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BRAIN TUMOUR DETECTION - A REVIEW

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ABSTRACT

Treatment of cancer has been a major research work that has been going on for several years. Early diagnosis of the tumour has been proven to be useful in treating it. Cerebral cancer is becoming common across the world. An artificial neuron model to segment tumour from Magnetic resonance images (MRI) may be of great help based in fast and effective diagnosis. The process involves use of image processing techniques like Pre-Processing, Segmentation techniques, feature extraction and classification of the image. A Classification of brain is done into Healthy and Tumorous brain. The Objective the proposed project is to help classify the brain by training the Artificial Neural Network (ANN) by inputting MRI images of Tumour free brain and Tumour infected brain to get the system to classify them. This paper describes the previous techniques used for segmentation of MRI images and their drawbacks and talks about the proposed work on how to detect and segment the tumour from the MRI image of the brain. The process includes noise removal and enhancement of the image, segmentation techniques and morphological operations. The whole process of tumour detection and elicitation of the tumour from the image is done using MATLAB.

KEYWORDS: ANN, Cerebral Cancer, MRI, Image segmentation, Brain tumor.

INTRODUCTION

Brain tumor is an abnormal growth of cells where they form a lump of cells because of uncontrolled growth and division of cells. The normal cells transform into carcinogenic cells which become unable to inhibit growth and hence result in uncontrolled growth of cells. There are two types: malignant tumors and benign tumors. Malignant tumors can be divided into primary tumours and secondary tumours. Primary tumours grow within the brain, secondary tumors that have migrated from some other part of the body, also known as brain metastasis tumors. Magnetic Resonance Imaging (MRI) is the most advance medical imaging technique which results in high resolution images of the human body parts. MRI images allow the doctors to locate and diagnose any abnormalities in the body. The images help the doctor in identifying the location, shape and size of the brain tumour and it's behaviour of spreading. Several methods like fuzzy methods, neural networks, knowledge based techniques, variation segmentation are used to classify MRI scans. The MRI scans provides complete understanding of the tumour in a non-invasive way and it's properties so as to allow it'd operation safely.[2] MRI provides an enhanced and high-resolution image as compared to CT Scans or X ray images. The MRI image is primarily pre-processed in order to make is enhanced and noise free, this leads to a better-quality image, then morphological functions are operated upon the image to detect the tumour. The morphological operations are applied on the assumptions made about the shape and size of the tumour and then the tumour is mapped on the grayscale image.[12] Evidently, there a large amount time required to read and diagnose the tumour which is a lot of work, an automated system which will be able to do this in advance will be very beneficial and time saving.

LITRATURE SURVEY

Today, the MRI imaging offers various techniques for segmentation of brain tumour which are basically classified into 4 main categories, viz. threshold based segmentation, edge based segmentation, region based segmentation and clustering based segmentation. The threshold based segmentation makes the use of a particular threshold to elicit the objects from the image. The edge based segmentation techniques take into account the instantaneous change in the value of intensity of an object in the image for elicitation. The region based segmentation techniques divide the image into separate regions based on the properties they possess. The clustering based segmentation allots each pixel in the image a membership function value and then divides the image into clusters based on those values.[3]

3.1 Thresholding: One of the most frequently used techniques for image segmentation is the threshold technique.[4] The differing intensities of the pixels in the image is what makes this method most appropriate to use and allows the image to be segmented into different regions.

(A) Global thresholding: This method elects one threshold value and uses it for the whole image. Bimodal images are processed using this method. This method offers comparatively faster and simpler computational time when certain conditions are met. The conditions being uniform intensity distribution and high contrast difference between foreground and background.

- Otsu's thresholding: Otsu's thresholding method depends on a discriminant analysis which divides the image into two classes based on the intensity of gray levels in the image.[5] The main advantage of Otsu's method is that it is simple and effective to implement. While Otsu's method can segment only larger objects from background and fails, if the image has variable contrast distribution.

(B) Local thresholding: In this method the image is divided into smaller images or sub-images and then the threshold values are calculated for each sub-image locally. The computational time is naturally greater than that of the previous method, but it gives satisfactory image result with background variation. It can only elicit smaller regions.

- Histogram thresholding: Histogram thresholding segmentation is based upon the thresholding of histogram features and gray-level thresholding in an image. It gives better results, but the computational time is more for histogram thresholding.

3.2 Edge Based Segmentation: The instantaneous changes in the pixel intensity near the edges allows this method to divide an image into a binary image in which the edges of the object are easily detectable.[6] Theoretically, edge bases segmentation can be divided into two methods viz. gray histogram and gradient based methods.

(A) Gray Histogram Technique: The preference of the threshold value (T) greatly affects the outcomes of this technique. In this technique the gray-level thresholding is applied on the histogram of the converted grayscale image of the original image.

(B) Gradient Based Method: This method takes into consideration the difference between intensity values of adjacent pixels.[7] The gradient based method works accurately when the

change in the intensity in a region of an image is instantaneous and the image noise is very less. Gradient operators are exerted on the images in this method. The basic edge detection operators used in this method are Sobel operator, Canny operator, Laplace operator, Laplacian of Gaussian (LOG) operator etc., out of which Sobel and Canny operators produce better results Edge detection methods exhibit a balance between accuracy and noise immunity.

3.3 Region Based Segmentation: These methods make use of a particular benchmark and then segregate the image into similar regions.[8] The present region segmentation techniques offer the following methods:

(A) Region growing: This method is one of the most popular segmentation methods. In this method an initial pixel or seed pixel is chosen and then it spreads out by assimilating the adjacent pixels on the basis of some threshold values, hence, widening the region until all the pixels get accumulated into one or the other region.[9] This method is effective if used for small and simple structures such as tumors, lesions etc.

(B) Region splitting and merging: On the basis of certain conditions, the image is split into a number of various regions and then remerged. In the beginning the whole image is treated as one whole region and afterwards the internal resemblance of the image is computed via standard deviation. The process of splitting of image using some threshold value is applied again if the variation comes out to be very large and is repeated until it becomes impossible to split the regions furthermore. A common data structure used for splitting is Quad tree.

(C) Watershed segmentation: This method for finding the weak edges in the image can only be used if the contrast distribution in the image is uniform and the foreground and the background intensity is distinguishable.

3.4 Clustering: This method is the most used method in the MRI Segmentation. This method can segregate the pixels into classes, without any information or training beforehand.[10] The pixels with greatest probability get classified into the same class. In the clustering technique, the training is done by utilizing the pixel characteristics with properties of each class of classified pixels.

(A) K-means: This algorithm is the simplest of the pre-existing clustering algorithms that utilize pixel properties to cluster pixels into various regions. In this method the clusters must

have a certain distance amongst each other and every pixel is assigned the membership function in such a way that it belongs to one particular region only and hence, this method is called hard clustering.

(B) Fuzzy C-means (FCM): This methods need no supervision for the analysis of given input image.[11] This algorithm imparts membership functions to every single pixel in an image related to each cluster centre based on the distance of the cluster centre from that particular pixel. The more the pixel is near the cluster's centre, the greater is its membership function value and vice versa.

(C) Hierarchical clustering: This method takes the data objects in an image and groups them into a tree of clusters. There is no need for prior specification of number of clusters in Hierarchical clustering.

DISCUSSION

The various approaches that can be used to achieve this result have some drawbacks. To get the best results we should use a combination of the various techniques, Pre-processing, segmentation, filtering, and other operations to get the desired result. This approach would help in getting the most clear, good quality and enhanced image as the output.

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