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EXTRACTION AND DETECTION OF BRAIN TUMOR FROM MAGNETIC RESONANCE IMAGES - A SURVEY

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ABSTRACT

Aim: Tumor is a rapid uncontrolled growth of cells; it can be three varieties malignant, benign or pre - malignant. When a tumor classified as malignant then the tumor leads to cancer. Tumor of brain is a collection or mass of abnormal cells in your brain. MRI (Magnetic Resonance Imaging) system is used for detection particularly in medical field and visualization of details in the internal structure of the body. It can detect the differences in the body tissues which is the best technique as compared to CT (Computed Tomography), Endoscopy, PET (Positron Emission Topography), Ultrasonic imaging system. This paper presents survey of various techniques applied on brain tumor extraction & detection from magnetic resonance image (MRI). It has also calculated the parameters of accuracy, sensitivity, and specificity. From the comparative analysis results, Region growing method is best suited for brain tumor extraction and fuzzy C-means can be used for efficient detection of brain tumor from MRI images. This paper is also used to show the relevant feature extraction technique that improves the classification accuracy rate.

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KEY WORDS

Medical images, brain tumor, Feature extraction, detection, MRI image, region growing, fuzzy C-means.

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INTRODUCTION

Medical imaging is process of creating the visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues. Medical Imaging is used to study the structure and pathological condition of human organ. Image Processing is a method to develop raw images received from sensors for various applications. Image Processing consist of two types are Analog Image Processing refers to the alteration of image through electrical means. Digital Image Processing refers to processing of a two-dimensional picture by a digital computer. Brain tumor detection and extraction is one of the most challenging and time consuming task in medical image processing.

IMAGE EXTRACTION

Feature extraction describes the relevant shape information contained in a pattern. It is used to create new features as a function of existing features. It has two functions are linear functions (PCA, ICA) and Non linear functions (hidden units in a neural network). It starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization.

IMAGE DETECTION

Feature detection is a low-level image processing operation. It is usually performed as the first operation on an image and examines every pixel. If this is part of a larger algorithm, then the algorithm will typically only examine the image in the region of the features. It may also provide complementary attributes, such as the edge orientation, edge detection, the polarity and the strength of the blob in blob detection.

EXISTING SYSTEM

In this work, the detailed study on brain tumor extraction and detection has been reviewed and analyzed. Some paper [2],[3],[4] based on different technologies has been discussed about extraction of brain tumor. Some paper [1],[5],[6],[7],[8],[9],[10] based on different technologies has been discussed about detection of brain tumor. The detailed description of various techniques was given below:

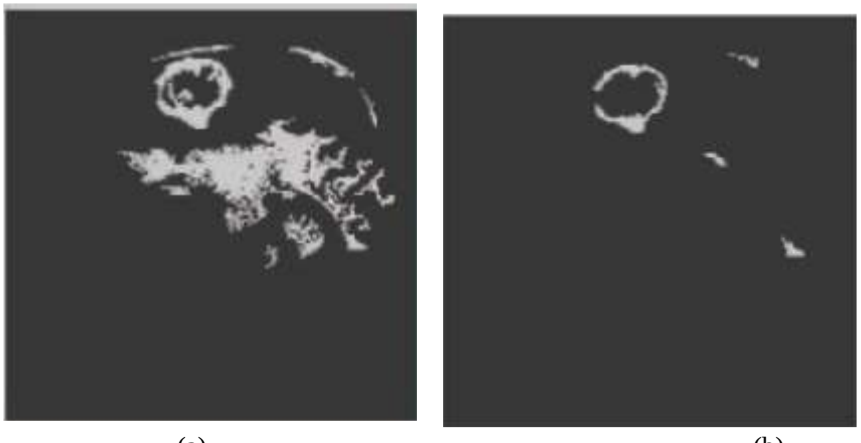
In [1] Elisee Ilunga-Mbuyamba, Juan Gabriel Avina-Cervantes , Dirk Lindner, Jesus Guerrero-Turrubiates, Claire Chalopin was proposed "**Automatic Brain Tumor Tissue Detection based on Hierarchical Centroid Shape Descriptor in T1-weighted MR images**" presents a novel scheme which uses a two method, the k-means method and the Hierarchical Centroid Shape Descriptor (HCSD). The clustering stage is applied to discriminate structures based on pixel intensity while the HCSD allow to select only having a specific shape. The automatic tumor detection can be achieved by using some features like texture, shape, intensity and symmetry.

