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A Survey on Detection of Brain Tumor in MRI Images Using Computer Vision Methodologies

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ABSTRACT

A brain tumor is the mass of unwanted and unusual growth of the cells in the brain. Brain tumor categorized in two types primary and secondary. Benign is the primary brain tumor. Primary brain tumor develops in the brain. A malignant tumor is secondary brain tumor which is too dangerous. A secondary brain tumor expands in other brain tissues. This paper discusses the performance analysis of a few existing image segmentation techniques, viz., Neural network algorithm, K-means clustering, Fuzzy c-means, Hopfield neural network, Watershed algorithm, Feature extraction for a medical test in which cells are taken from your body and studied about that cells. Brain tumor partitioning is still a task for the uncertain appearance and shape of the brain tumor. A number of computer vision methodologies exist for segmentation of tumor region from non-tumor region. We present here a summary of the outcomes and limitations of some recent and popular methods of brain tumor segmentation and detection.

Index Terms: Fuzzy c-means, Hopfield neural network, K-means algorithm, Neural network, Watershed segmentation.

1. INTRODUCTION

This paper explores existing methods of brain tumor from MR images. Image partitioning is an important position in the area of medical image processing. Partitioning can be used to detect tumor from MRI images, the tumor could be primary or secondary. Benign is the primary brain tumor[9]. Primary brain tumor invent in the brain. Malignant is the secondary brain tumor [9]. Secondary brain tumor (spread to the brain from in one place or else in the body throughout metastasis). A malignant tumor is more dangerous. So identification of the tumor is extremely an essential in earlier stages. Great observation and experience on radiology are required for accurate tumor detection in medical imaging. MRI is the most flexible of our diagnostic imaging modalities, possessing the ability to characterize a broad range of parameters in the living subject and provide exquisite spatial resolution. To detect the tumor a few preprocessing steps are used i.e. median filtering and morphological opening [9]. Different brain tumor detection algorithm is used for detecting the brain tumor. The purpose of brain tumor segmentation is to label the pixels into appropriate classes, which may be usual tissues or unusual pathological tissues.

2. RELATED WORK

Eman Abdel-Maksoud proposed a brain tumor segmentation method based on K-means clustering technique. The method consists of three steps: K-means clustering; Fuzzy C-means; Expectation Maximization. The K-means algorithm is fast and simple to run on large datasets, but it suffers from incomplete detection of the tumor, mainly if it is a malignant tumor. On the other hand, other systems use Fuzzy C-means algorithm because it retains the more information of the original image to detect malignant tumor cells accurately compared to the K-means [1].

Geetika Gupta proposed an approach of watershed segmentation, CNN (convolution neural network), k-Means clustering algorithm. Watershed segmentation is a well-known edge based segmentation algorithm. The execution time for k-means clustering was less compared to another clustering method [2]. CNN

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technique has been shown to take lesser time to detect the brain tumor. Also, the results of this technique have been compared with the previous technique. The execution time for K-means clustering was less compared to the other clustering methods. The proposed work also reduces the computational complexity and also provides an accurate method of extracting the Region of Interest (ROI) [2].

Yehualashet Megersa proposed an approach of hybrid intelligent algorithms skull stripping to detection and segmentation of brain tumor is proposed with fuzzy Hopfield neural network as its final tumor segmentation technique. In this paper, they are used fuzzy Hopfield neural network technique. To enhance brain tumor region extraction and visualization process. Yan Zhu and Hong Yan proposed an efficient method for tumor boundary detection using a Hopfield neural network. The neural network is proposed to improve the computational speed and reliability of the Hopfield network. The Hopfield network is constructed from a single layer of neurons, with feedback connections from each neuron to every other neuron. The boundaries of the brain tumor in each image slice and separate the tumor from normal brain tissues successfully [4].

Padmakant Dhage proposed a method based on watershed segmentation. They used three different segmentation method thresholding, clustering, and level set method. In thresholding based segmentation discriminates pixels according to their gray level value. Thresholding process is a choice of a threshold value. Clustering is dividing of data into a group of similar objects. The level set technique represents the evolving contour using a signed function, where its zero level corresponds to the actual contour [5].

