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Content Based Image Retrieval of User's Interest Using Feature Fusion and Optimization Using Genetic Algorithm: A Survey

Ajimi Ameer[#], SreeKumar.K[*], Minu K.K[#]

[#]*Department Of Computer Science, College Of Engineering Poonjar,Cochin University Of Science And Technology Poonjar, Kottayam District, Kerala, India*

[*]*Department Of Mathematics, College Of Engineering Poonjar,Cochin University Of Science And Technology Poonjar, Kottayam District, Kerala, India*

***Abstract*- The research in content based Image retrieval (CBIR) systems is becoming wide as more and more applications are building up over it. In order to imitate the way human being treat the image management, the conventional way of text based retrieval systems are being replaced by the visual content based systems. The image content has several dominant characteristics like color, texture,shape and it is interesting to see the classification of images on content-basis can be achieved with these features. These different descriptor for the images can form a combined feature vector. However, in order to have optimum performance and to reduce the feature dimensionality for making system real-time, genetic algorithm (GA) based feature selection may be used. Single feature describes image content only from one point of view, which has a certain one-sided. Fusing multi- feature similarity score is expected to improve the system's retrieval performance. For the purpose of assigning the fusion weights of multi-feature similarity scores reasonably, the genetic algorithm is applied.**

***Keywords*- Content based image retrieval (CBIR), Genetic Algorithm, image retrieval,fusion**

I. INTRODUCTION

With the rapid development of multimedia and network technology, people can access a large number of multimedia information. For people who want to make full use of multimedia information resources, the primary question is how to query the multimedia information of interest. Text query can be applied to multimedia information retrieval, but it has inherent deficiencies. One hand, text annotation of multimedia information will spend a lot of manpower and resources and it is inefficient. On the other hand, annotated text is usually a person's perception of multimedia information. It is subject to impact of individual difference and state of human and environment, and the described results may be more one-sided. In addition, it is clearly incomplete to describe content-rich multimedia information with a small amount of text. Content Based Image Retrieval (CBIR) techniques uses low-level features like color, texture and shape to describe image content, and breaks through the limitation of traditional text query technique.

CBIR system can be implemented based on single feature. Single image feature describes the content of an image from a specific angle. It may be suitable for some images, but it also may be difficult to describe other images. Moreover, describing an image with single feature is also incomplete. Representing an image with multi-features from multi-angles is expected to achieve better results[1]. Information is multi- source, and information fusion approach is diverse. The problem how to organize multi-source information in a suitable way to achieve the intended results attracts extensive attention from the researchers in this field.

Information fusion can be carried out in feature level [3]. Information fusion in feature level has advantage in some extent. Because different features reflect the different characteristics of the image, if those features are integrated reasonably, the results will both reserve the discriminate information of multi-feature and eliminate the interference resulted from the difference of multi-feature.

II. DESCRIPTORS FOR CONTENT BASED IMAGE RETRIEVAL

A. *Color*: Several methods for retrieving images on the basics of color similarity have been describe in the literature. Each image is added to the collection is analyzed to compute a color histogram which shows the proportion of pixels of each color within the image. The color histogram for each image is then stored in database. The way matching process then retrieves those images whose color histogram match those of the query most closely. The matching technique most commonly used, histogram intersection and HSV[2]. The color has different features like average,variance and texture can be represented by co-occurrence matrix[1].

B. *Texture*: Based on optimal texture features extracted from GLCM[4]. Texture is usually characterized by the values of energy, entropy, contrast and homogeneity[5].Gabor wavelet proves to be very useful texture analysis[23]. Texture features are found by calculating the mean and variation of the Gabor filtered image. Rotation

normalization is realized by a circular shift of the feature elements so. that all images have the same dominant direction. Discrete Wavelet Transform (DWT) is used for analysis of textures recorded with different resolution. Histogram of Oriented Gradient (HOG) is used for extracting features for the images[25].

C. *Edge:* Edges in images constitute an important feature to represent their content. Human eyes are sensitive to edge features for image perception. One way of representing such an important edge feature is to use a histogram. An edge histogram in the image space represents the frequency and the directionality of the brightness changes in the image. Edge histogram descriptor (EHD) can be used to describe edge distribution with a histogram based on local edge distribution in an image[6].

