Extract Area of Tumor through MRI using Optimization Technique with Fuzzy C Means

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ABSTRACT
Image processing is any type of signal processing in which we take any abnormal image of brain tumor and then produce an output which is extracted portion of tumor by applying genetic algorithm with fuzzy clustering means method. FCM is superior over different clustering approaches. This combined approach is used to improve segmentation efficiency and obtain higher value of true positive pixels belong to tumorous region. Genetic algorithm is a stochastic global optimization algorithm, their combination can prevent FCM being trapped in local optimum and give more better results in comparison to neural networks and CAD approaches.

Keywords
Clustering, Brain tumor segmentation, fuzzy c means, Genetic Algorithm, Digital Imaging and Communications in Medicine

1. INTRODUCTION
Brain tumor segmentation is a recent research in field of biomedical application. Image segmentation is the process of partitioning an image into different clusters. The goal of image segmentation is a domain independent decomposition of an image into distinct regions such as color, intensity, brightness, textures etc. An important step in segmentation is to extract the region of area in which we are interested in. Clustering is a technique which classifies patterns in such a way that true positive pixels of same group who actually belongs to cancer than false positive pixels who does not belong to tumor belongs to different group. A brain tumor is any intracranial mass created by abnormal and uncontrolled cell division. Tumors can destroy brain cells or damage them indirectly by causing inflammation, compressing other parts of the brain, inducing cerebral edema or by exerting internal pressure as they grow [1]. Brain tumors are classified into:

- Primary brain tumor.
- Secondary brain tumor.

Most Research in developed countries show that the number of people who develop brain tumors and die from them has increased perhaps as much as 300 over past three decades. The overall annual incidence of primary brain tumors in the U.S is 11 to 12 per 100,000 people for primary malignant brain tumors, that rate is 6 to 7 per 1,00,000. In the UK, over 4,200 people are diagnosed with a brain tumor every year (2007 estimates In India, totally 80,271 people are affected by various types of tumor (2007 estimates) [2].
Many approaches have been applied to find tumorous part from image. A neural network approach is given in 7 steps of training data (in 2010) [3]. T.LOGESWARI has defined a work on brain tumor detection using soft computing. In this paper, the proposed technique ACO hybrid with Fuzzy and Hybrid Self Organizing Hybrid with Fuzzy describe segmentation consists of two steps [4]. A cellular automata approach is used for radio surgery applications which gave results with far more accuracy than previous results (in 2012) [5]. A CAD approach is also applied to detect tumor which works upon global threshold segmentation is done on the sharpened image to segment the brain tumor [6].

An automated diagnosis system for brain tumor detection should consist of multiple phases including noise removal, brain image segmentation and brain tumor extraction. This paper presents a fuzzy clustering approach combined with genetic algorithm for brain tumor detection. Our systems extracts tumor by using three phases, pre processing, and genetic algorithm combined with fuzzy clustering means and post processing.

This paper is arranged in four parts. Section II explains the proposed method and step by step procedure for automated brain tumor detection and segmentation. Experimental results & their analysis are shown in section III and IV and finally conclusion is explained in section IV that wraps up whole paper.

2. PROPOSED METHOD
2.1 Image Preprocessing
Read a true color image RGB of brain tumor then convert it into grayscale intensity image by eliminating hue and saturation information while retaining luminance. After that convert grayscale image into double precision. Display grayscale image by specifying display range in [LOW, HIGH]. The value LOW displays pixels as black; the value HIGH displays pixels as white. Complement and adjust the intensity values of image. A histogram for the intensity image is displayed whose number of bins is specified by image type. If image is gray scale then it uses 256 bins as default value and if image is binary then it uses only 2 bins. Histogram shows the distribution of pixel values. A size of histogram is calculated by specifying the number of rows. It vanishes the noise coefficients by thresholding the detail components. In this paper, I have used segmented threshold value as 0.2.