Praveen proposed a method brain tumor detection using fuzzy c-means and (support vector machine) SVM technology. The MRI images are enhanced using Contrast improvement and Mid-range Stretch techniques. After the image is enhanced, segmentation step can be done easily. Segmentation is a technique to extract suspicious region from images. In this paper Segmentation technique was done by Fuzzy C-Mean (FCM) clustering [6]. Before applying FCM clustering technique, skull striping has been done. Suchita Yadav, proposed k-means method Clustering is a process of partitioning or grouping a given sector unlabeled pattern into a number of clusters. Such that similar patterns are assigned to a group which is considered as a cluster. Manual segmentation of brain tumors from MR images is a challenging and time-consuming task. The hybrid methodology of combining support vector machine and fuzzy c-means clustering for classification gives accurate result for identifying the brain tumor. For future work, to get better accuracy rate and less error rate a hybrid SVM algorithm is to be proposed.

Karishma Sheikh developed a method Clustering based Segmentation Approach to Detect Brain Tumor from MRI Scan in this paper they used algorithms such as pixel to pixel comparison, gray scale, segmentation, K-mean. K- Means algorithm is used to implement a clustering is a process of organizing similar objects into groups. The k-means algorithm is used for partition the MRI into K cluster [7]. The segmentation of the MRI brain image. K-means algorithm to find out the tumor is affected or not. The cluster is the important part of the brain and it finds the structure of data which is not labeled. K-means algorithm is used to extract features from the brain cells. Noise is removed before the K-means process. The noise-free image is taken as an input to the k-means and tumor is extracted from the MRI image. Finally approximate reasoning for calculating tumor shape and position calculate.

Ashwini A. Mandwe proposed k-means and fuzzy c means algorithm. The brain MRI images for detection of tumor using clustering techniques. A cluster can be defined as a group of pixels where all the pixels in a certain group defined by a similar relationship [1]. Clustering is also known as unsupervised classification technique. The name unsupervised classification because the algorithm automatically classifies objects based on user-given criteria. K-means clustering algorithm for segmentation of the image followed by morphological filtering is used for tumor detection from the brain MRI. Fuzzy c means plays a major role. The patient's stage is determined by this process, whether it can be cured with medicine or not. Also, they studied difficulty to detect Mild traumatic brain injury (mTBI) the current tools are qualitative, which can lead to poor diagnosis and treatment and to overcome these difficulties.

S. Ghanavati describes the brain tumor detection method by extracting the features like intensity, deformation, symmetry and texture features. Tumor detection with an average accuracy of 90.11% gets by preliminary results on simulated & patient MRI. Atiq.Islam represents a stochastic model using MRI for characterizing tumor texture in the brain. This model implements patient-independent task of texture feature extraction and segmentation of brain tumor. Multiresolution- the fractal model is used for brain tumor texture formulation [10]. The new patient-independent scheme for tumor segmentation is proposed by extending the AdaBoost algorithm which is well known. The modification in AdaBoost is done by allocating weights to component classifiers depending on the ability to classify difficult samples & confident in such samples.

3. MATH

Consider an image with the resolution of p*q and the image has to be cluster into k number of cluster. Let A(p, q) be input pixels to be a cluster and C*k* be the cluster centers. The algorithm for k-means clustering is as follows:

1. Input a number of cluster k and center.
2. For every pixel of an image, calculate the Euclidean distance d, between the center and each pixel of an image using the relation given below.

$$Distance = \left\| A(p,q) - C_K \right\|$$

3. Assign all the pixels to the nearest center based on distance d.
4. After all pixels are assigned; recalculate the new position of the center using the relation given below.

$$C_K = \frac{1}{k} \sum_{q \in C_X} \sum_{p \in C_X} A(p,q)$$

5. Repeat the process up till it satisfies the tolerance or error value.
6. Resize the cluster pixels into image.

4. THEREFORE, IN ORDER TO GAUGE THE CURRENT STATE-OF-THE-ART (DESKTOP/WEB BASED) IN AUTOMATED BRAIN TUMOR SEGMENTATION AND COMPARISON BETWEEN DIFFERENT METHODS ARE SUMMARIZED IN TABLE.

