Brain Tumour Segmentation using BFOA Technique

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Abstract-In MRI, brain tumor segmentation is most difficult task since it is necessary for diagnostic purpose. This project put forward a unique image segmentation algorithm. It uses Markov Random Field (MRF) cross with biologically inspired technique Bacteria Foraging Optimization Algorithm (BFOA) for Brain Magnetic Resonance DICOM Images. The proposed algorithm works on the image pixel data and a region/neighborhood map to form a context in which they can merge. Hence, the MR brain tumor image is segmented by MRF-BFOA technique and the results are compared to traditional metaheuristic segmentation method Genetic Algorithm. All the experiment results show that MRF-BFOA has better performance than that of standard MRF-GA.

Keyword - Magnetic Resonance Image (MRI), Brain Image Segmentation, Markov Random Field, Bacteria Foraging Optimization Algorithm (BFOA).

I. INTRODUCTION

In healthcare, Brain tumor is the major cause for the growth in death among humans. A tumor can be more accurately defined as an unusual growth caused by cells reproducing themselves in an uncontrolled fashion. Recent survey shows that about 23800 adults (13,450 men and 10,350 women) were affected by brain tumor. Brain tumors account for 85% to 90% of all primary CNS tumors. Also, about 4,830 children will be diagnosed witha brain or CNS tumor this year.

Medical imaging is a required tool forimproving the analyses, understanding and treatment of a wide range of diseases including cancer. Revealingof brain tumor needs high-resolution brain MRI. Most Medical Imaging was conductedusing MRI, Positron Emission Tomography (PET) and Computed tomography (CT) Scan. Now a days MRIsystems are the most significant in medical image analysis. It has a multidimensional nature of data provided fromdifferent sequential pulses magnetic resonance imaging (MRI) can provide thoroughdata about diseaseand can categorize many pathologic conditions, giving an exact diagnosis.

The Segmentation of an image is the procedure of separation of the image into sections of related structure andbehavior. The main purposeofvarious image processing applications is to extract significant features from the imageandoffers description, interpretation, or understanding of the scene can be provided by the machine.Separation of tumor region from the brain MR Images is aserious but time-consuming taskachieved by Radiologists and Medical Experts.There are many procedures used to split the brain images into tumors, edema and necrotic tissues from theMR Image.Several authors suggested various algorithms for segmentation.The rest of this paper is organized as followsSection I describes the preprocessing and enhancementprocess. Section II deals with the segmentation of MR images using MRF hybrid with BFOA algorithm.Section III compares the result of MRF-GA with the proposed MRF hybrid with BFOA. Section IV gives the conclusion for the paper.

II. FLOWCHART

A. Description

To obtain and use the real DICOM medical images for carrying out research is a very difficult due to various technicalproblems. A sample weighted images of size 256x256x16 are taken and used for enhancement and segmentationpurpose. The DICOM images are allowed for removal of noises by means of Center Weighted Median Filter. The Markov Random Field creates a map value for segmenting the image by pixel-by-pixel. The mapped values are made to hybrid with Genetic Algorithm and Bacteria Foraging Optimization Algorithm and the parameters are compared to analyze the performance. The segmented image has only tumor affected area.

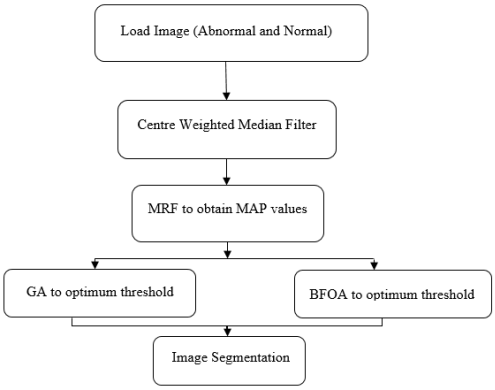

Fig. 1: Flow Chart

III. PREPROCESSING

The process of image processing is done by following stages. They are as follows:

A. Filtering

The input DICOM images are taken as series of slides with 5mm thickness in axial position shown in fig 2. It contains noise that comes due to movement of patient while undergoing scanning procedure, even slight shaking makes a wide variation in image diagnosis. This can be removed by using Center Weighted Median Filter (CWM), which is a weighted median filter giving more weight only to the

central value of each window. It preserves only image details and suppress additive white and noise shown in fig 4.

