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Image Processing Techniques for Brain Tumor Detection: A Review

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Abstract

MRI Imaging play an important role in brain tumor for analysis, diagnosis and treatment planning. It's helpful to doctor for determine the previous steps of brain tumor. Brain tumor detections are using MRI images is a challenging task, because the complex structure of the brain. Brain tumor is an abnormal growth of cell of brain. MRI images offer better difference concern of various soft tissues of human body. MRI Image provides better results than CT, Ultrasound, and X-ray. In this the various preprocessing, post processing and methods like; (Filtering, contrast enhancement, Edge detection) and post processing techniques like; (Histogram, Threshold, Segmentation, Morphological operation) through image processing (IP) tool is available in MATLAB for detection of brain tumor images (MRI-Images) are discussed.

Keywords: Brain Tumor (BT), MRI-Images, CT, IP, X-ray.

1. INTRODUCTION

Human body is made up of several type of cells. Brain is a highly specialized and sensitive organ of human body. Brain tumor is a very harmful disease for human being. The brain tumor is intracranial mass made up by abnormal growth of tissue in the brain or around the brain.

Brain tumour can be detected by benign or malignant type. The benign being non-cancerous and malignant is cancerous. Malignant tumour is classified into two types; primary and secondary tumour benign tumour is less harmful than malignant. The malignant tumour it spread rapidly entering other tissues of the brain therefore, worsening condition patients are loosed. Brain tumour detection is very challenging problem due to complex structure of brain [1].

Brain tumor diagnosis is quite difficult because of diverse shape, size, location and appearance of tumor in brain. Brain Tumor detection is very hard in beginning stage because it can't find the accurate measurement of tumor. But once it gets identified the brain tumor it gives to start the proper treatment and it may be curable. Therefore, the treatments depend on tumor like; chemotherapy, radiotherapy and surgery [2].

Medical imaging is useful to diagnose the noninvasive possibilities. The various types of medical imaging technologies based on noninvasive approach like; MRI, CT scan, Ultrasound, SPECT, PET and X-ray. In the field of medical diagnosis systems (MDS), Magnetic resonance Imaging (MRI), gives the better results rather than Computed Tomography (CT), because Magnetic resonance Imaging provides greater contrast between different soft tissues of human body [3]. In MRI-scan is a powerful magnetic fields component to determine the radio frequency pulses and to produces the detailed pictures of organs, soft tissues, bone and other internal structures of human body. The MRI-Technique is most effective for brain tumor detection.

The brain tumor detection can be done through MRI images. In image processing and image enhancement tools are used for medical image processing to improve the quality of images. The contrast adjustment and threshold techniques are used for highlighting the features of MRI images. The Edge detection, Histogram, Segmentation and Morphological operations play a vital role for classification and detecting the tumor of brain.

The main objective of this paper is too studied and reviewed the different research papers to find the various filters and segmentation techniques, algorithms to brain tumor detection.

The various steps of MR imaging like; preprocessing, feature extraction, segmentation, post-processing, etc. which is used for finding the tumor area of MRI-images. The figure-1 shows basic structure of feature extraction through digital image processing.

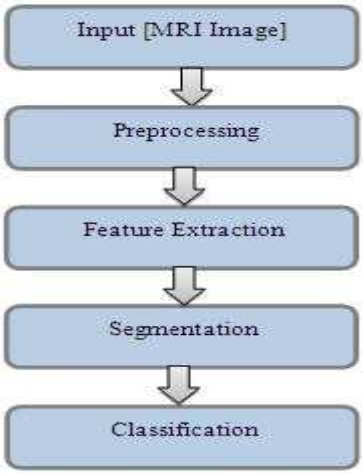


Fig. 1 Block diagram of feature extraction through Digital Image processing

2. LITERATURE REVIEW

Many of the researchers proposed many methods, and algorithms for to find brain tumor, stroke and other Kinds of abnormalities in human brain using MR Images. Manoj K Kowar and Sourabh Yadav et al, 2012 his paper "Brain Tumor Detection and Segmentation Using Histogram Thresholding", they presents the novel techniques for the detection of tumor in brain using segmentation, histogram and thresholding [4].

Rajesh C. Patil and Dr. A. S. Bhalchandra et al, in his paper "Brain Tumor Extraction from MRI Images Using MATLAB", they focused on Meyer's flooding Watershed algorithm for segmentation and also presents the morphological operation [5].

Vinay Parameshwarappa and Nandish S. et al, 2014 in his paper "Segmented morphological approach to detect tumor in brain images", they proposed an algorithm for segmented morphological approach [6].

M. Karuna and Ankita Joshi et al, 2013, in his paper "Automatic detection of Brain tumor and analysis using Matlab" they presents the algorithm incorporates segmentation through Nero Fuzzy Classifier. The problem of this system is to train the system by neural network and it desires many input images are used to train the network. The developed system is used only for tumor detection not for other abnormalities [7].

