iterative algorithm that produces optimal partitions based on minimization of the following objective function, Fuzzy c-means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. It is frequently used in pattern recognition.

4.3 PROPOSED METHODOLOGY

The present research is considered as two phases. In the first phase, the pre-processing of an image is to be done for a better image retrieval. Then feature extraction on image retrieval is to be accomplished. In the pre-processing stage various filter has been used, among them the spatial noise filter gives better performance for efficient noise removal on image retrieval. Hence, spatial noise filter is applied in the research for pre-processing on image. In the segmentation is the process of partitioning an image into multiple images. Content based image retrieval is done efficiently by using the combination of texture and shape features. Here, Gustafson-kessel algorithm and fuzzy shell clustering are used for segmentation. Then the two algorithms are used to improve the retrieval accuracy of the images. To get a high retrieving accuracy and efficient result instead of k means and fuzzy c means here used Gustafson-kessel algorithm and fuzzy shell clustering for segmentation. The shape and texture features are extracted and combined together for the retrieval. Finally, the features of the query are compared to those of the images in the database in order to rank each image according to its distance to the query. The detailed description of the proposed methodology is discussed.



4.1 Process Flow

4.3.1 Preprocessing

There are numerous tasks to be completed before performing image retrieval. An image must be scanned and converted into gray scale image for pre-processing. Pre-processing consists of a few types of sub process to clean the image and make it appropriate to carry the image retrieval process accurately. Noise can cost the efficiency of the image retrieval system. Noise may occur due the poor quality of the image or that accumulated whilst scanning, but whatever is the cause of its presence it should be removed before further processing. We have used spatial filtering for the removal of the noise from the image. Generally filters are used to filter unwanted things or object in a spatial domain or surface. In digital image processing, mostly the images are affected by various noises. The main objectives of the filters are to improve the quality of image by enhancing is to improve interoperability of the information present in the images for human visual.

4.3.1.1 Spatial Noise Filtering

To transferring an image, sometimes transmission problems cause a signal to spike, resulting in one of the three point scalars transmitting a incorrect value. This type of transmission error is called “salt and pepper” noise due to the bright and dark spots that appear on the image as a result of the noise. The ratio of incorrectly transmitted points to the total number of points is referred to as the noise composition of the image. The goal of a noise removal filter is to take a corrupted image as input and produce an estimation of the original with no foreknowledge of the characteristics of the noise or the noise composition of the image. In images containing noise, there are two challenges. The first challenge is determining noisy points. The second challenge is to determine how to adjust these points. In the Vector Median Filter (VMF), a point in the signal is compared with the points surrounding it as defined by a filter mask. Each point in the mask filter is treated as a vector representing a point in a three dimensional space. Among these points, the summed vector distance from each point to every other point within the filter is computed. The point in the signal with the smallest vector distance amongst those points in the filter is the minimum vector median. The Spatial Median Filter is a new noise removal filter. Spatial Median Filter and the Vector Median Filter follow a similar algorithm and it will be shown that they have comparable results. To improve the quality of the results of the Spatial Median Filter, a new parameter will be introduced and experimental data is shown demonstrating the amount of improvement. The Spatial Median Filter is a uniform smoothing algorithm with the purpose of removing noise and fine points of image data while maintaining edges around larger shapes.

4.3.1.2 Segmentation

Segmentation refers to the process of partitioning a digital image into multiple segments. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. The Gustafson-Kessel algorithm associates each cluster with both a point and a matrix, respectively representing the cluster centre and its covariance. Whereas the original fuzzy c-means make the implicit hypothesis that clusters are spherical, the Gustafson-Kessel algorithm is not subject to this constraint and can identify ellipsoidal clusters. The cluster centre is computed as a weighted mean of the data, the weights depending on the considered algorithm, as detailed in the following. This cluster parameter updating step is alternated with the update of the weighting coefficients until a convergence criterion is met.

4.3.4 Gustafson-Kessel Algorithm

The Gustafson-Kessel algorithm associates each cluster with both a point and a matrix, respectively representing the cluster centre and its covariance. The original fuzzy c-means make the implicit hypothesis that clusters are spherical, the Gustafson- Kessel algorithm is not subject to this constraint and can identify ellipsoidal clusters. The covariance matrix is defined as a fuzzy equivalent of classic covariance. A size constraint is imposed on the covariance matrix whose determinant must be 1. As a consequence, the Gustafson-Kessel algorithm can identify ellipsoidal clusters having approximately the same size. This cluster parameter updating step is alternated with the update of the weighting coefficients until a convergence criterion is met.

Algorithm: Gustafson-Kessel Algorithm

Input: Query images
Output: Segmented regions

Step 1: Start the process
Step 2: Calculate the cluster centre and covariance matrix are computed using fuzzifier.
Step 3: Initialize the cluster.
Step 4: To calculate maximum iteration
Step 5: Calculate the covariance matrices
Step 6: Calculate the distance norms using equation 5.1.
Step 7: Update the coefficients until convergence criteria meet.
Step 8: Repeat the step 3 to step 6.