Hierarchical Centroid Shape Descriptor is a binary shape descriptor with the centroid coordinates extracted from a binary image and it is based on the k-tree technique decomposition. The two methods for brain tumor tissue detection were introduced.

This method combines the k-means clustering algorithm followed by the use of a shape descriptor based on features called Hierarchical centroids. On the first step, the k-means algorithm group image pixels in k clusters, then the image is binarized by using a threshold value equal to k. The tumor structures are found in remained binary elements but they are often surrounded by healthy structures. The second step method is used to discard other tissues in order to detect only those corresponding to the tumor.

The Fuzzy C means algorithm is used for classifying brain tumor images and it works well for tumor detection. Like the mean-shift this method has a high computation complexity; however it is suitable when the number of clusters are unknown a priori. In the brain symmetry was used for tumor segmentation and detection by using the texture and intensity. Another automatic method for tumor detection based on the brain symmetry is introduced. The application of this kind of feature is limited on axial and coronal planes because there
is no symmetric structures in the sagittal plane.

As applied in various works, the thresholding technique and the morphological operations such as erosion, dilation, closing and opening are used in a pre-processing step for skull removing. To overcome the ineffectiveness of algorithms to automatically detect and localize tumor in human brain, to use the k-means clustering method followed by the selection of the shape that can better describe the tumor.



(a) (b)

Fig: 2.1. (a) Otsu method and (b) k-means method

k-means is one of the most popular clustering algorithm. HCSD & K-Means methods is robust in detecting brain tumor tissue even this kind of data. Otsu and K-Means results are very similar because the segmented structures are often identical, but sometime they have different shape.

In [2] Arashdeep Kaur was proposed "**An Automatic Brain Tumor Extraction System using Different Segmentation Methods**" presents some algorithms for brain tumor extraction namely Otsu, K-means, Fuzzy-c-Means and thresholding. In these four techniques have been used to identify region of interest i.e. tumor. Morphological Analysis forms an integral part of Image processing. Binary morphology can be used to extract objects from a binary image.

a) K-means

K-means is a clustering technique which aims to partition a set of observations so as to minimize the within cluster sum of squares. The evaluating function for an image a (m, n) is given as:

$$C(i) = \text{Arg min} \left| mxy2 \ -nxy2 \right| x2 \quad (1)$$

Where i is the number of clusters.

b) Otsu's Method

Otsu's Method divides the image into two classes of regions namely foreground and background. The background and foreground regions are selected using the following weighted class variance:

$$\sigma 2 = W1\sigma 2 + W1\sigma 2 \quad (2)$$

Where W1 and W2 are class variance for background and foreground region respectively.

c) Fuzzy-c-means

Fuzzy-c-means is also a clustering technique based on fuzzy logic to segment the image. Fuzzy clustering algorithms determine an optimal partition of a given data set as follows:

$$A = \{x\, j \mid j = 1 \ldots n\} \quad (3)$$

Where, A is the partitioned image into c clusters by minimizing the following objective function:

$$f = \Sigma m=1 \ \Sigma j=1 \ umjdmi \quad (4)$$

Where, m and n are the rows and columns of the image.

d) Thresholding

It is a process of creating a black-and white image of a grayscale image consisting of setting exactly those pixels to white whose value is given threshold, setting the other pixels to black.

$$a(m,n) = f(x) = \begin{cases} 1, \text{object if } a(m,n) \geq 0 \\ 0, \text{backround otherwise} \end{cases} \quad (5)$$

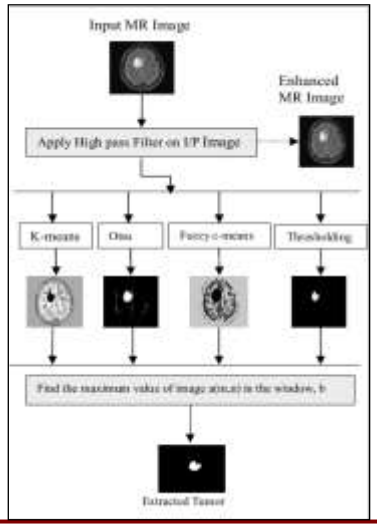


Fig: 2.2.Flowchart for brain tumor extraction

This paper presents accuracy and computation time of tumor extracted using four different segmentation techniques. Computational time is defined as the time taken for the algorithm to execute and extract the tumor.