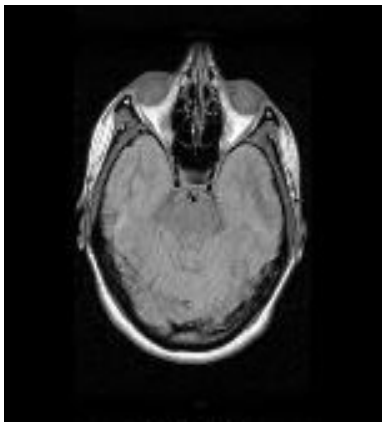

Fig 2. Original Image

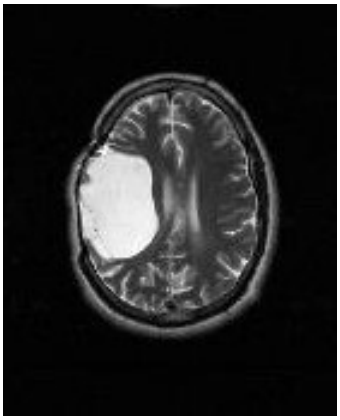

Fig 3. Tumor Image

IV. SEGMENTATION

Segmentation is the process of separating a digital image regions or sets of pixels. Actually, it involves highlighting the pixels which are similar with respect to some characteristic or computed property, such ascolor, intensity, or texture. Nearby regions are completely different with respect to same characteristics.

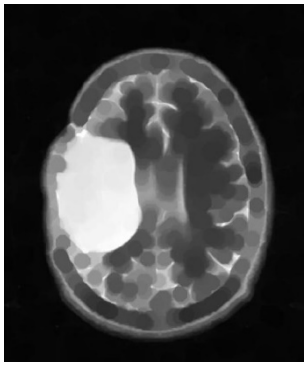

Fig 4. Filtered Image

B. MRF-GA

Charles Darwin introduced a Genetic Algorithm based on natural selection. This Algorithm uses natural selection of fittest individuals for optimizing the problem. Optimization for the problem can be implemented through natural exchange of genetic material between parents. Off springs are created from parent genes by allowing only the fittest individuals to breed. In our perspective of Genetic Algorithm, genetic material is replaced by strings of bits and natural selection replaced by fitness function to find the optimal solution. The two main operation for the matting of parents is by cross-over and mutation operations. Divide the image into kernels of size 3 x 3 and assign labels for each kernel using the principle of Markov Random Field iteratively and apply the crossover and mutation operation to find the optimum label among the kernels. The central pixel of the corresponding kernel will be the threshold value. The image is then segmented using this value as threshold.

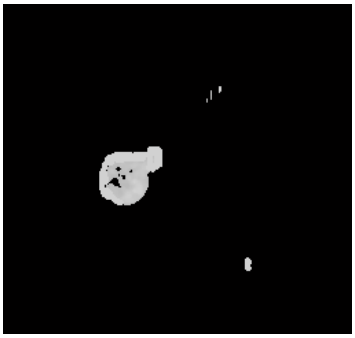

Fig 5. GA – Segmented Tumor

C. MRF-BFOA

Bacteria Foraging Optimization Algorithm (BFOA) was proposed by Passino. This algorithm is based on the application of group foraging strategies of a swarm of E. coli bacteria in multi-optimal function optimization. Bacteria search for nutrients in a manner to maximize energy obtained per unit time Foraging is the method for locating, handling and ingesting food. During foraging activity of the real bacteria, movement is achieved by a set of tensile flagella. Flagella help an E. coli bacterium to tumble or swim, which are two basic operations performed by a bacterium at the time of foraging.

Fig 6. BFOA – Segmented Tumor

V. RESULT

Select the image pixels, which are having optimum label, are stored as a separate image. This image is the segmented image of brain MR image. For comparison, the same image was tested using the meta-heuristic segmentation methods such as the genetic algorithm. As can be seen, the proposed method is more efficient than the other methods.

VI. CONCLUSION

	Segmentation using MRF-GA	Segmentation using MRF-BFOA
Adaptive threshold	179.20	185.30
Number of segmented cells	1016	878
Execution time (min)	33.55	31.21

TABLE 1. COMPARISON BETWEEN GA AND BFOA

In this paper, the population based image segmentation approach was presented. The approach used for segmentation is the Bacteria foraging optimization of the E. coli bacteria. The improved accuracy rate according to the experimental results is due to better characterization of natural brain structure. Table 1.shows that the segmentation result of the proposed method has higher accuracy compared to existing algorithms.

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