2.2 Genetic Algorithm Using FCM Technique
The word "genetics" is derived from the Greek word "genesis" meaning "to grow" or "to become". Genetic Algorithms (GAs) was invented by John Holland. Holland proposed GA as a heuristic method based on "Survival of the fittest". An implementation of genetic algorithm begins with a population of (typically random) chromosomes. A chromosome is a long, complicated thread of DNA

(deoxyribonucleic acid). Hereditary factors that determine particular traits of an individual. Each trait is coded by some combination of DNA (there are four bases, A (Adenine), C (Cytosine), T (Thymine) and G (Guanine). Like an alphabet in a language, meaningful combinations of the bases produce specific instructions to the cell.
GA was discovered as a useful tool for search and optimization problems [7]. FCM clustering degrades the accuracy of image because it takes only pixel attributes and do not consider neighbor pixels but when GA is used in combination with FCM then this approach reduces population size and consider parent neighbor also. As GA is rule based probabilistic approach and always search for global optimum.

2.3 FCM Clustering Approach

Clustering is a form of unsupervised learning of grouping together similar data items into one cluster according to some selection criteria. Clustering is a main task of explorative data mining, and a common technique for statistical data analysis used in many fields, including machine learning, pattern recognition, image analysis, information retrieval, and bioinformatics. Different types of algorithms have been designed based on clustering model such as connectivity, centroid, distribution models etc. Clustering is a method of data exploration which extracts the patterns from images according to interest. In this paper, a centroid model such as fuzzy c means algorithm is used to detect tumor part from abnormal image and run over 100 iterations of genetic algorithm parameters. In fuzzy clustering, each point has a degree of belonging to clusters. The degree of belonging is inversely proportional to the centre of cluster which is examined in previous pass of running code by operators. This method however finds local optimum and run over multiple times to find correct output. The input arguments of this function fcm is the data set and number of clusters (first cluster belongs to tumor part and second cluster belongs to non tumorous part) and the output is final matrix cluster centers and intermediate values of objective functions during iterations.

Genetic Algorithm uses three operators with FCM to complete 1 iteration of data. In this paper, 100 iterations are taken to detect tumor part and take population vector as fitness function. Flow chart representation is shown in figure 1 and algorithm is shown in figure 2.