D. *Shape:* Shape feature using Zernike moments[7] The shape of image was analyzed by clustering model which was compared with glcm based retrieval . Finally, practical results proved that the better retrieval performance obtained for maximum test images based on shape features compared to texture features[8].

E. *Frequency*: Speeded-Up Robust Features (SURF) combined with Bag-of-Visual-Words (BoVW) are used in this proposed method[24]. The combination yields a good retrieval and classification result when compared to other methods. The two dimensional discrete wavelet transform (DWT) is an effective tool to analyze images in a multiscale framework and to capture localized image details in both space and frequency domains[26].The DWT is efficiently implemented via the Mallat's tree algorithm that applies iterative linear filtering and critical down sampling on the original image yielding three high frequency directional sub bands at each scale level in addition to one low frequency sub band usually known as image approximation.

III . MULTI-FEATURE SIMILARITY SCORE FUSION

Since the physical meanings of different features are different, and value ranges are totally different, similarity scores of different features cannot be compared. So, before multi-feature similarity score are fused, they should be normalized. Similarity scores can be normalized through the following ways. Let Q be the query image. Using Genetic Algorithm Image Retrieval Based on Multi-Feature Similarity Score Fusion[9].

By calculating distances between the query image and images in database, similarity score set $\{Si\}$ can be gotten, where $i = 1,L , N$, N is the number of images in database. Thus, similarity score normalization can be implemented as

$$S\,Ni$$
$$S - \min\{S\} = i\,i$$
$$\max\{Si\} - \min\{Si\}$$
$$S - \min\{S\} = i\,i$$
$$\max\{Si\} - \min\{Si\}$$

individuals in population N is taken as I . N is set a bigger value, the aim of which is to gain the optimal solution quickly. The individuals are initialized as follows. The solution space is divided into N equal portions, the centers.The results of multi-feature similarity scores is

$S = S\,NCi \square WC + S\,NTi \square WT$,

of which are taken as the initial values of the individuals.

IV. GENETIC ALGORITHM BASED APPROACH

The major objective behind the application of genetic algorithm in this work is to find important feature elements that contribute more to classifier for distinguishing one word from others. This enhances the recognition accuracy of an image classifier. At the same time, the number of feature elements is also reduced. This reflects in to the reduced length or size of the feature vector. The length of chromosome of GA is to be decided based on the length of feature vector. This chromosome has real value between 0 and 1, randomly generated at each position, in its first form[1]. The position values will further be modified by comparing with some randomly generated value between 0 and 1. If the position value is less than this instantaneous random value then the position in chromosomes will be made to zero. This modification transforms the wide range variations in usable percentage variation of total feature elements, which enables to evaluate the chromosome's performance of recognition with having even small percentage of elements. This chromosome may be then multiplied (element wise) with feature vector to be optimized, before using it for recognition[10].

*Interactive Genetic Algorithm,*IGA is a branch of evolutionary computation. The main difference between IGA and GA is the construction of the fitness function, i.e., the fitness is determined by the user's evaluation and not by the predefined mathematical formula. A user can interactively determine which members of the population will reproduce, and IGA automatically generates the next generation of content based on the user's input[18].

V. IMPLEMENTATION OF GA BASED APPROACH

Anita and Mahima have proposed a cbir using ga with relevant feedback.To cut off semantic gap, relevance feedback technique is used in CBIR system. In relevance feedback technique,for retrieved images, user's feedback is taken[11]. Since user's judgment improves the results of CBIR greatly, but sometime user becomes impatient due to waiting for the refined results as it is large iteration process and time-consuming property. However, the previous users' feedback log contains lots of effective user information related to images, which can help to reduce the semantic gap between high-level concept and low-level features as well as shorten the iteration process.

In the context of CBIR, they are usually based on some form of supervised learning and allow retrieval systems to reduce the semantic gap, converting the search into an iterative,dynamic and interactive process that gradually adjusts the results to the interest of the user. The most common form of relevance feedback mechanism consists of requesting the user to judge on the results retrieved at each iteration, either marking the pictures

retrieved as "relevant", "not relevant" or "neutral", or by means of a slide bar which assigns a "grade of similarity" to each of the results[12]. After obtaining some relevant images, the system provides an interactive mechanism via *Interactive GA*, IGA,which lets the user evaluates the retrieved images as more or less relevant to the query one, and the system then updates the relevance information to include as many user desired images as possible in the next retrieval result[13].

