International Journal of Soft Computing 9 (4): 240-245, 2014
ISSN: 1816-9503

Soft Computing Based Medical Image Retrieval Using Shape and Texture Features

[1]M. Mary Helta Daisy and [2]S. Tamil Selvi
[1]Department of ECE, St. Xavier's Catholic College of Engineering, Chunkankadai, India
[2]Department of ECE, National Engineering College, Kovilpatti, India

Abstract: Image retrieval is a challenging and important research applications like digital libraries and medical image databases. Content-based image retrieval is useful in retrieving images from database based on the feature vector generated with the help of the image features. In this study, researchers present image retrieval based on the Genetic algorithm. The shape feature and morphological based texture features are extracted images in the database and query image. Then, generating chromosome based on the distance value obtained by the difference feature vector of images in the data base and the query image. In the selected chromosome the genetic operators like cross over and mutation are applied. After that the best chromosome selected and displays the most similar images to the query image. The retrieval performance of the method shows better retrieval result.

Key words: Medical image, Genetic algorithm, image retrieval, query image, chromosome, data

INTRODUCTION

Content based image retrieval is applied to visual contents for search images from the feature databases. In the medical field enormous images are produced and used for diagnostic purposes (Daisy and Selvi, 2012). The visual and multimedia data are steadily increasing. So, there is a need for fast retrieval methods apart from text-based retrieval. To search large multimedia databases for retrieval purposes, the visual and audio content use commonly (Muller *et al*., 2004). The visual content of images like color, texture and shape are use by the CBIR System. During the time of the retrieval, the visual feature can be use by the user. Then, the retrieval system can able to find the similar images from the database. The gap between the high level and low level feature, perception of visual content by human are the two distinct characteristic of CBIR (Rui *et al*., 1998).

The Genetic algorithm is introduced to do the optimization, Genetic algorithm to evolve chromosome population using the various genetic operations like selection, crossover and mutation. The objective of the selection and reproduction operator is to keep copies of best element in the chromosome to propagate for next generation. The fitness function is used to evaluate the chromosome. The crossover operator creates a new structure by exchanging element in the chromosome (Cuevas *et al*., 2002). Optimization of CBIR is a time consuming task because the entire image in the database indexed again when each time the Indexing algorithm is use for that purpose (Saadatmand-Tarzjan and Moghaddam, 2007). The crossover operator exchanges the subset of genes with pair of individuals and generates two others. Mutation operator replaces randomly selected genes from an individual (Santos *et al*., 2008).

The Genetic algorithm application begins with initial population and the individuals which are randomly generated. The fitness value of the each chromosome is evaluated and determines the appropriateness of the problem. The individual selected from the population before the recombination are called parent. After the recombination the chromosome are called as the children (Cho and Lee, 2002). The genetic cross over is applied to the feature vectors. The new chromosome after the crossover and feature vector in the database are compared based on similarity measure. The most similar chromosome are use for the next generation (Yoo and Cho, 2007).

Literature review: Saadatmand-Tarzjan and Moghaddam (2007) was presented optimization of CBIR using Evaluationary Group Algorithm (EGA). In this approach, the image database subdivided in to small groups. Ga use the small group for evaluation. The chromosome consists of genes. The chromosome has evalutionary genes and history genes. EGA shows good precision and recall values. Santos *et al*. (2008) proposed GA based image retrieval. This method considering the local features of the image. By considering the combination of the right features of the image together to get suitable results. The user preference and similarity uses GA.

Corresponding Author: M. Mary Helta Daisy, Department of ECE, St. Xavier's Catholic College of Engineering, Chunkankadai, India

Cho and Lee (2002) proposed interactive GA for Retrieval System. Wavelet transform are used for the feature extraction from the images. This method provides the user friendliness to retrieve images from the large databases. This enable the implicit queries rather than the explicit queries.

Gali *et al.* (2012) have proposed GA for Content Based Image Retrieval System. The low level image features like color, texture and shape are combined and trained with different weight values. To evaluate and optimize features weights of CBIR coded chromosome used. The optimum weight of the feature calculated with better fitness function.

