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A New Approach for Hierarchical Geometric Centroid Content Based Image Retrieval

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Abstract
Recovery images as one of the major issues in the field of image processing has many applications, which in recent decades has been welcomed by many researchers. In this paper, also features content are used to retrieve the images that these features are extracted by Hierarchical Geometric Centroids method, so after extracting them, these features in the proposed method are used to retrieve the images. The proposed method is composed of two algorithms of Multi-Layer Perceptron Artificial Neural Network (MLP ANN) and Discriminant Analysis (DA) that to evaluate it two criteria of accuracy evaluation and recalling were used that the results of the proposed method with two MLP ANN and DA algorithms have been studied. Results showed that the proposed method has the Precision rate of 0.931 and recall rate of 0.943, and MLP ANN algorithm has the Precision rate of 0.751 and recall rate of 0.758 and DA has the Precision rate of 0.681, and recall rate of 0.651.

Keywords: Context Based Image Retrieval, Discriminant Analysis, Multi-Layer Perceptron Artificial Neural Network.

1. Introduction

Sources of information, including text, image and audio files in today's society is increasing. Images are as important and complex source of information being used in the different fields including education, medical care, weather forecasting, criminal investigation, journalism, advertising, art design, web, social media and entertainment. Many processing is done on the image that the most important one is image recovery. Image Recovery is one of the issues in the field of image processing that on this topic, the recovery of the images associated with the query image among a library of digital images based on visual characteristics will be discussed. In the first stage of the image recovery process, unique features for each image should be extracted that usually more researchers are used content features of any image such as color, texture and shape as the extracted features [1, 2]. Among the features associated with the content, image's color is used mostly compared to the texture and shape feature due to its easily extracted feature [3, 4]. Features extracted from Color Histogram is only associated with the colors of the image and values of each one. Also, it should be careful that Color Histogram is sensitive to light and compression techniques. Therefore, this feature with two other features must be combined to achieve the optimal response.

When features in the images extracted by humans, features extracted at a higher level and when those features are extracted by machine, considering that only numerical descriptions are cited, they are extracted at a lower level that this difference cause a gap between features extracted by human and machine for which to reduce these gaps, tags in

the form of meta-data attach to the image interpolation by human which these features is used when the extracted texture feature is used [5].

We have organized different sections of the paper as follows. Section 2 presents the review of previous related works. Section 3, the geometric center of the image. Section 4, the proposed method. Performance evaluation model presented in Section 5 and in Section 6, conclusions and future work is presented.

2. Related Works

With the increasing need for discriminating related images from the unrelated images, the issue of image recovery is important. Therefore, many researchers have proposed many methods in order to identify and recover images. For example, researchers use Support Vector Machine (SVM) algorithm to classify the image into one category or two categories that in [6] the available images in the database are classified into two categories of related and unrelated images, and in [7] only relevant images have been placed in a category. In [8], researchers used adaptive clustering algorithm to recover the images. These researchers are received first an image as the query image from the user and then related image is selected and displayed to the user and at this point the user has identified images and then linked them to the predestinated categories by Bayesian algorithm. Other researchers to recover images used algorithm K, the best neighbor. In this paper, researchers first searched the database based on the image determined by the user and then combined features of related images and used them to categorize. With the increasing of medical images, recovery of these images have a significant impact on the accurate diagnosis of the disease, research and medical education. For this purpose, researchers have presented the different systems with different uses to retrieve medical images [9].

The number of these systems can be used for specific organs of the body, typically spine X-ray system is presented by [10] and dental X-ray by researchers [11] that these systems have no application for other organs. Yong and et.al. [12] have presented a new system for retrieving medical imaged in which distance standard is used for its training. In this system they used visual and semantic similarities to retrieve the images. In this system, at first, the images are converted into a series of binary information and then based on this information and the weighted hamming distance algorithm, the distance between the images is calculated and the most similar image is presented. The system is evaluated based on two database containing medical images. Many researchers asked the user's point of view at each stage of the training phase to enhance the accuracy of the recovery and hybrid of higher level features with lower level ones and based on users' opinions the logarithm will be continued that this process in this method named Relevance Feedback. Researchers in [13] and [14] have been used SVM algorithm and Relevance Feedback method for retrieving images, in these two studies to reduce the overlap in the retrieved images at any stage images, the images are mapped to the new space. In [15], the hybrid of SVM algorithm, merge attitude and filtering features is used. In this algorithm similar features obtained from Relevance Feedback combine with each other and weights of features are reformed considering the images' rate and accuracy of information.

