

Tumor Location and size Identification in Brain Tissues Using Fuzzy C- Clustering and Artificial Bee Colony Algorithm

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Abstract - Clustering approach is widely used in biomedical applications particularly for brain tumor detection in abnormal magnetic resonance (MRI) images. Fuzzy clustering using fuzzy C-means (FCM) algorithm proved to be superior over the other clustering approaches in terms of segmentation efficiency. MRI imaging forms one of the core methods to identify Brain Tumors, and access the existence, size and thickness of the tumor. MRI Images are prone to high noise, as the whole principle works on strong electric fields. We try to remove the noise using Artificial Bee Colony Algorithm and then try to abstract the tumor part using Fuzzy C-Means Clustering.

Key Terms – MR brain tumor, Fuzzy C-Means Clustering, Artificial Bee Colony

I. INTRODUCTION

In the analysis of medical images for computer-aided diagnosis and therapy, segmentation is often required as a preliminary stage. Medical image segmentation is a complex and challenging task due to the intrinsic nature of the images. The brain has particularly complicated structure and its precise segmentation is very important for detecting tumors, edema, and necrotic tissues, in order to prescribe appropriate therapy. Magnetic resonance imaging (MRI) is an important diagnostic imaging technique for the early detection of abnormal changes in tissues and organs. It possesses good contrast resolution for different tissues and has advantages over computerized tomography (CT) for brain studies due to its superior contrast properties. Therefore, the majority of research in medical image segmentation concerns MR images.

MRI Imaging forms one of the core methods to identify Brain Tumors, and access the existence, size and thickness of the tumor. MRI Images are prone to high noise, as the whole principle works on strong electric fields[2].

Many image processing techniques have been proposed for brain MRI segmentation, most notably thresholding, region-growing, and clustering. Since the distribution of tissue intensities in brain images is very complex, it leads to difficulties of threshold determination.

Therefore, thresholding methods are generally restrictive and have to be combined with other methods like Region growing, Fuzzy C-means (FCM) clustering and Expectation–maximization (EM) algorithms [1].

II. PROPOSED METHODOLOGY

The technique for MR brain tumor Image segmentation is shown in Figure1. The proposed methodology consists of the following stages, viz. MR image database, and feature extraction. FCM based segmentation and modified FCM based segmentation[3].

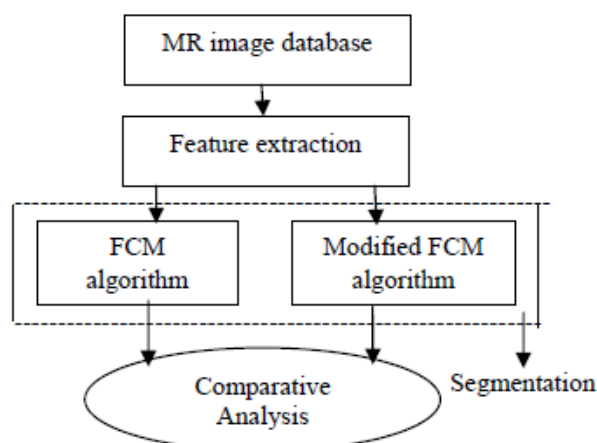


Fig 1 Proposed Methodology

MR image database

A set of MR brain tumor images comprising of four tumor types namely meningioma, astrocytoma, glioma and metastase are collected from radiologists. The images used are 256*256 gray level images with intensity value ranges from (0 to 255). Initially, these MRI images are normalized to gray level values from (0 to 1) and the features are extracted from the normalized images. Since normalization reduces the dynamic range of the intensity values, feature extraction is made much simpler. some of the mri data set is given in the figure.