Lai and Chen (2009) have proposed interactive Genetic algorithm for CBIR. They combined the color feature and texture feature for the retrieval purposes. The differences of the retrieved result and user query are adjusted by the weight of color and texture features based on the expectation of the user.

Raghuwanshi *et al.* (2012) have presented implicit and explicit feedback based image retrieval using Genetic algorithm. The combining approach improves the user perception of the image resemblance. It provides two tier architecture. The color and texture features are considered as low level features for image retrieval.

Torres *et al.* (2008) proposed GA framework for the combination of the similarity measure was presented. The GA is more suitable for combining the simple descriptors of CBIR which similar images returned from the database.

Ferreira *et al.* (2008) presented GA based image retrieval using the relevance feedback. This approach consider the color, texture and shape feature of an image in the data base for the retrieval purpose. The GA find out the better combination of the feature descriptor to produce similar images.

Syam and Rao (2013) proposed GA for CBIR using extensive feature. The extensive feature vectors of the contour, texture and color of the image are extracted. The GA based approach is applied both query and database images. Then, the retrieval accuracy is evaluated by the precision and recall measure.

Hatwar and Hatwar (2012) proposes GA based retrieval for the relavence feedback. The query image and database images are segmented first. The texture and color feature of the images are extracted to form the feature vector for the comparison. By considering the three regions of the image are selected and combining the three to form the chromosome of the Genetic algorithm.

MATERIALS AND METHODS

Feature extraction: As per the proposed technique, two features can be computed from each region of an individual image in a database. The calculated features are stored individually in a database. The two features are (Daisy and Selvi, 2012):

- Texture feature
- Shape feature

Texture feature: The texture feature provides the better image description of the visual content. The texture analysis can make use of the different attributes like segmentation and recognition. For the feature extraction purpose different approaches like statistical and structural are considered by CBIR. The structural method describes the texture as the primitive form. The texture features usually provides the smoothness and coarseness of the image. So, many types of method describe the texture as the primitive form. The texture features usually provides the smoothness and coarseness of the image. So, many types of methods for computing the texture feature of the image. But no one is suitable to all the varieties of the features.

Gabor filters: Gabor filter can be represented by the following equation in the spatial domain as Eq. 1. Equation 1 is the representation of the Gabor filter:

$$G_{\sigma,\phi,\theta}(x,y) = g_{\sigma}(x,y)\exp[2\pi j\phi(x\cos\theta + y\sin\theta)] \quad (1)$$

Where:

$$g_{\sigma} = \frac{1}{2\pi\sigma^2}\exp[(x^2 + y^2)/2\sigma^2]$$

The Gabor filter $G_{\sigma,\phi,\theta}(x, y)$ forms the complex valued function. Decomposing $G_{\sigma,\phi,\theta}(x, y)$ leads into real and imaginary parts in Eq. 2:

$$G_{\sigma,\phi,\theta}(x,y) = R_{\sigma,\phi,\theta}(x,y) + jI_{\sigma,\phi,\theta}(x,y) \quad (2)$$

Where:

$$R_{\sigma,\phi,\theta}(x,y) = g_{\sigma}(x,y)\cos[2\pi\phi(x\cos\theta + y\sin\theta)]$$

$$I_{\sigma,\phi,\theta}(x,y) = g_{\sigma}(x,y)\sin[2\pi\phi(x\cos\theta + y\sin\theta)]$$

Shape features: The shape features of the image can be the gray scale equivalent of every image in the database. Human can perceive the scenery which composed of many objects together. The object can use for the better identification of their shapes. The shape is one of the features for the user to describe as query.