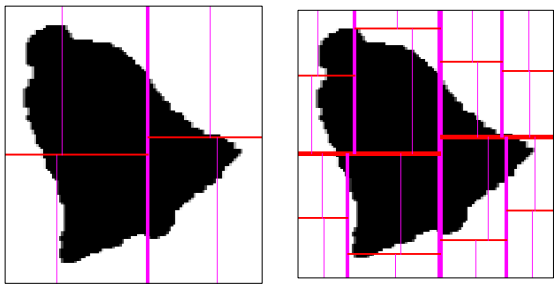
The researchers in [16] have presented a new method for retrieving medical images which at this method, the query image is considered as homogeneous classes, after this stage, the categorizing the homogeneous classes occurs consecutively and according to the theory of integration and from the classes that have overlapping.

3. Hierarchical Geometric Centroids

For obtaining general information as well as local information available in different parts of the image. At this method, the overall center of the picture is determined on the first level and then based on this centrality, the image is divided into parts and the centrality of specified parts is determined and is presented as the second level. These divisions are made according to user needs at various levels. The division has two main differences with the usual assortment. First, the purpose of this division is access to content distributed across the image and Second in this division rather than considering the central point, a point that has more attractions is used.

In this algorithm, at first a pixel which has the highest density is selected as the center point and the first level of segmentation is done based on this point. In the next stage and to divide the second level, the pixel with the highest density in each of four parts of image is selected as central point of each section and each part is divided based on these points. The number of occurrences of this algorithm is dependent on a number of levels specified by the user. For example, in Figure 1, for segmentation, algorithm

implemented Figure 1.a three times and the Figure 1.b for 5 times.



(a) (b)

Figure 1. Image segmentation by Hierarchical Geometric Centroid algorithm

4. Proposed Method

In recent years, due to the need for optimal recovery of images in large databases, extensive researches have been done in this area. At the present paper, a hybrid algorithm for optimal recovery of image is suggested. In the proposed method in the first stage of the image recovery, an image as query image is selected by the user and then effective features to retrieve images are extracted for all the available images in the database and user's selected image by geometry center extraction method sequentially and is used as effective features in classification. In the next stage, the extracted features for existing images in the database have been presented as input of training phase and extracted features for the user's selected image have been presented as input of testing phase to the MLP ANN algorithm. After that the MLP ANN algorithm finished, the extracted data from the training is provided as input to the classification algorithm of DA and in this algorithm based on derived data from training phase of MLP ANN algorithm, images are divided into two categories of related and unrelated and related images are displayed as output to the user and based on the evaluation methods are examined. The performance of the proposed method is displayed in Figure 2.

