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A Study on Brain Tumor Segmentation of MRI 3 Tesla Using a Fuzzy Approach with Algorithm

R. Rathika, N. Venkatesan
M. Phil, Research Scholar, Research Adviser
[12]Department of Mathematics, Prist University, Thanjavur.

ABSTRACT

Image segmentation algorithms and techniques find its applications in a wide number of domains. Segmentation of brain tumor and overall internal structure of the brain is one of the main applications in the field of medical imaging. Magnetic resonance imaging (MRI) technique is one of the many imaging modalities that are available to scan and capture the internal soft tissue structures of the body. In this paper, proposed techniques have been given to extract the tumor portion, successfully demarcate the tumor boundary, and locate the tumor with a bounding circle and to diagnose whether the tumor is present or absent. A fuzzy clustering-based technique is proposed which helps to study & analyze the intricate structure of the brain, hence can be used as a visual analysis and a study tool.

Keywords: Fuzzy Systems, Brain Tumor Segmentation, Tumor Segmentation in Brain MRI.

INTRODUCTION

Fuzzy set theory is the mathematical Background to capture the way people think. The object of fuzzy logic has been to make computers "Think" like humans and to remove the barrier between us and the full utilization of computer capabilities. Neural Networks are efficiently used for learning membership functions. This disease is one of the most common metabolic disorders which affect the eyes kidneys, blood vessels and nerves. Analysis of heart rate variability has been shown useful to detect diabetic autonomic neuropathy and is capable of detecting abnormalities before patients develop systems. This is clinically important as the presence of diabetic autonomic neuropathy is a good predictor of increased mortality. We study about tumor segmentation in brain MRI using a fuzzy approach with the algorithm. Fuzzy based automatic detection and classification approach for MRI brain tumor and automatic detection of the brain in MRI 3 tesla using the fuzzy image we study about the Automatic segmentation of Non- enhancing Brain Tumors in Magnetic Resonance Images and knowledge Guided Algorithm. Application of fuzzy system in the segmentation of MRI brain tumor.

2. BRAIN TUMOR

It is a collection (or mass) of abnormal cells in the brain. The skull is very rigid and the brain is enclosed so any growth inside such a restricted space can cause brain tumor can be cancerous (malignant) or noncancerous benign.

2.1 DEFINITION

A benign or malignant growth in the brain. Primary brain tumors initially form in brain tissue secondary brain tumor are cancerous that have spread to the brain tumor tissue elsewhere in the body. A brain tumor can occur in people of any age. When benign or malignant tumors grow they can cause the pressure inside the skull to increase. This can cause brain damage and even death.

Note

Brain tumors are categorized as primary brain tumors originate in the brain. According to the University of Maryland medical center about half of primary brain tumors occur when cancer cells spread to the brain from another organ such as the lung or breast.

2.2. TYPE OF BRAIN TUMORS IN PRIMARY TUMOR

It originates in the brain. They can develop from brain cells the surround the brain (meninges) nerve cells or glands. In adults, the most common types of brain tumor are "Gliomas and meningioma's" primary tumors can begin or cancerous.

(a) GLIOMAS

Gliomas are a tumor that develops from glial cells. These cells support the structure of the CNS, provide nutrition clean cellular, waste and break down dead neurons. It is developed from the variety of glial cells, including Australia, Microglio, Oligodendroglia, satellite cells and Schwann cells.

Most meningioma's and Schwannomas occur in patients between the age of 40 and 70. Meningioma is more common in women while Schwannomas occur equally in both soxes. These tumors are usually benign but can cause death because of their size &locution. Cancerous meningioma and Schwannomas can be very aggressive.

2.3. SECONDARY BRAIN TUMORS.

It is made up the majority of brain cancers. They start in one part of the body and spread or metastasize to the brain. Cancers of the lung, breast kidney or skin can metastasize to the brain. Secondary (metastatic) brain tumors are always malignant. Benign tumors do not spread from one part of the body to another.

2.4. DESCRIPTION

Each year more than 17,000 brain tumors are diagnosed in the US. About half of all primary brain tumors are benign but life threatening locations. The rest are malignant and inverse.

2.5. KEY TERMS

- **Central nervous system (CNS):** It is consisting of the brain and spinal cord.
- **Cerebrospinal fluid (CSF): a** Clear liquid that fills brain cavities and projects the brain and spinal cord.
- **Gamma knife:** High close radiation treatment for the intracranial tumor.
- **Intracranial: Located** within or on the surface of the brain.