Fourier descriptor: Fourier transformation mainly used for shape analysis. It can able to represent the object in the frequency domain. The common general features of

the shape can be represented by lower frequency of the Fourier transformation. The important details of the shape are representing by the higher frequency of the Fourier descriptor. Fourier transform usually generate large number of coefficients. The discrete Fourier transform of s(t) is given by Eq. 3:

$$u_n = \frac{1}{N}\sum_{t=0}^{N-1} s(t)\exp\left(\frac{-j2\pi nt}{N}\right), n = 0, 1, \ldots, N-1 \quad (3)$$

Here, u_n, n = 0, 1, ..., N-1, are usually called coefficients of the shape of Fourier descriptors denoted as FD_n, n = 0, 1, .., N-1.

Algorithms

Algorithm 1 (generation of feature vector from database image and query image):

1. Convert the input image to gray scale.
2. Apply Gaussian filter to blur the images in database and query.
3. Apply Fourier descriptor operation to extract the shape feature.
4. Apply Gabor filter operation to the ith image for extracting texture feature.
5. Apply morphological operator for opening texture feature for further operation.
6. Concatenate the shape and texture feature values to get the feature vector of ith image.
7. Repeat the step 2-6 for the query image and extract query image feature vector (Daisy and Selvi, 2012).

- Gene: it is the difference of the feature vector value of the image in the database and query image
- Chromosome: each chromosome consists of 10 genes
- Distance value: this is the sum of the gene in a given chromosome
- Cross over: crossover is one of the genetic operators It mates two chromosomes to generate a new offspring
- Mutation: mutation is also one of the genetic operators. That make change one or more gene value in the chromosome from its starting state

Algorithm 2 (genetic based image retrieval):

1. Generate 10 chromosomes without repeating the same gene once again in it.
2. Find the distance value of all chromosomes.
3. Select the best five chromosomes (n1) based on the distance value to perform crossover and mutation.
4. After genetic operation get the five chromosomes (n2).
5. Combine the n1 and n2 chromosome to use next generation.
6. Repeat the steps 2-5 for ten generations.
7. At the end of the ten generation select the best chromosome based on the minimum distance value.
8. Display the images based on the genes in the selected chromosome.

RESULTS AND DISCUSSION

The proposed approach contains a database of 1500 images. This includes 500 brain images, 500 liver images and 500 lung images (Fig. 1-3). The experiments were

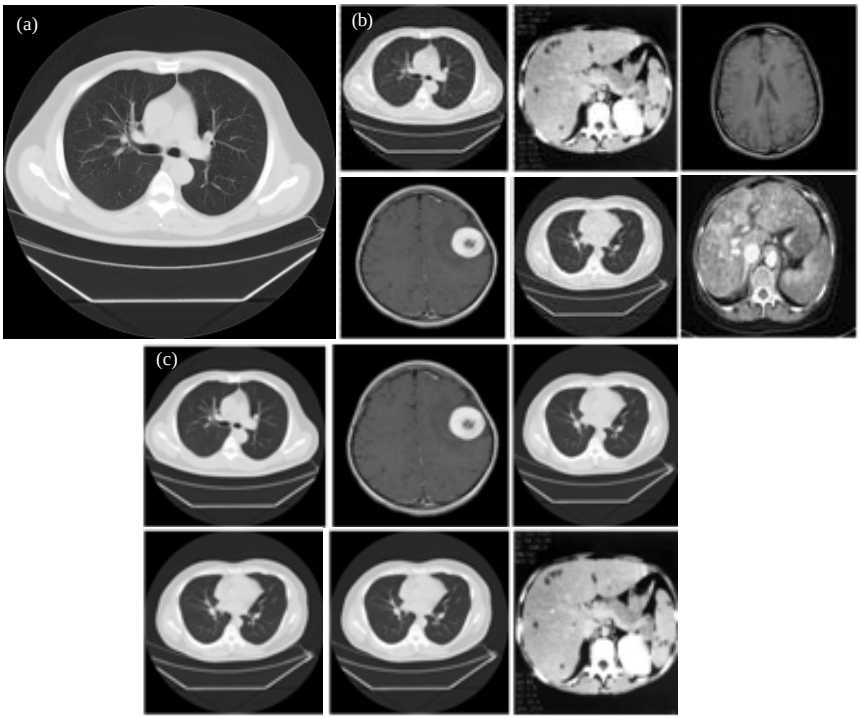

Fig. 1: Sample output obtained for lung image. a) query image; b) retrieved images without GA and c) retrieved images with GA