V. SIMILARITY MEASUREMENT

5.1 HAUSDROFF DISTANCE

The Hausdroff distance is defined as function for directed hausdroff distance from A to B. This function discovers the point, which is farthest from any point and calculates the distance from its neighbourhood.

$$h(A,B) = \max_{a \in A} \{ \min_{b \in B} \{ d(a,b) \} \} \quad \text{--- (5.1)}$$

5.3 ACCURACY

Accuracy refers to the degree of conformity and correctness of something when compared to a true or absolute value. The accuracy is calculate by taking the ratio difference between the total number of images present in the database that are use for comparison to the total correct similar images that are retrieved as output. This performance evaluation is conducted in the coral database which has been taken as output value. The accuracy is calculated as follows:

$$Accuracy = \frac{(True\ positive + True\ negative)}{(True\ positive + True\ negative + False\ positive + False\ negative)} \quad \text{--- (5.2)}$$

5.4 PRECISION

Precision refers to a state of strict exactness how consistently something is strictly exact. Precision value is determined based on the retrieval of information at true positive prediction, false positive. The precision of image retrieval is calculated based how much percentage the values are retrieved correctly among the total number of images that are retrieved as output. The precision is calculated as follows:

Precision =True Positive/ (True Positive + False Positive) ---(5.3)

5.5 RECALL

Recall value is determined based on the retrieval of information at true positive prediction, false negative. Recall in this context is also referred to as the True Positive Rate. In that process the fraction of relevant instances that are retrieved. Recall is ratio between the correction predictions of images over the set of images that are taken as input from the values that are retrieved as output. The recall is calculated as follows:

Recall =True Positive / (True Positive + False Negative) ---(5.4)

6. EXPERIMENTATION & RESULTS

The proposed methodology is experimental with coral data set. The images with different sizes are considered in this data set in the JPEG format. This simulation was conducted in the MATLAB simulation environment which will retrieve the images present in the database in terms of query image which has been submitted. The Content retrieval process is implemented efficiently using the MATLAB toolkit. Coral dataset is considered in this work. This dataset contains image features extracted from a Corel image collection. Four sets of features are available based on the color histogram, color histogram layout, color moments, and co-occurrence. There are 10000 images which contain 100 categories. Every category contains 100 images of size 192×128 or 128×192 in JPEG format. All images come from Corel Gallery Magic 20, 0000 (8 cds).The first 5000 images form Corel-5K Dataset, and all of the 10000 images form Corel-10K dataset. It only used for academic communication and cannot be used in commercial products. Corel-5K and Corel-10K datasets are used in the algorithms of multi-texton histogram(MTH), micro-structure descriptor(MSD) and color difference histogram(CDH) , which have been accepted for publication in Pattern Recognition. The categories of images that are considered are given in the following figures

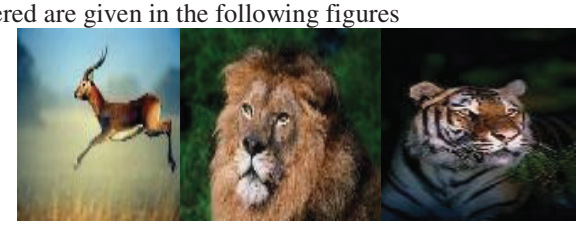


Figure 4.2 Sample images from corel 1000

The above figure 4.2 is the various sample images of the image database corel 1000. The images considered for experimentation are from these different classes of their image database. The proposed algorithm Gustafson-kessel based segmentation and the fuzzy shell based segmentation is implemented and the experimentation has been done. A set of training images including deer, lion and tigers are taken and the learning process is done by extracting different features which are then grouped together. For a testing part input image of Lion image is considered as input image for this experimentation for which proposed approach is implemented. The similarity calculating is done with the consideration of the different parameters based on which content based retrieval is done. The input image considered is given in the following figure 4.3.

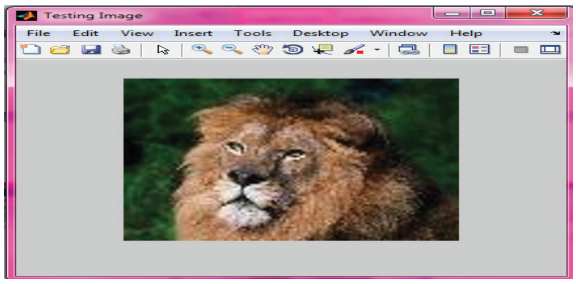


Figure 4.3 Testing image

The above input image is processed in different level for efficient and accurate retrieval of contents that are stored in the database. The processes that are done over the test input image is listed and represented in the following figure 4.4.