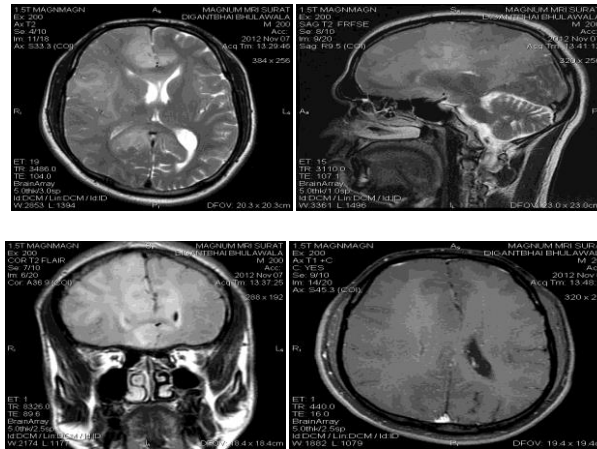


Fig 2 MRI image

Feature extraction

The purpose of feature extraction is to reduce the original data set by measuring certain properties, or features, that distinguish one input pattern from another pattern. The extracted feature should provide the characteristics of the input type to the classifier by considering the description of the relevant properties of the image into a feature space. Three textural features namely contrast correlation and entropy based on the gray level co-occurrence matrices (GLCM) have been used in this work.

Contrast:

$$S_C = \sum_i \sum_j (i - j)^2 P(i, j) \tag{1}$$

Correlation:

$$S_O = \frac{\sum_i \sum_j (i j) P(i, j) - \mu_x \mu_y}{\sigma_x \sigma_y} \tag{2}$$

Where $\mu_x, \mu_y, \sigma_x, \sigma_y$ are the means and standard deviations of P_x and P_y .

Entropy:

$$S_E = - \sum P(i, j) \log \{p(i, j)\} \tag{3}$$

Each set of features are individually normalized to the range of 0 to 255. The features used in this paper are selected based on the previous works [3]. These features work well especially for MRI brain tumor Images[4].

Conventional FCM Techniques

Fuzzy C-means (FCM) is a method of clustering which allows one pixel to belong to two or more clusters [4]. The FCM algorithm attempts to partition a finite collection of pixels into a collection of "c" fuzzy clusters with respect to some given criterion. Depending on the data and the application, different types of similarity measures may be used to identify classes. Some examples of values that can be used as similarity measures include distance, connectivity, and intensity. In this work, the images are segmented into four clusters namely white matter, grey matter, CSF and the abnormal tumor region based on the feature values[4].

Modified FCM Technique

Clustering can also be thought of as a form of data compression, where a large number of samples are converted into a small number of representative prototypes or clusters. High dimensional feature space based image segmentation is time intensive than in one dimensional feature spaces. The modified FCM algorithm is based on the concept of data compression where the dimensionality of the input is highly reduced. The data compression includes two steps: quantization and aggregation.

The quantization of the feature space is performed by masking the lower 'm' bits of the feature value. The quantized output will result in the common intensity values for more than one feature vector. In the process of aggregation, feature vectors which share common intensity values are grouped together. A representative feature vector is chosen from each group and they are given as input for the conventional FCM algorithm. Once the clustering is complete, the representative feature vector membership values are distributed identically to all members of the quantization level. Since the modified FCM algorithm uses a reduced dataset, the convergence rate is highly improved when compared with the conventional FCM.[4]

III. ARTIFICIAL BEE COLONY ALGORITHM

Artificial Bee Colony (ABC) is a novel optimization algorithm inspired of the natural behavior of honey bees in their search process for the best food sources, which proposed by Karaboga and Basturk in 2006[5]. In groups of insects which live in colonies like the ants and bees, an individual only can do simple task on its own, while the cooperative work of colony is the main reason determining the intelligent behavior of them. A colony of artificial bees in ABC algorithm contains three groups of bees: *employed*, *onlooker* and *scout* bees [6]. Employed bees carry with them information about their food sources, its distance and direction from the nest, and the nectar amount of the source; scout bees are searching the environment surrounding the nest for finding new food sources; and onlooker bees waiting in the hive and finding a food source through the information shared by employed bees. In ABC, two key behaviors are defined: recruitment to a nectar source, and abandonment of a source. In ABC algorithm, a stochastic selection scheme based on the nectar (fitness) values, which carried out by onlooker bees, is similar to the "roulette wheel selection" in GA. Also the production mechanism of neighbor source (solution) that used in ABC algorithm is similar to the mutation process in GA. Unlike GA, there is no precise crossover in ABC algorithm. However, the sharing of information between the bees is carried out by the mutation process in ABC[6]. In ABC, a food source represents a possible solution to the optimization problem. Therefore, at the initialization step, a set of food source positions are randomly considered. The nectar amount of a food source corresponds to the quality of the solution represented by that source searched by the bee. So the nectar amounts of the food source existing at the initial positions are determined. On the other hand, the quality values of the initial solutions are calculated