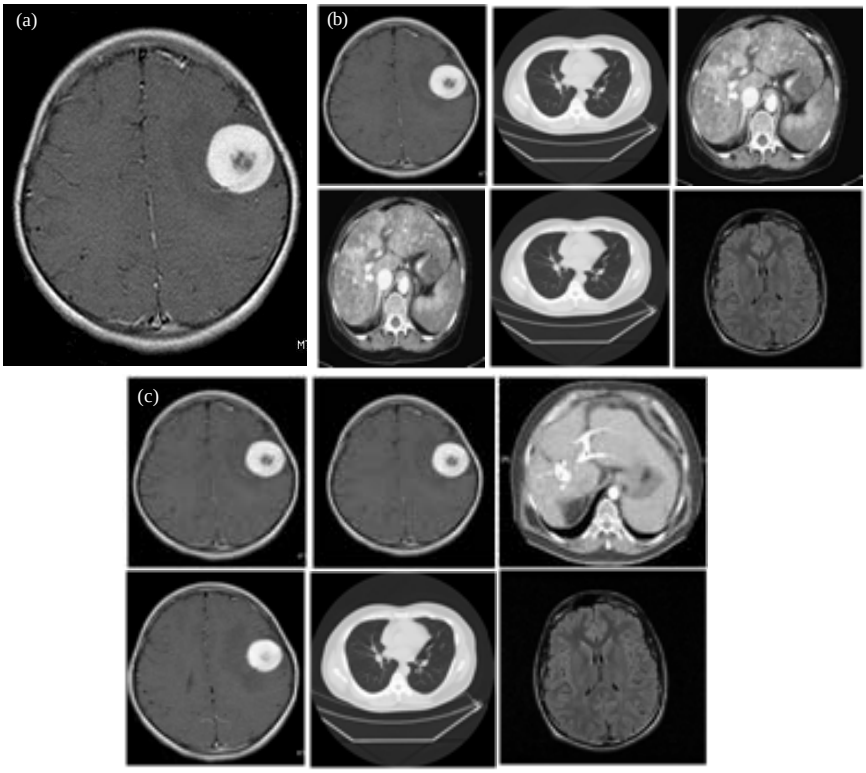

Fig. 2: Sample output obtained for brian MRI image. a) query image; b) retrieved images without GA and c) retrieved images with GA