In [3] Rana Banik, Md. Rabiul Hasan, Md. Saif Iftekhar was proposed "**Automatic Detection, Extraction and Mapping of Brain Tumor from MRI Scanned Images using Frequency Emphasis Homomorphic and Cascaded Hybrid Filtering Techniques**", presents these techniques to detect brain tumor from MRI scanned images. Brain tumor regions are detected, extracted and mapped by Frequency Emphasis Homomorphic and Cascaded Hybrid Filtering Techniques. The hybrid filter is a combination of wiener filter and median filter. The salt and pepper noise, Gaussian noise, impulse noise, Rayleigh noise are the type of noises are produced during transmission. The methods now present to detect brain tumors are generally three types: atlas-based methods , feature-based methods and symmentary-property-based methods. High pass filter also reduces frequency domain Gaussian noises.

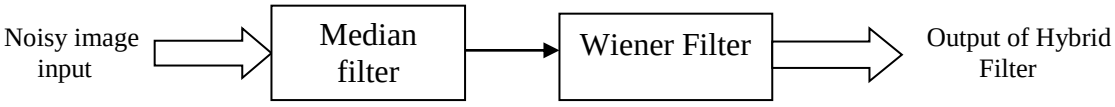


Fig: 3. Block diagram of hybrid filter

This method is used to difference of the intensity perfectly by using Frequency Emphasis in Homomorphic Filtering. The final results are mapped with edge detected image of the real time patient by mathematical logic operations.

In [4] Jitendra Singh Sengar and Priyanka Chanderiya was proposed " **Review: A Survey on Brain Tumor Extraction from MRI**" presents the brain image are segmented & artificially colored to represent original data through modified fuzzy c-means algorithm, SCNNA(supervised computational neural network approach), KBT(knowledge based technique), FBTD(fractal-based brain tumor detection), ASBT(automatic segmentation of brain tumor). Segmentation applied for Gray Matter (GM), White Matter (WM), and Cerebra Spinal Fluid (CSF) and tumor region extraction of brain images.

In [5] Ishmam Zabir, Sudip Paul, Abu Rayhan, Tanmoy Sarker, Shaikh Anowarul Fattah, and Celia Shahnaz was proposed " **Automatic Brain Tumor Detection and Segmentation from Multi-Modal MRI Images Based on Region Growing and Level Set Evolution**" They presents a type of tumor named as GLIOMAS. It has high frequent and survival rate of patients from both high grade & low grade glioma is approximately less than two or three years. The drawback of using only region-based models is that they fail to detect exact boundary of tumor because of tumor intensity variations from center to boundary tumor regions. It provide outcome of the region growing approach automatically equally the initial contour and the final decision is made iteratively. The contour based iterative Distance regularized level set evolution (DRLSE) method is thus aided by region growing approach and improves the segmentation performance than both the region growing and DRLS methods. The accuracy value calculated in detecting tumor containing slices & no tumor from the normal slices are also calculated taking 26 tumor containing slices and 14 normal slices. Level set function is defined as a partial differential equation-

$$\frac{\partial \Phi}{\partial t} = F\,|V\Phi| \qquad (6)$$

where F is the speed function that controls the motion of the contour. However, in DRLSE level set function is formulated in terms of distance regularized term & an external energy term.

