Segmentation and Classification of Brain Tumor on Magnetic Resonance Images using Neutral Networks

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Abstract
Now a days, Brain tumor is the great challenge to the doctors for treatment, because detecting the tumor region and its type is very difficult .We propose a System for identifying the tumor types in the magnetic resonance images using neural networks. First step is to pre-process the magnetic resonance image for removing the noise. Second step is automatically identifying the tumor region approximately by intensity of the magnetic resonance Image by Fuzzy C-means Clustering algorithm. Finally classify the segmented region using neural networks for the benign and malignant tumors.

Keywords - *Segmentation, Clustering, Magnetic Resonance Images (MRI), Classification, Neural Networks.*

I. INTRODUCTION

Brain tumors include all tumors inside the human skull. They are created by an abnormal and uncontrolled cell division in brain. Any brain tumor is inherently life-threatening and serious because of its invasive and infiltrative character in the limited space of the intracranial cavity. Brain tumors can be cancerous (malignant) or non-cancerous (benign).Its threat level depends on the combination of factors like the type of tumor, its size, its location and its state of development. Medical Imaging plays a central role in the diagnosis of brain tumors. Early imaging methods—non-invasive, high-resolution techniques, especially magnetic resonance image (MRI).

Normally the anatomy of the Brain can be viewed by the CT scan or MRI scan. In our project the MRI scanned image is taken for the entire process. The MRI scan is more comfortable than CT scan for diagnosis. It will not affect the human body. Because it does not use any radiation. It is based on the magnetic field and radio waves. Radio surgery is a treatment that uses computerized calculations to focus radiation at the site of the tumor while minimizing the radiation dose to the surrounding brain. The goal of radiation therapy is to kill tumor cells while leaving normal brain tissue unharmed.

Segmentation of brain is a very important task in analysis of magnetic resonance image. Segmentation subdivides an image into its region of objects and an important tool in medical image processing.

There are different types of algorithm were developed for brain tumor detection. But they may have some drawback in detection and extraction. Accurate identification and segmentation of brain magnetic resonance image can be used to reduce the false positive rate while detecting the tumor. Therefore, the proposed system uses fuzzy c-means clustering algorithm for brain segmentation.

The remainder of the paper is organized as follows: Section 2 involves literature survey, Section 3 involves the proposed method in magnetic resonance images. Section 4 presents the results. Finally, the conclusion of the paper is presented.

II. LITERATURE SURVEY

Many techniques have been employed for the segmentation of brain. A Self-Organizing Map (SOM) is a competitive artificial neural network with unsupervised learning[5]. To increase the SOM learning effect, a Fuzzy-Soft Learning Vector Quantization (FSLVQ) algorithm has been proposed in the literature, using fuzzy functions to approximate lateral neural interaction of the SOM. In 1985, Computational performance of FSLVQ is still not good enough, especially for large data sets. In this work, we propose a suppressed FSLVQ(S-FSLVQ) using suppression with a parameter learning schema. We then apply the S-FSLVQ to MRI segmentation and compare it with several existing methods.

The Grow-cut algorithm is equivalent to the Bellman-Ford algorithm, which calculates the shortest paths on a weighted graph[2]. However, there, the motivation and emphasis was on fast hardware implementation of the CA algorithms, due both increasing availability of low-cost graphical hardware

(GPUs), and CA algorithm's suitability to run on parallel processors[9].

Region-based active contour models are widely used in image segmentation. In general, these region-based models have several advantages over gradient-based techniques for segmentation, including greater robustness to noise. However, when using level-set surfaces in 3D, classical active contours had the problem of initialization. Because the tumor class does not have prior spatial information, many tiny structures, especially blood vessels, are categorized as tumor since they also enhance with contrast.

Ho et al. used fuzzy classification of pre- and post-contrast T1 images to obtain a tumor probability map to evolve a level-set surface. Liu et al. have adapted the fuzzy connectedness framework for tumor segmentation by constructing a rectangular volume of interest selected through identifying the first and last slice of the tumor and specifying a set of pixels in the tumor region. Interactive algorithms have become popular for image segmentation problem in recent years.