3. TUMOR SEGMENTATION IN BRAIN MRI USING A FUZZY APPROACH

Magnetic resonance imaging MRI of the brain is often used to monitor tumor response to the treatment process. It is important in medical diagnosis because it provides information associated with anatomical structures as well as potential abnormal tissues necessary to treatment planning and patient follow – up. It can also be helpful for general modeling of pathological brains and the construction of pathological brain atlases.

3.1. THE FUZZY CLUSTERING ALGORITHM FCM MEANS

Its object is to partition data points within one cluster are as similar to each as possible and as far away as it can be from the data points of another cluster. In the content of our work, the FCM approach can be formulated as follows. Let us consider an image composed of a set of N points. Let us suppose that this volume has to be segmented into K (K≥2) classes, in a fuzzy fashion. This means that a point i does not necessarily belong to one of the K classes but can partially belong to several ones. For each point i ∈N let $(\mu_{ic})^{k}{}_{c=1} = \mu_{i1}, \mu_{i\,2}, \mu_{i3}, \mu_{i\,4}$…….. μ_{ik} be the membership of the point i with respect to these k classes. Such that $\sum_{c=1}^{k} \mu = 1$& $\mu_{ic} \in [0, 1]$ for all c. let V c be the centroid of this class (mean value points). In the FCM approach the segmentation process of the image can be defined as minimization of the energy function.

$$J_{FCM} = \sum_{C=1}^{K} \sum_{i=1}^{N} \mu_{ic}^{\,m} \, \|y - v\|^2 \qquad (1)$$

The parameter m is a weighting exponent on each fuzzy membership and determines the amount fuzziness of the resulting classification. This function (1) can be easily minimized using the Lagrange multiplier (λ) so the constrained optimization becomes

$$J_{FCM} = \sum_{C=1}^{K} \sum_{i=1}^{N} \mu_{ic}^{\,m} |y_i - v_c|^2 + \lambda \left(1 - \sum_{C=1}^{K} \mu_{ic}{}^{m}\right) \qquad (2)$$

A solution can be obtained by alternatively computing the membership rates $\mu_{i\,c}$ and the centroids v_c until convergences

$$v_c = \frac{\sum_{i=1}^{N} \mu_{ic}{}^{m} \, y_i}{\sum_{i=1}^{N} \mu_{ic}{}^{2}} \qquad (3)$$

$$u_{ic} = \frac{\frac{1}{d_{ic}}}{\sum_{i=1}^{N} \frac{1}{d_{ic}}} \quad (4)$$

Where $1/d_{ic} = \| y_i - v_c \|^2$

The membership functions are often initialized with random values between 0 &1. Such that constraints of the membership is satisfied. The FCM objective function is minimized when high membership values are assigned to points whose intensities are close to the centroid of its particular class and low membership values are assigned when a point's intensity is far from the centroid.

4. AUTOMATIC DETECTION OF BRAIN TUMORS IN MRI 3 TESLA USING FUZZY IMAGES

Due to the fact that deadly brain tumors are detected in early stages increases the success rate for treatment. With the advance in science and technology development diagnosis without surgery performed on the image of internal organs. Now image method magnetic resonance image 3 [MRI 3 tesla] of the most. Accurate methods for the diagnosis and evaluation of internal organs and palpable. MRI 3 tesla field strength of 1.5, 0.2 and 3 tesla is included below. It is rate is very high. Because of fact that over 55% of brain tumors are the most malignant type of brain tumors are affected by the location of the tumor tissues. The analysis of tumors in MRI images is performed by physicians. The ranking varies according to different medical conclusions.

MRI image noise typically modeled by Rican distribution. The noise would have a great effect on the images. In this regard, it should reduce the number of noise in the image. A large number of researchers in the field of tumor grading machine are done. The classification is based on the region growing images pixels with similar properties are grouped together. Watersheds of regionalization method based edge and facilities for analyzing weak points along the border region. K means clustering of the learning algorithm is unsupervised. The algorithm first determines the number then K- clusters centers randomly selected. The distance between each pixel in each of the cluster is calculated all articles' and studies cited in the classification and localization.