In [6] William Thomas H M,S C Prasanna Kumar was proposed " **Detection of a brain tumor using segmentation and morphological operators from MRI scan with FPGA**" work uses K-Means clustering where the detected tumor shows some abnormality is rectified by the morphological operators are used with basic image processing techniques to meet the goal of separating the tumor cells from the normal cells. The Threshold and Watershed segmentation is very simple and popular but using morphological operators on applying to the output image of other two provided a better detection of tumor. It has used to detect the tumor using Image Segmentation

approach for the detection of damaged cells of brain but detect particularly the abnormal cells of human brain is not an abstract rather it is possible by using combination of thresholding and watershed segmentation along with applying the morphological operators we get the output of the MRI image which is possible for doctors to detect accurately where the tumor is located.

In [7] Rasel Ahmmed, Md. Foisal Hossain was proposed" **Tumor Detection in Brain MRI Image Using Template based K-means and Fuzzy C-means Clustering Algorithm**", presents a combination of TKFCM(template based K-means and modified Fuzzy C-means) clustering algorithm that reduces operators and equipment error. In TKFCM, the small deviation of gray level intensity of normal and abnormal tissue is detected and the performances of TKFCM method is analyzed over neural network provide a better regression and least error.

The performance parameters show comparable results which are effective in detecting tumor in multiple intensity based on brain MRI image. The main drawback of thresholding is cannot be applicable for multiple channel images. In addition, it does not provide spatial characteristics, which causes it to be sensitive to noise as well as inhomogeneity intensity. On the other hand, foundation of restricting threshold is also used methods such as classifier, ANN, clustering etc. Based on some predefined criteria i.e. intensity information and/or edges, the connected region of an image is extracted in region growing.

In [8] Praveen G.B, Anita Agrawal was proposed" **Hybrid Approach for Brain Tumor Detection and Classification in Magnetic Resonance Images**" presents the brain tumor are detected and classified in magnetic resonance images has been proposed using hybrid approach. Segmentation methods includes a various approaches based on classification using extracted features, level set methods, Markov random field (MRF) methods, fuzzy c-means (FCM), k-nearest neighbor (KNN) and region growing methods. Level Sets method requires initial curves identification. Advantage and drawbacks of hybrid approach is a combination of region based and texture based methods for brain tumor detection and classification. Fast bounding box algorithm is used as region based method for tumor segmentation. This methodology is more efficient than the existing methods and segmentation accuracy is 96.63%.

In [9] Anupurba Nandi was proposed" **Detection of human brain tumor using MRI image segmentation and morphological operators**" presents clustering is suitable for biomedical image segmentation uses unsupervised learning. This paper work uses K-Means clustering used for detected tumor shows some abnormality is rectified by the use of morphological operators with image processing techniques to meet the goal of separating the tumor cells from the normal cells. In [8] presents preprocess the two-dimensional magnetic resonance images of brain and subsequently detect the tumor using Image Segmentation approach.

In [10] William Thomas H M ,S C Prasanna Kumar was proposed " **A review of segmentation and edge detection methods for real time image processing used to detect brain tumor**" presents surveyed based approaches to extract the tumor from set of brain images. Some methods are thresholding, clustering, level set method, region growing, morphological based segmentation, graph based detection, histrogram thresholding. The various types of edge detection is Robert edge detection, Prewitt edge detection, Sobel edge detection.

COMPARATIVE ANALYSIS OF EXISTING SYSTEM

This section describes a comparison of the brain tumor extraction and detection of MRI and processes using rate of parameters for several techniques. To measure the accuracy, sensitivity, and specificity show that below table.

Table: I. Comparison of tumor detection and extraction techniques

Tumor Extraction				
S.no	Algorithms	Sensitivity (%)	Specificity (%)	Accuracy (%)
1.	Thresholding	84	80	83.3
2.	Region Growing	88.46	75	86.7
3.	Second order + ANN	91.42	90.1	92.22
Tumor Detection				
4.	Texture Combined + ANN	95.4	96.1	97.22
5.	Fuzzy C-Mean	96	93.3	86.6

6.	K-Mean	80	93.12	83.3
7.	TKFCM	96.67	100	97.1

PROBLEM DEFINITION

We have described that survey of various techniques for extract and detect the brain tumor. Tumor is one of the problem for uncontrolled patient. The doctors rectify the tumor of brain. In various techniques, doesn't have accurate values. A tumor does not mean cancer – tumors can be benign (not cancerous), pre-malignant (pre-cancerous), or malignant (cancerous). If tumor is cancer, possible treatments are chemotheraphy, radiation, surgery, Targeted cancer theraphy.