Graph based seeded segmentation framework includes some generalizations such as random walker (RW) , graph-cuts (GC) , shortest paths, and power watersheds have been clarified as special cases of a general seeded segmentation algorithm. This combined framework solves a minimization problem involving a graph's edge weights con-fined by probabilities or adjacent vertex variables. In the association between GC, RW, and shortest paths was shown to depend on different norms in the energy that is optimized. Geodesic distances between foreground and background seeds were also consolidated into other shortest path-based segmentation algorithms by [3] and [7]. Cellular Automata algorithm is basically a computer algorithm that is discrete in space and time and operates on a lattice of pixels. Cellular Automata were introduced by Ulam and Von Newmann[2]. Cellular Automata can be successfully applied in various Image processing applications such as Noise removal, border detection, Image Enhancement, segmentation and Filtering.

III. PROPOSED METHOD

Our proposed method consists of four phases namely, pre-processing, tumor region identification, classification. The overall block diagram of the proposed method is shown in Fig. 1.

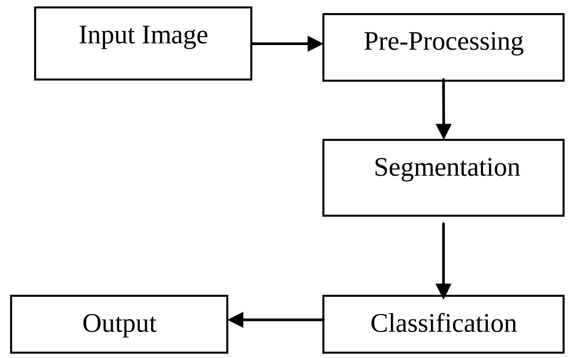


Figure 1: Diagram of Proposed Method.

A. PRE-PROCESSING

The image of the brain obtained through MRI. According to the need of the next level the pre processing step convert the image into gray color image, i.e., 2D image. In this step we remove the noise from the image for next step. The gray color image consists of pixel intensity between 0-255 where 0 represents black and 255 is used for white.

B. Segmentation

Tumor region is detected by using Fuzzy C-means clustering algorithm. A cluster is a collection of objects which are similar between them and are dissimilar to the objects belonging to other clusters. Clustering is an unsupervised learning method which deals with finding a structure in a collection of unlabeled data. A loose definition of clustering could be the process of organizing objects into groups whose members are similar in some way. The grouping (clustering) is done by minimizing the Euclidean distance between data and the corresponding cluster center.

Let x_i be a vector of values for data point g_i, following steps are performed in the fuzzy c means clustering algorithm.

a. Initialize membership $U^{(0)} = [\ u_{ij}\ ]$ for data point g_i of cluster c_j by random.
b. At the k^{th} step, compute the fuzzy center $C(k) = [\ c_j\ ]$ for $j = 1, .., n$, where n is the number of clusters, using

$$c_j = \frac{\sum_{i=1}^{n} (u_{ij})^m x_i}{\sum_{i=1}^{n} (u_{ij})^m}$$

c. where m is the fuzzy parameter and n is the number of data points.

d. Update the fuzzy membership $U^{(k)} = [\, u_{ij} \,]$, using

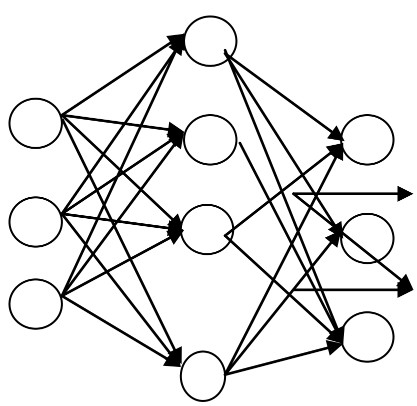
$$u_{ij} = \frac{\sum_{j=1}^{n} \left(\left\| x_i - c_j \right\| \right)^{\frac{1}{(m-1)}}}{\left(\left\| x_i - c_j \right\| \right)^{\frac{1}{(m-1)}}}$$

e. If $\|U^{(k+1)} - U^{(k)}\| < \varepsilon$, then STOP, else return to step b.

f. Determine membership cutoff for each data point g_i, assign g_i to cluster clj if u_{ij} of $U^{(k)} > \alpha$.