4.1. FIGURE AND TABLES

Table 1
Related Work

Ref	*Strategy*	*Year*	*Methodology/ Outcomes etc*	*Limitations/ Conclusion*
[6]	Fuzzy c-means and SVM	2015	Fuzzy c-means (FCM) is the clustering method used for the partitioning of the image to detect the suspicious region in brain MRI image. Grey level run length matrix (GLRLM) is used for feature extraction of the brain image, after which support vector machine(SVM) technique is applied to divide the brain MRI images, which provide an exact and more effective outcome for classification of brain MRI images.	Time consuming process.
[1]	Hybrid clustering	2015	A fuzzy c-means algorithm using thresholding and level set partitioning stages to provide exact brain tumor detection.K-means clustering for the image partitioning in the feature of less computation time. The Fuzzy C-means used in the aspects of exactness.	Fuzzy c-means fails to segment noisy images.

(*contd...Table 1*)

Ref	*Strategy*	*Year*	*Methodology/ Outcomes etc*	*Limitations/ Conclusion*
[3]	Hybrid intelligent algorithm	2015	The various technique used. Fused image remove irrelevant data. Initial tumorous classification slice is segmented to extract the tumor part in the image and apply the final hybrid intelligent fuzzy Hopfield neural network algorithm based tumor segmentation and tumor region detection and extraction is achieved.	Cannot clearly define borders between tissues successfully
[5]	Watershed segmentation	2015	The various methods are used. Preprocessing, segmentation, Connected-component labeling (CCL) and multi-parameter calculation. Preprocessing includes filtering of the image. Partitioning is carried out by watershed algorithm. Used Connected component labeling (CCL) position is found out and the region is calculated of tumor in MR image.The benefit of this technique is its clarity and efficiency.	Does not work well on images with smooth transitions and low contrast. Sensitive to noise. Robust edge linking is not trivial
[8]	Clustering K-based Segmentation	2015	Various Algorithms are used. Such as pixel to pixel comparison, gray-scale, segmentation, K-mean. K-means algorithm is used to implement the partitioning of the MRI brain image. Clustering finds the structure of data which is not labeled. The k-means algorithm is used for segmentation of the MRI into K cluster.	
[9]	K-Means Clustering	2015	K-means clustering gives 'n' number of observations and the algorithm grouped these observations into clusters. The number of clusters 'k' is assumed to be fixed. Cluster centroids are initialized with random values.	When a tumor is near to bone that time k-means is unable to detect that tumor.
[2]	Extraction Techniques from MRI Images	2014	Various algorithms are used. The watershed algorithm has proved that brain tumor is better detected from colored MRI image than the grey scale image. Features extraction removes the relevant data from the input data, so that the desired task can be performed by using this reduced representation instead of the complete initial data.	Computational complexity and extended computational time.
[11]	Segmentation of brain tumors.	2013	This model implements patient-independent task of texture feature extraction and partitioning of the brain tumor. This model implements patient-independent task of texture feature extraction and partitioning of the brain tumor. In this paper the used both the technique feature based and atlas-based technique.	Extract features from the data without any learning involved.
[7]	Clustering method	2013	The used concept of rand index, Global consistency and k-means. Rand index measures the similarity between two clusters. The global consistency error calculates the extent by which one segmentation can be viewed as a refinement of the other. The tumor portion is correctly partitioned if values of global consistency error and variation of information are lower as compared to the value of rand index.	Reduced complexity and simplicity in implementation
[10]	Magnetic resonance images.	2012	Detection is done by extracting features like intensity, deformation, symmetry and texture features. Tumor detection with an average accuracy of 90.11% gets by preliminary results on simulated & patient MRI.	Extended computational time

4.2. Abbreviations and Acronyms

MRI: Magnetic resonance imaging

SVM: Support vector machine

CCL: Connected component labeling

GLRLM: Grey level run length matrix

FCM: Fuzzy c-means

mTBI: Mild traumatic brain injury

5. CONCLUSION

In the survey work it has been observed that use both supervised and unsupervised algorithm techniques for the segmentation of brain tumor, In future, this research can be done more advanced so that tumor can be categorized according to its type. Also, tumor growth can be analyzed by planning a graph which can be obtained by studying sequential images of tumor affected patient. Many image processing technique has been initiated in a few years ago. These techniques carry neural network algorithm, Component Labeling Algorithm, Fuzzy C-Mean Algorithm, Hybrid intelligent algorithm, feature extraction, k-means clustering. However using these uncovered images processing data in the field of image segmentation is hard to implement and not so much effective. This is because of some useful segmentation with high specificity, minimum accuracy. This work will be expanded for a new algorithm for brain tumor detection. This will give us more systematic result than the existing methods in near future computational time will also be considered to differentiate this method efficiently.

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