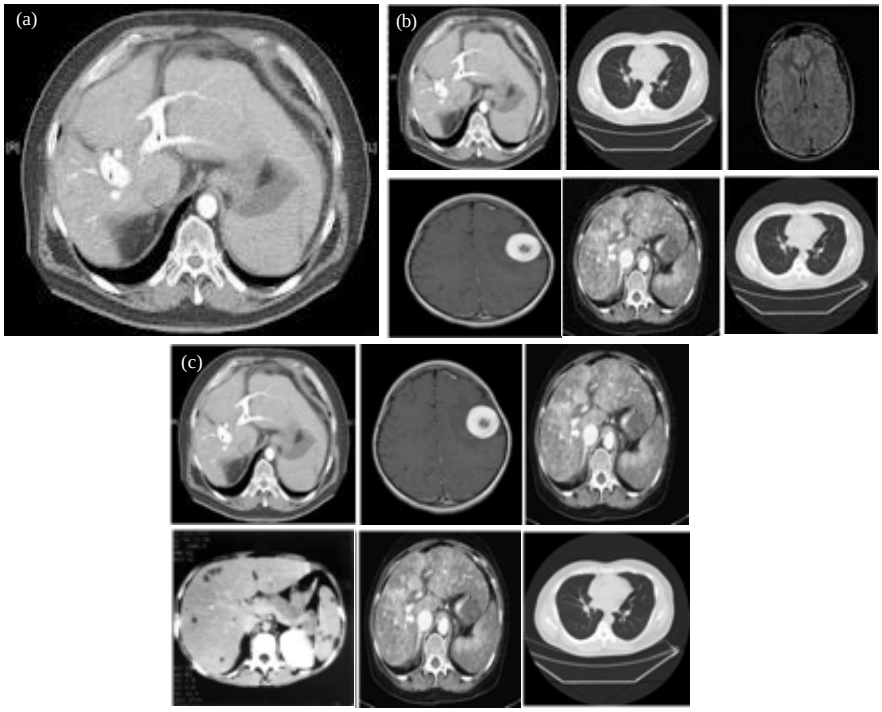

Fig. 3: Sample output obtained for liver image. a) query image; b) retrieved images without GA and c) retrieved images with GA

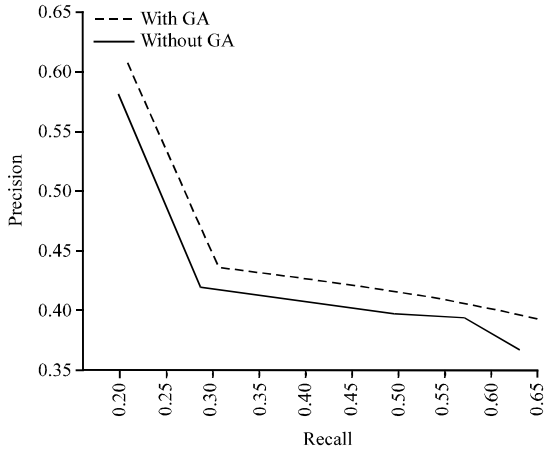

Fig. 4: Performance comparison for lung images

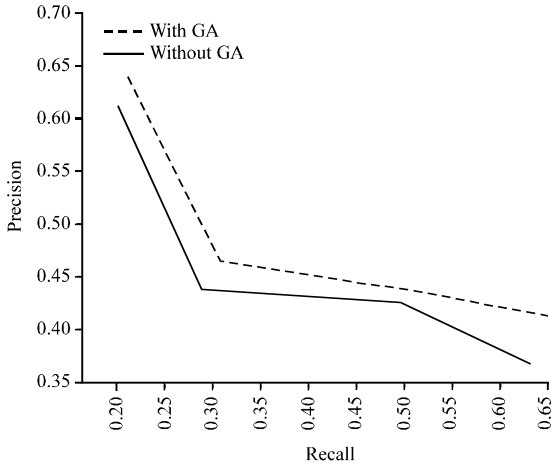

Fig. 5: Performance comparison for brian images

conducted using MATLAB. The efficiency of the retrieval accuracy is measured by precision and recall measure. By considering the Genetic algorithm and without Genetic algorithm, the precision and recall is estimated. The precision and recall of the method based Genetic algorithm outperforms the method considering without genetic algorithm. The precision and recall mentioned in the proposed method which are computed for a given query images and the associated precision-recall graph is shown in Fig. 4-6. The retrieved images and the precision-recall graph show that the proposed CBIR System claims effectiveness in retrieving images that are most similar to the given query image:

$$\text{Precision} = \frac{\text{Number of retrieved images relevant to the query image}}{\text{Total number of images retrieved}}$$

$$\text{Recall} = \frac{\text{Number of retrieved images relevant to the query image}}{\text{Total number of relevant images in the database}}$$