Brain tumour was detected and clear that tumor of patient. Then by using some algorithms in mathematical operations. Thus this solution is one of the problem of brain tumor, Region Growing method is best to extract the particular boundary regions of tumor and Fuzzy-c-means is also a clustering technique based on fuzzy logic to detect the tumor in brain image. Fuzzy C-means method is used to detect the tumor with accuracy.

PROPOSED SYSTEM

Thus the paper proposed that region growing methods to extract the tumor of brain. The initial contour of the seed point is to be selected to the iterative level set method. Thus the need of selecting the initial region of interest is removed. Region grow areas are automatically detected as the initial Level Set Functions. The proposed method is capable of improving the accuracy of overall extraction and detection performance of tumor for different parameters publicly available database. T2 weighted and flair modalities of MRI images are used in parallel to find the tumor Extraction and Detection.

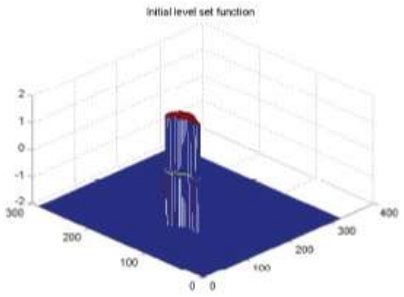


Fig: 3.1.Initial level set function obtained after applying

region growing approach in T2 image.

MODULES

Our project, brain tumor has been extracted and detected is made up of three modules. They are:

- Region of Interest (ROI)
- Feature Extraction
- Fuzzy C- means algorithm.

MODULE DESCRIPTION

Region of Interest (ROI)

The segmented area obtained from the region-growing approach is automatically selected as the initial contour to the iterative distance regularized level set evolution method thus removing the need of selecting the initial region of interest by the user. As diagnosis tumor is a complicated and sensitive task ; accuracy and reliability are always assigned much importance. Hence, an elaborated methodology that highlights new views for extracting more robust image extraction technique is much sought.

Feature Extraction

Feature Extraction is extract the boundary of regions. It is used to create new features as a function of existing features. In this proposed method, we use region growing method for extracting the brain tumor. The initial seed point starts to grow by searching for neighborhood pixels or regions with similar properties that create connected regions. In this method, a tolerance level of 12 is selected. Each pixel around the boundary of growing region having less than 12 pixel intensity value is included in that region. However, this region may not be the actual segmentation of tumor, because of irregular pixel intensity in tumor region. In this method, the performance of the conventional region growing approach is improved by the re-estimation of proper seed point. It is mainly used in this report, for extraction of MRI brain tumor image.

Fuzzy C- means algorithm

The Fuzzy C means algorithm is used for clustering brain tumor images and it works well for tumor detection. Fuzzy C means uses fuzzy logic values to each pixel. Tumor is detected using fuzzy c-means has the highest accuracy is 90.5% amongst all the other segmentation. The accuracy achieved is better than the methods or algorithms already existing in the literature. Also, when proposed algorithm is compared with the manual tumor extraction, provides more accuracy.

Region based methods mainly rely on the assumption that the neighboring pixels within one region have similar value. It has to extracted and fuzzy C means algorithm has to detected. The radiologist found that tumor with accuracy and rectify to the controllable patient.

CONCLUSION

This paper presents survey of various extraction and detection techniques for real time MRI brain image has been accomplished. As the diagnosis tumor is a complicated, sensitive task, accuracy and reliability are always assigned much importance. It is used to doctor rectify the brain tumor easily. This paper presents survey has been made on the different types of methods and algorithms used for tumor extraction and detection. It was also found out that region growing for extraction and Fuzzy C-Means for detection gives better performance. It gives more accuracy value compared to the various techniques used to extract and detect the tumor in human brain using MRI images.

CONFLICT OF INTEREST

The authors declare no conflict of interests.

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FINANCIAL DISCLOSURE

None

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