Each employed bee is moved onto her food source area for determining a new food source within the neighborhood of the present one, and then its nectar amount is evaluated. If the nectar amount of the new one is higher, then the bee forgets the previous one and memorizes the new one. After the employed bees complete their search, they come back into the hive and share their information about the nectar amounts of their food sources with the onlookers waiting in the hive [6]. If the nectar amount of a food source is much higher in comparison with other food sources, it means that this source will be chosen with more probability by the onlooker. This process is similar to the natural selection process in evolutionary algorithms. Each onlooker determines a neighbor food source within the neighborhood of the one to which she has been assigned and then its nectar amount is evaluated. The search process to discover the best solutions by the artificial bees can be summarized as follow:

1. Employed bees move randomly to find solutions in the search space.
2. Review the information obtained by the employed and scout bees with onlooker bees in colony space (note that at the first yet there is no scout bee).
3. Check the stopping criterion: stop, if satisfied condition, otherwise continue.
4. Selecting scout bees and perform the recruitment process for them.
5. Vocalize of new population of bees.
6. Search neighborhood using scout bees guide, and also search randomly with some employed bees.

IV. PROPOSED ALGORITHM

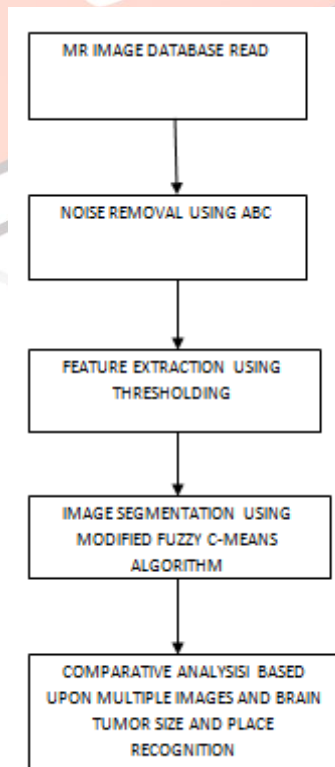


Fig 3 Proposed Algorithm

V. SIMULATION

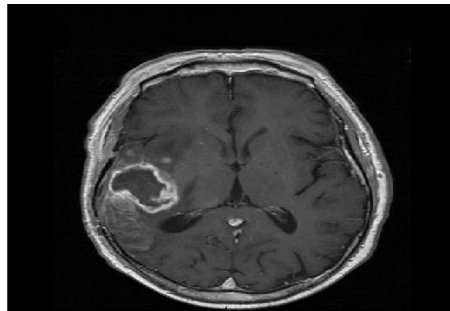


Fig 4 original image



Fig 5 image after Thresholding

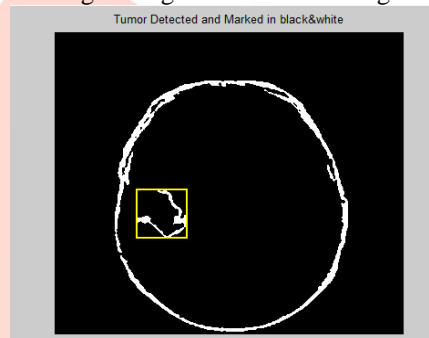


Fig 6 detecting Brain Tumor

VI. CONCLUSION AND FUTURE WORK

From this, simple brain tumour detection is done we are try to detecting brain tumor FCM algorithm and try to remove noise using ABC Algorithm. So my future work is size and location identification of brain tumor. And thank full to MRI SCAN CENTER at surat to provide the MRI image to me.

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