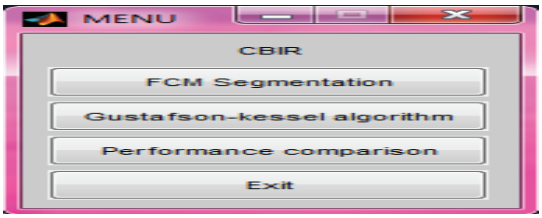


Figure 4.4 List of operation

Initially image would be converted into the gray scale image for the efficient segmentation. By converting into gray scale image accurate segmentation can be done over the given test input image. The grey scale image is represented as follows:

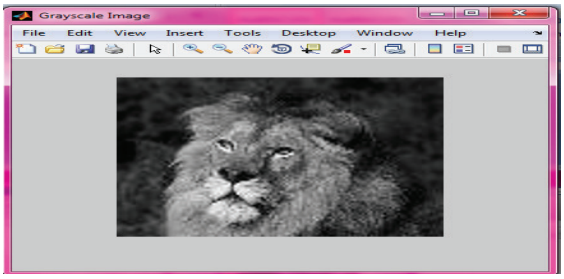


Figure 4.5 Grey scale image

After converting into grey scale image different segmentation mechanism would be applied over the input image extracting the required part alone for efficient construction. The segmented image which was segmented using fuzzy shell clustering algorithm is given as follows

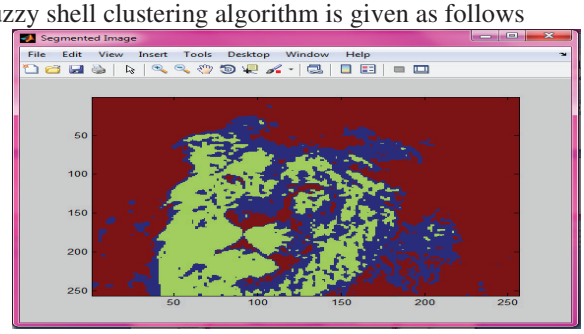


Figure 4.6 Fuzzy shell clustering

The segmented image which was segmented using gauston kessel segmentation approach is given as follows:

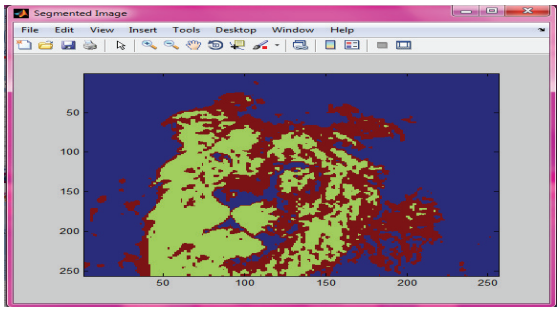


Figure 4.7 Gauston kessel

Based on these segmented result, the comparison would be done with the database stored images based on which image retrieval would be done with the consideration of the various results part. The retrieval result which has been obtained after comparison is given as follows:

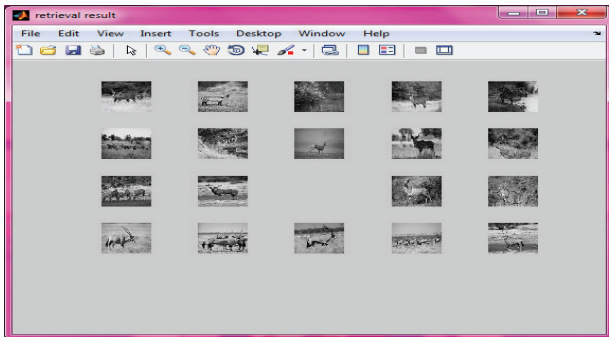


Figure 4.8 Retrieval result

6.2 PERFORMANCE EVALUATION

The performance evaluation is conducted in terms different performance metrics which is compared in different levels. The performance measures that are used to compare the effectiveness of the proposed mechanism than the existing approaches are

Category	K-means clustering	FCM	Gustafson-Kessel
Accuracy	74.73%	5.35%	90.10%

Table 4.1 Accuracy Comparison

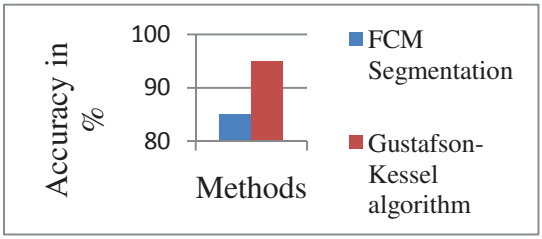


Figure 4.9 Accuracy Comparison

From the table 4.1 Accuracy values which were obtained in terms of different segmentation approaches in terms of different parameter values is compared. This retrieval of images in terms of different segmentation algorithm is compared which shows that the proposed approach is improved in its performance 10 % more than the existing approach.

7. CONCLUSION

The proposed system introduced a Gustafson-kessel algorithm and fuzzy shell clustering algorithm which is used for detect various shapes easily. The median filtering is applied in the proposed work for removing the noise, where the value of an output pixel is found by the median of the neighbourhood pixel. The shape such as Shape moment invariants and texture features such as Tamura and Haralick features are extracted from the segmented image. Finally Euclidean distance and Hausdroff distance are calculated for similarity measurements. According to that similarity value the images in the data bases are retrieved. Experimental prove that the proposed methodology provides better result than the existing work.

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