C. Classification:

Probabilistic Neural Network is used for classifying the brain tumor, because it gives fast and accurate classification and is a promising tool for classification of the tumors. Performance of the PNN classifier was evaluated in terms of training performance and classification accuracies. Existing weights will never be alternated but only new vectors are inserted into weight matrices when training. Since the training and running procedure can be implemented by matrix manipulation, the speed of PNN is very fast. The network classifies input vector into a specific class because that class has the maximum probability to be correct. The PNN has three layers: the Input Layer, Hidden Layer and Output layer, that is shown on the Fig 2.



Input Layer Output Layer
Hidden layer

Figure 2: overview of PNN

IV. RESULT

Next figures show the images as an output. i.e input image, preprocessed image , clustered image, Finally input image and extracted tumor from MRI image. For this purpose real time patient data is taken for analysis. As tumor in MRI image have an intensity more than that of its background so it become very easy locate it and extract it from a MRI image. Following is the first MRI image which the input to this program.

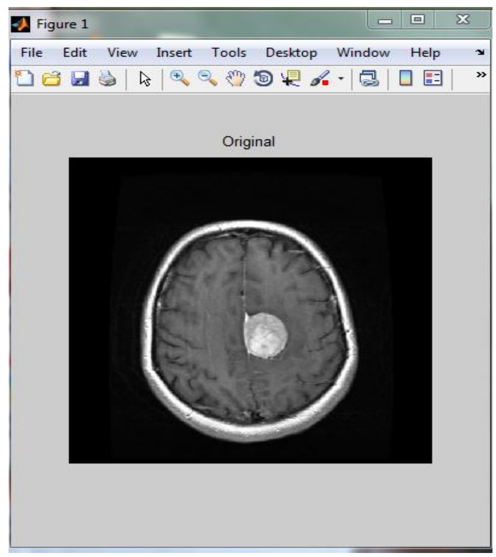


Figure: 3 Input Image

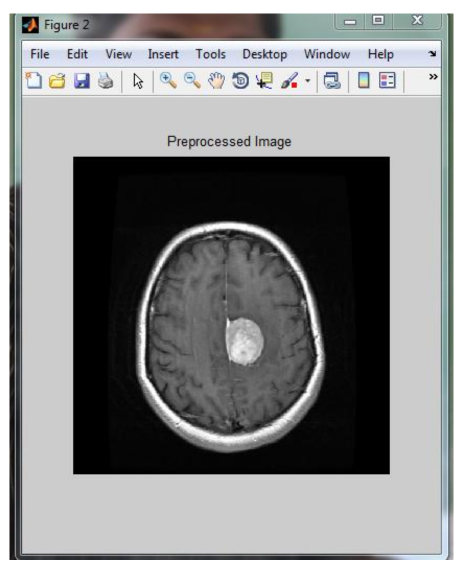


Figure: 4 Preprocessed Image

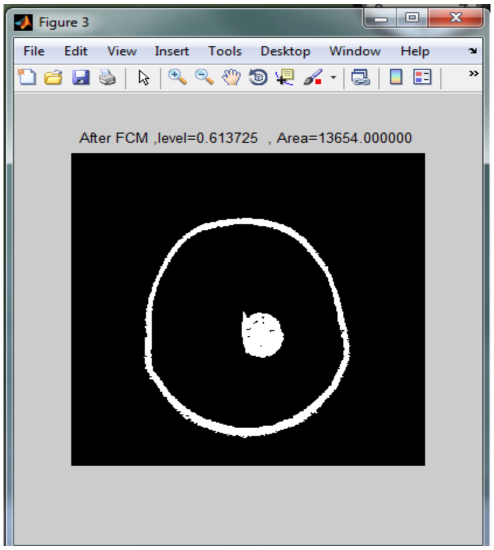


Figure 6: Tumor Region

V. CONCLUSION

The proposed approach gives very promising results in classifying the healthy and pathological brain. The benefit of the system is to assist the physician to make the decision. The proposed method is efficient for classification of the human brain normal or abnormal (benign and malignant tumor).

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