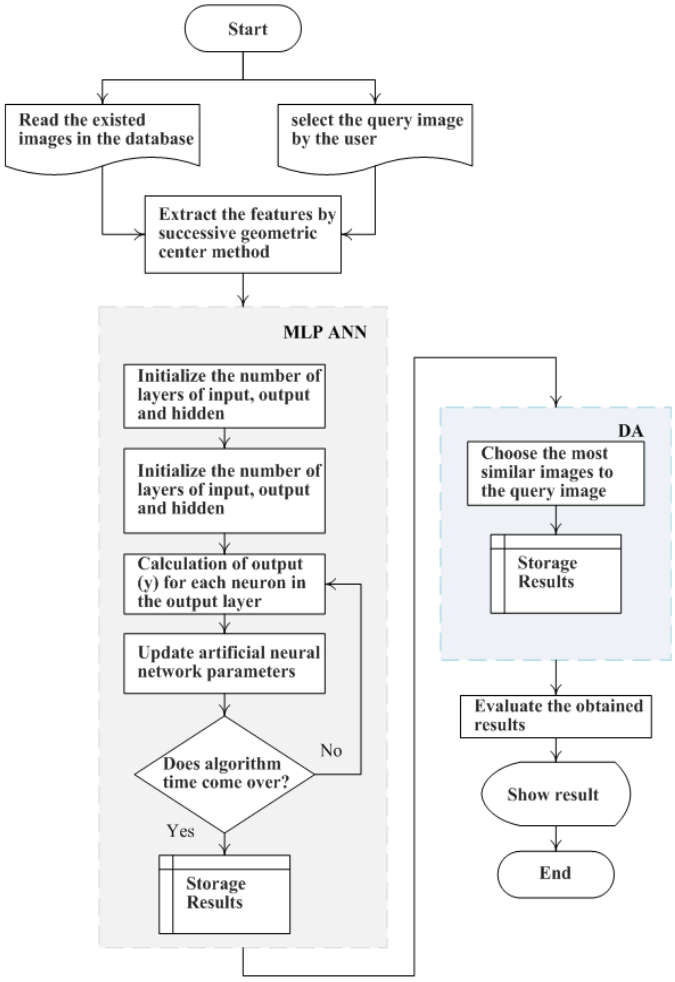


Figure 2. Flowchart of Proposed Method

To extract effective features in image retrieval, geometry center method to the sixth level is used, consecutively. And the implemented MLP ANN algorithm includes three layers that the input layer contains 124 neurons equals to the number of extracted features. The hidden layer consists of 20 neurons and output layer contains 43 neuron equals to the number of classes of images and logistic activation function and propagation algorithm are used. In general, the proposed method is displayed in Figure 3.

Table 1. The Evaluation of the Proposed Method

Image	Method	Precision	Recall
	MLP ANN	0.55	0.50
	DA	0.7	0.63
	Proposed Method	0.98	0.99
	MLP ANN	0.95	0.97
	DA	0.89	0.90
	Proposed Method	0.97	0.98
	MLP ANN	0.70	0.50
	DA	0.66	0.45
	Proposed Method	0.89	0.88
	MLP ANN	0.86	0.95
	DA	0.85	0.94
	Proposed Method	0.92	0.99
	MLP ANN	0.69	0.68
	DA	0.66	0.63
	Proposed Method	0.85	0.83
	MLP ANN	0.76	0.95
	DA	0.33	0.36
	Proposed Method	0.98	0.99

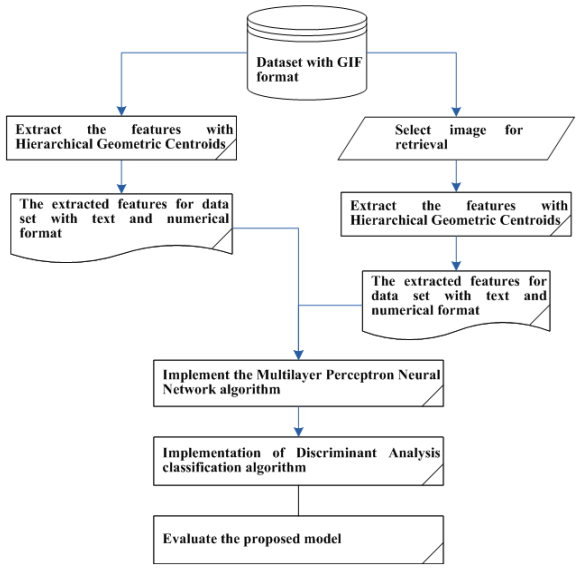


Figure 3. The model of the Proposed Method with Detail

5. Result and Discussion

There is a need for an evaluation criterion to assess the presented new methods which in this paper to evaluate the performance of the proposed method, two criteria of Precision evaluation and recalling were used [17] that the stated evaluation criteria are presented in the formula (1) and formula (2).

$$Recall = \frac{No.of\ relevant\ images\ retrieved}{Total\ no.of\ relevant\ image\ in\ the\ collection} \quad (1)$$

$$Precision = \frac{No.of\ relevant\ images\ retrieved}{Total\ no.of\ images\ retrieved} \quad (2)$$

The obtained results from the evaluation of the proposed method on Kimia-216 data set [18] which is a subcategory of MPEG-7 data set [19] are presented in Table 1. The accuracy rate and recalling are displayed for several images. Based on the obtained results from the table, it can be said that the proposed method has better performance than ANN algorithms and DA algorithm. The evaluation results are displayed over the entire data set as average at Table (2).

Table 2. The Evaluation of the Proposed Method as Average over the Entire Data Set

Method	Precision	Recall
MLP ANN	0.751	0.758
DA	0.681	0.651
Proposed Method	0.931	0.943

5. Conclusion

With ever increasing need to recover images in different areas of research, this topic is already raised as an issue in the field of image processing. In this paper a new method for solving this problem is presented based on learning that at the proposed method, the hybrid of MLP ANN algorithms and DA algorithms is used. Considering that the extracted features for image retrieval is of great importance, the present article tried to extract the image content features by using Hierarchical Geometric Centroids. And these features are provided as input to the proposed method. The results of implementing procedures can be expressed as follows:

The Precision rate of the proposed method is 0.931 and recall is 0.943, and the Precision rate of MLP ANN algorithms is 0.751 and recall is 0.758 and DA Precision is 0.681, and again the recall is 0.651.

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