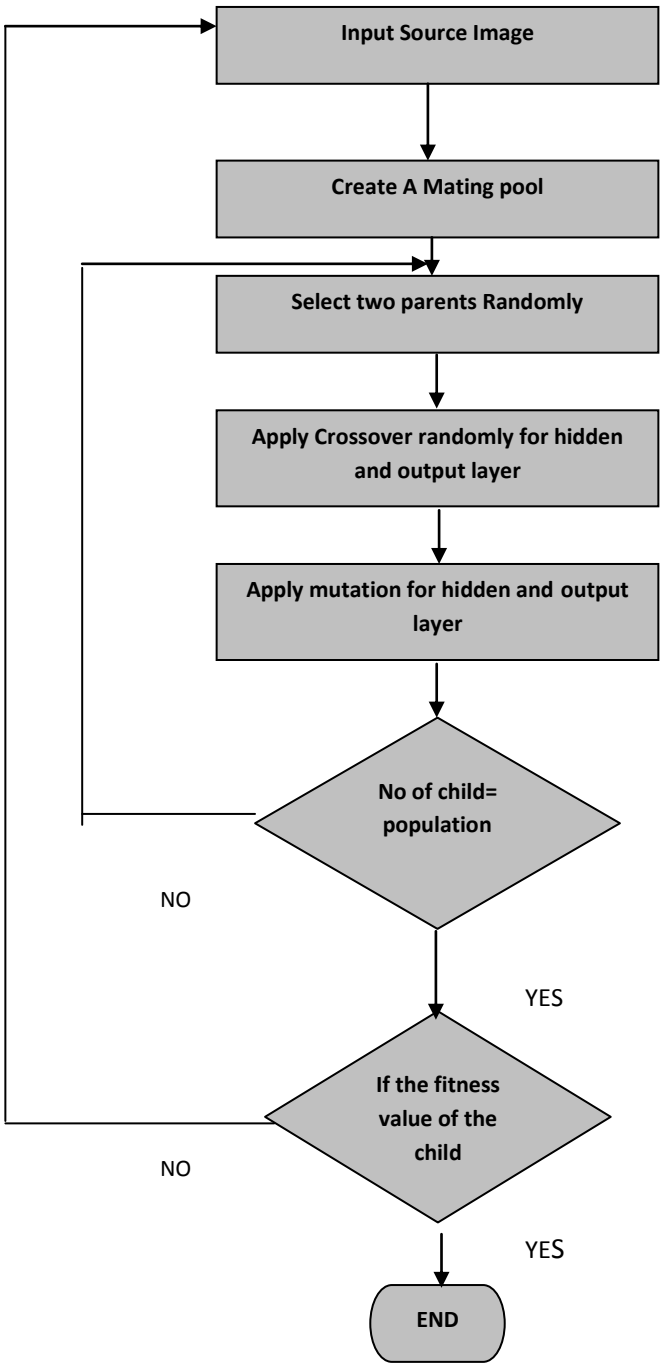


Figure 1. Flowchart Representation

BrainTumorDetection (Image)

/*Image is the input source image*/

{

1 Convert the image to Grayscale
2 Perform the image enhancement using preprocessing Tools to Normalize the Image
3 Initialize the population respective to the Genetic algorithm

4 Perform the Image Segmentation using Fuzzy C Means
5 Define the initial Fitness Function
6 For i=1 to MaxIteration
[Repeat Steps 6 to 11]
7 Perform the Selection of Selection on this Training Dataset
8 Perform the Crossover on selected parents and generate the next level child
9 Perform the Mutation to neglect the values that does not support fitness function
10 Recombine the generated child with existing population to Generate new Population Set
11 Apply the Fuzzy C Means on this new population Set.
12 Generate the Mean of this Image
13 Compare the image pixel with this obtained clustered Threshold value, And derive the result image
14 Present the tumor detected image.
}

Figure 2: Algorithm of Brain Tumor Detection

2.3.1 Selection

It is the process of choosing two random values from population for next generation. According to Darwin's theory of evolution, the best ones survive to create new off springs. Sum of elements is stored and then cumulative sum of elements is calculated. Choices of values are taken between selected value 0 and 1.

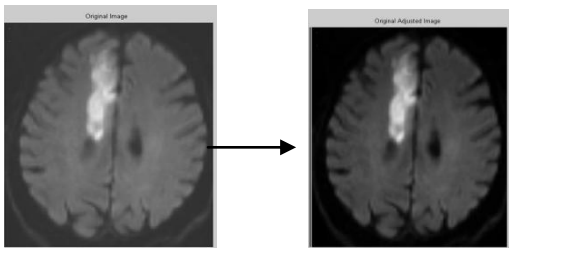
2.3.2 Cross over

Set values as vector containing centroid of clusters. In this paper, crossover value is taken 0.8. We set population as 30 and number of generations as 200. The basic parameter is crossover probability (pc) which describes how often crossover will be performed.

2.3.3 Mutation

Using this operator, it converges to get global minima instead of local minima. The important parameter is mutation probability (pm) which decides how often parts of chromosome will be mutated. If any vector have valueless than equal to 30 then we consider mutation probability as 0.2 if it is between 30 and 50 then we consider it as 0.03 else we consider it as 0.02. The process of one image is shown in figure 3.