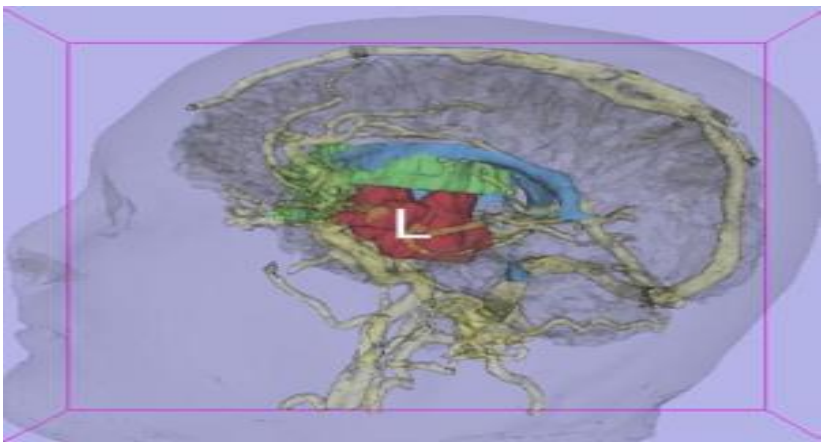

Figure 1. Brain Tumor

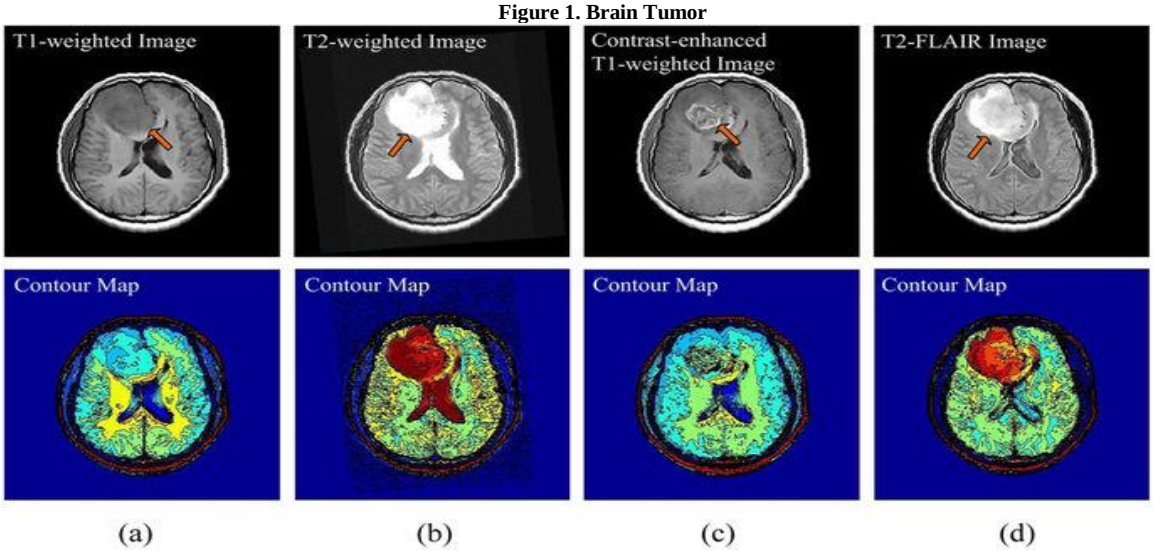

Figure 2. (a). T1-weighted image. (b) T2-weighted image. (c) Contrast-enhanced T1-weighted image. (d) T2-FLAIR image.