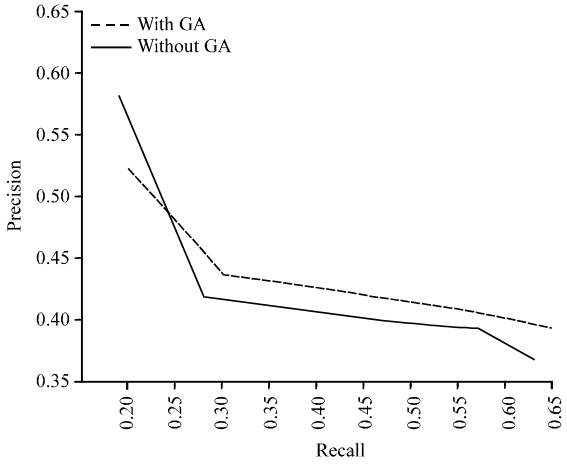

Fig. 6: Performance comparison for liver images

CONCLUSION

Researchers proposed CBIR based medical image retrieval using Genetic algorithm for retrieving relevant images from image database. This approach extracted the features like shape and morphological based texture from the image using Fourier descriptor, Gabor filter, respectively. The cross over and mutation operators are applied to the chromosomes. The best chromosome is selected then displays the related images to query image from the database. The retrieval result gave better result.

REFERENCES

Cho, S.B. and J.Y. Lee, 2002. A human-oriented image retrieval system using interactive genetic algorithm. IEEE Trans. Syst. Man, Cybernet. Part A: Syst. Humans, 32: 452-458.

Cuevas, F.J., J.H. Sossa-Azuela and M. Servin, 2002. A parametric method applied to phase recovery from a fringe pattern based on a genetic algorithm. Optics Communicat., 203: 213-223.

Daisy, M.M.H. and S.T. Selvi, 2012. Content based MRI brain image retrieval by combining fourier descriptors and gabor filters with morphological operation. Eur. J. Sci. Res., 87: 469-478.

Ferreira, C.D., R.S. Torres, M.A. Goncalves and W. Fan, 2008. Image retrieval with relevance feedback based on genetic programming. Proceedings of the 23rd Brazilian symposium on Databases, October 13-15, 2008, Campinas, SP, Brazil, pp: 120-134.

Gali, R., M.L. Dewal and R.S. Anand, 2012. Genetic algorithm for content based image retrieval. Proceeding of the International Conference on Computational Intelligence, Communication Systems and Networks, July 24-26, 2012, Phuket, pp: 243-247.

Hatwar, N.R. and R.F. Hatwar, 2012. Content based image retrieval genetic algorithm for relevance feedback. Int. J. Adv. Comput. Res., 2: 381-385.

Lai, C.C. and Y.C. Chen, 2009. Color image retrieval based on interactive genetic algorithm. Next-Generation Applied Intelligence, 5579: 343-349.

Muller, H., N. Michoux, D. Bandon and A. Geissbuhler, 2004. A review of content-based image retrieval systems in medical applications-clinical benefits and future directions. Int. J. Med. Inform., 73: 1-23.

Raghuwanshi, G., N. Mishra and S. Sharma, 2012. Content based image retrieval using implicit and explicit feedback with interactive genetic algorithm. Inter. J. Comput. Appli., 43: 8-14.

Rui, Y., T.S. Huang, M. Ortega and S. Mehrotra, 1998. Relevance feedback: A power tool for interactive content-based image retrieval. IEEE Trans. Circ. Syst. Video Technol., 8: 644-655.

Saadatmand-Tarzjan, M. and H.A. Moghaddam, 2007. A novel evolutionary approach for optimizing content-based image indexing algorithms. IEEE Trans. Syst., Man Cybernetics-Part B: Cybernet., 37: 139-153.

Santos, J., C.D. Ferreira and R. Torres, 2008. A genetic programming approach for relevance feedback in region-based image retrieval systems. Proceedings of the 21 Brazilian Symposium on Computer Graphics and Image Processing, October 12-15, 2008, Campo Grande, pp: 155-162.

Syam, B. and Y. Rao, 2013. An effective similarity measure via genetic algorithm for content based image retrieval with extensive features. Int. Arab J. Inform. Technol., 10: 143-151.

Torres, R.S., A.X. Falcao, M.A. Goncalves, J.P. Papa, B. Zhang, W. Fan and E.A. Fox, 2008. A genetic programming framework for content-based image retrieval. Patt. Rec., 42: 283-292.

Yoo, H.W. and S.B. Cho, 2007. Video scene retrieval with interactive genetic algorithm. Multimedia Tools Appli., 34: 317-336.