For water quality monitoring, Ni Bin Chang *et.al.* proposed an Integrated Data Fusion and Machine-learning (IDFM) which is an early warning system for the prediction of microcystin concentrations and distribution by measuring the surface reflectance of the water body using satellite sensors[14]. A fused image is created by the algorithmic fusion of the spectral, temporal, and spatial properties of two or more images. For improved content based retrieval a *neural network optimization* using genetic algorithm is proposed in [20]. Feature is extracted from an image using Discrete Cosine Transform, extract relevant features using information gain and Gaussian Fuzzy Feed Forward Neural Network algorithm for classification and optimize the momentum and learning rate using Genetic algorithm.

Joey Mark Diaz *et.al*. utilized genetic algorithm as a method of feature (genes) selection for the support vector machine and artificial neural network to classify lung cancer status of a patient in Lung Cancer Classification study. Genetic algorithm (GA) successfully identified genes that classify patient lung cancer status with notable predictive Performance[16].

Content-based image retrieval (CBIR) of medical images, according to its domain specific image features, is a valuable tool for physicians[17]. The method has three major steps: 1. Feature are extracted from the CT images using Coif let wavelets; 2. The features extracted are classified using Support Vector Machine; 3. The parameters of the SVM are optimized using Particle Swarm Optimization (PSO), and modified PSO with a genetic algorithm.

Ji Zhoung *et.al* [22] proposed a Land Surface temperature retrieval from Moderate-resolution Imaging Spectroradiometer (MODIS) data by integrating regression models and the GA in an arid region. Song and Zhao applied the GA to retrieve component temperature from MODIS data based on a linear spectral mixing model [19]. The GA appears to be a good method for retrieving the Land surface temperature(LST) from thermal remote sensing images.

Ashok Samal et.al. proposed a method for searching satellite imagery with integrated measures[21].In Retrieval of geospatial imagery, The model structure is determined by a structure learning algorithm with feature selection capabilities. The parameters of the models are optimized through a genetic algorithm. The system is used to classify the landcover wet- land and agricultural zones in a lake–wetland ecosystem in Greece using IKONOS imagery

VI. APPLICATION

1. Crime prevention**:** Automatic face recognition systems, used by police forces.
2. Security Check**:** Finger print or retina scanning for access privileges.
3. Medical Diagnosis**:** Using CBIR in a medical database of medical images to aid diagnosis by identifying similar past cases.
4. Intellectual Property**:** Trademark image registration, where a new candidate mark is compared with existing marks to ensure no risk of confusing property ownership.
5. Architectural and engineering design:Designer needs to be aware of previous designs, particularly if these can be adapted to the problem at hand. Hence the ability to search design archives for previous examples which are in some way similar, or meet specified suitability criteria, can be valuable.
6. Searching Satellite imagery: The search engine SIMR—Satellite Image Matching and Retrieval system. SIMR provides an efficient means to match remotely sensed imagery. It computes spectral and spatial attributes of the images using a hierarchical representation.
7. Land Surface Temperature retrieval: It is possible to estimate the water vapor content from remote sensing images. RM-GA (regression model-genetic algorithm) method for retrieving. LST from the at-sensor spectral radiances of MODIS channels. The main advantage of this method is that no auxiliary atmospheric parameter is required.

VII. CONCLUSION

This review paper has presented a user-oriented framework in interactive CBIR system. In contrast to conventional approaches that are based on visual features, our method provides an interactive mechanism to bridge the gap between the visual features and the human perception. The color distributions, the mean value, the standard deviation, and image bitmap are used as color information of an image. In addition, the entropy and edge histogram is considered as texture descriptors to help characterize the images. In particular, the IGA can be considered and used as a semi automated exploration tool with the help of a user that can navigate a complex universe of images. In further, more low-level image descriptors or high-level semantics in the proposed approach can be developed. In this article, I outlined content based image retrieval methods done using one or two low level features such as shape, color and texture and its fusion using genetic algorithm. The conventional Content Based Image Retrieval (CBIR) systems display the large amount of results at the end of the process this will drove the user to spend more time to analyze the output images.Previous researches shows that content based image retrieval using interactive genetic algorithm methods gives better results than conventional methods.

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