3 EXPERIMENTAL RESULTS



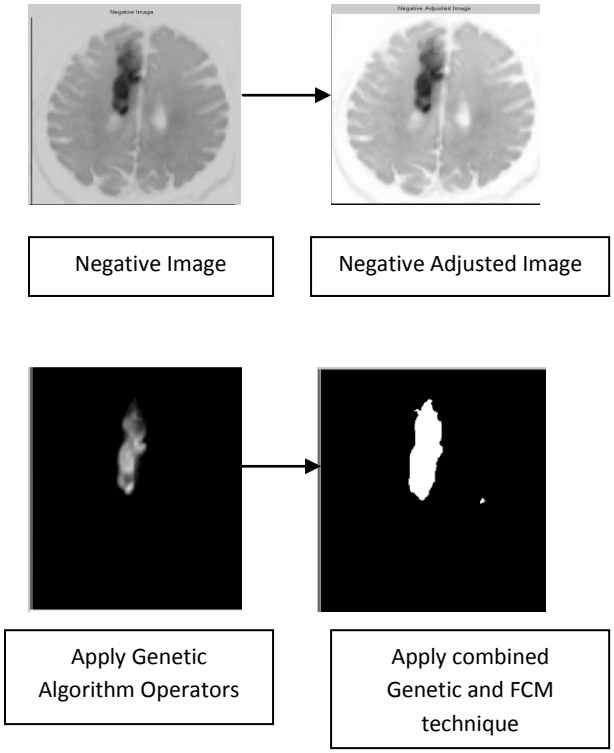
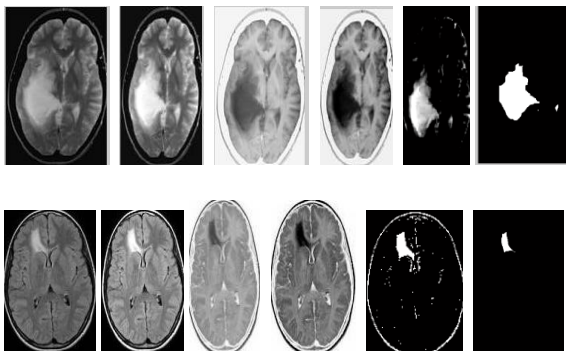


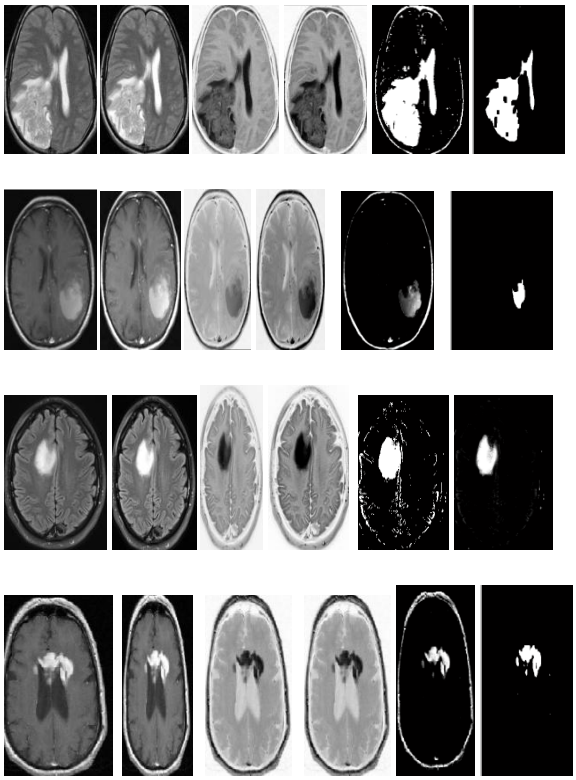
Figure3: Step by step procedure of Brain Tumor Detection

4 ANALYSIS

Experimental results are performed in Matlab Toolbox. MATLAB (matrix laboratory) is a numerical computing environment and fourth-generation programming language. Developed by Math Works, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces[8].

This combined approach which is explained in this paper is applied on different types of images such as epidermoid, gliblastoma, glioma, and astrocytoma brain tumor images which is shown in figure 4.





a) b) c) d) e) f)

Figure 4: a) Original JPEG image, b) Adjusted image, c) Negative image,d) Enhancement image, e) Apply GA operators and fcm technique f) Tumor extracted image

5. CONCLUSION

In this paper, brain tumor detection is done in 6 steps on MR images. The proposed study of tumor detection is successful with the help of fuzzy c means clustering applied many times on genetic algorithm parameters. It is divided into pre processing and post processing stages. This technique is applied on various sizes and intensities of tumor either it is primary or secondary type of abnormal image.

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