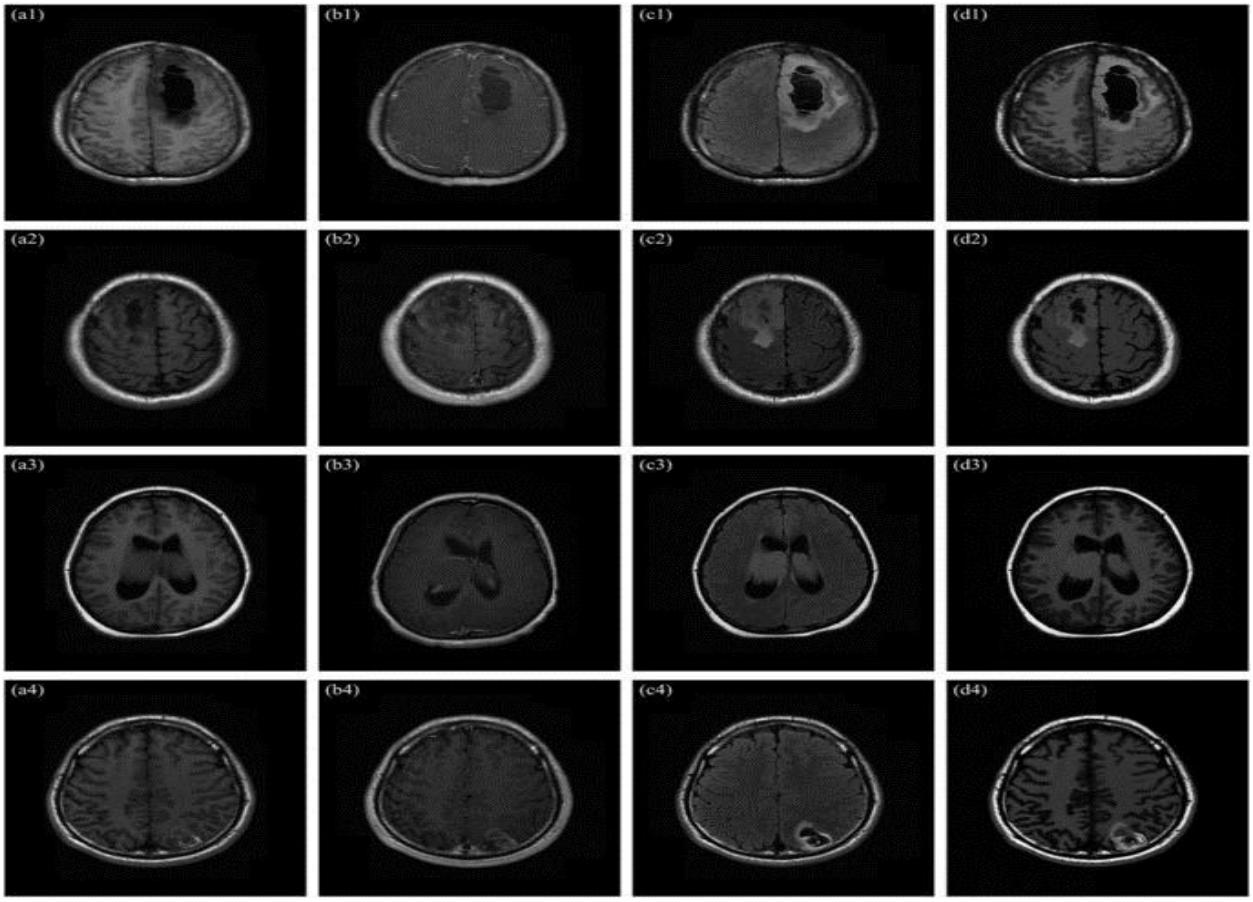

Figure 3.Brain MRI original images

5. APPLICATION OF FUZZY SYSTEM IN SEGMENTATION OF MRI BRAIN TUMOR

The main advantages of this approach seem to be the possibility of implementing. "Rule of thumb" experience, intuition, heuristics, and the fact that it does not need a model of the process. Fuzzy systems are been used for solving a wide range of problems in different application domain Genetic algorithm for designing. Fuzzy systems allow in introducing the learning and adaptation capabilities. The driving problem discussed in this paper is the segmentation of 3-D brain tumors from magnetic resonance image data. Tumors vary in shape, size, location and internal texture and tumor segmentation is therefore known to be a very challenging and difficult problem. Intensity thresholding followed by erosion, connectivity, and dilation is a common procedure but only applicable to a small class of tumors presenting simple shape and homogeneous interior structure. Warfield et al. suggested a methodology based on elastic atlas warping for brain extraction and statistical pattern recognition for brain interior structures. The intensity feature was augmented by a distance from the boundary feature to account for overlapping probability density functions. This method was found to be successful for simple-shaped tumors with homogeneous texture.

6. CONCLUSION

In this paper, it is proposed a new step wise procedure to detect and classify. The Brain tumor in MRI images. The main motto is to introduce the best approach to bring up the efficiency of a new system to be developed. It is proved that the efficiency of the proposed approach is better than existing approaches. And accuracy obtained from the proposed approach is 99% for 200 images. It is also improved by experimenting on real – time hospital images benchmark database image and on ground truth images. An automated system for the exact area we have provided images MRI 3 Tesla. Due to the fact that the images are noisy MRI Rican Fuzzily noisy elimination method is used. Pie of the histogram of the image to be applied with a record to the means of fuzzy clustering algorithm region studied. First elected to the brain is divided into the region with suspected brain tumor and healthy part of the cause. Human error and lack of proper cure of the most important factors in the algorithm is proposed for use in clinics and treatment center's tumor. Tumor volume is an important diagnostic indicator in treatment planning of brain tumors. The measurement of brain tumor volume could assist tumor staging for effective treatment surgical planning. Imaging plays a central role in the diagnosis and treatment planning of the brain tumor. In this study, a semi-automated system for brain tumor volume measurements is developed based on MR imaging.

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