R. B. Dubey, M. Hanmandlu, Shantaram Vasikarla et al, 2011, compare the image segmentation techniques in his paper "Evaluation of three methods for MRI brain tumor segmentation", they apply preprocessing techniques like; de-noising, image smoothing, image contrast enhancement and comparison of the level set methods and morphological marker controlled watershed approach and modified gradient magnitude region growing technique for MRI brain tumor segmentation. They concluded the MGMRGT method gives better result [8].

Sentilkumaran N and Thimmiaraja et al, 2014, Compare the image enhancement techniques in his paper "Histogram equalization for image enhancement using MRI brain images", they presented the study of image enhancement techniques and comparison of histogram equalization basic method like Brightness preserving adaptive histogram equalization (AHE), Local histogram equalization (LHE), global histogram equalization (GHE), Dynamic histogram equalization using different quality objective measures in MRI images. They also presented the better result on contrast using BPDHE method [10].

R. Preetha and G. R. Suresh et al, 2011, in his paper "Performance analysis of fuzzy C means algorithm in automated detection of brain tumor" they used fuzzy C means clustering for segmentation. That method given the high computational complexity. FCM shows good performance result in segmented the tumor tissue and accuracy of tumor. Segmentation was identified by applied the SVM classifier [11].

Amer AlBadarneh, Hasan Najadat and Ali M. Alraziqi et al, 2012, [12] proposed the method for brain tumor classification of MRI images. The research work applied, based on Neural Network (NN) and k- Nearest Neighbor (k-NN) algorithms on tumor classification has been achieved 100% accuracy using k-NN and 98.92% using NN.

Many researchers has proposed many algorithms and segmentation techniques to find abnormalities in the brain using MRI images. Most of them proposed various algorithms to find the abnormality in the brain like Brain tumor.

3. IMAGE PROCESSING TECHNIQUES

3.1 Median Filtering for Noise Removal

Median filter is a non-linear filtering technique used for noise removal.[5] Median filtering is used to remove salt and pepper noise from the converted gray scale image. It replaces the value of the center pixel with the median of the intensity values in the neighborhood of that pixel. Median filters are particularly effective in the presence of impulse noise. Impulse noise is also called as salt and pepper noise because of its appearance as white and black dots covered on image. The median filter is used for remove salt and pepper noise from MRI images is shown in figure 2

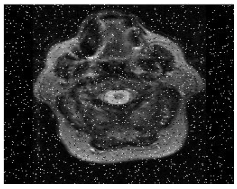
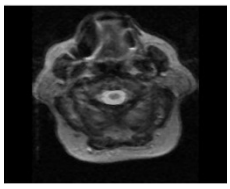


Fig. 2 (a) Salt and pepper Noise apply



(**b)** Median filter

3.2 Various De-noising Filters

We have studied the various filtering techniques in digital image processing, that are shown in table 1.[13]

Table 1: Various de-noising filters

Various Filters	Working Principle	Advantages	Disadvantages
Mean Filter	Based on average value of pixels	Reduces Gaussian noise. Response time is fast	Results in distorted boundaries and edges
Median Filter	Based on the median value of Pixels	Efficient for reducing salt & pepper noise, speckle noise. Boundaries and edges are Preserved	Complex and time consuming as compared to mean filter.
Wiener Filter	Based on inverse filtering in frequency	Efficient for removing blurring	Due to working in frequency domain, its

	domain	effects from images	speed is slow. Doesn't provide good results for speckle noise.
Hybrid Filter	Combination of median and wiener filter	Removes speckle noise, impulse noise and blurring effects from images	Complex and time consuming
Modified hybrid median Filter	Combination of mean and median Filter	Efficient for removing speckle, salt and pepper and Gaussian noise	Computation time is more as compared to simple median filter
Morphology Based De-noising	Based on Morphological opening and closing Operations	Efficient and producing better results as compared to other filters	

3.3 Image Enhancement

Poor contrast is one of the defects found in acquired image. The effect of that defect has great impact on the contrast of image. When contrast is poor the contrast enhancement method plays an important role. In this case the gray level of each pixel is scaled to improve the contrast. Contrast enhancements improve the visualization of the MRI images. [8] contrast enhancement technique is used for enhance the MRI image is shown in figure 3

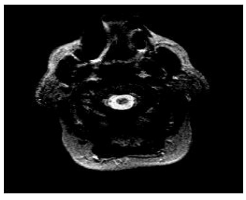


Fig.3 (a) Reduced Contrast

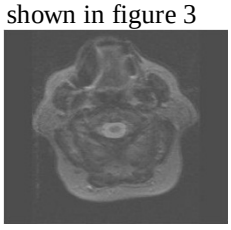


Fig. 3 (b) Increase contrast

3.4Edge Detection

Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision, and machine vision. Common edge detection algorithms include methods like Sobel, Canny, Prewitt, Log, and Zero cross. Edge detection methods are used for finding object boundaries from MRI images and the results are shown in figure 4

Fig. 4 (a)

Fig.4 (b)

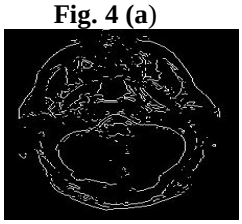


Fig.4 (c)

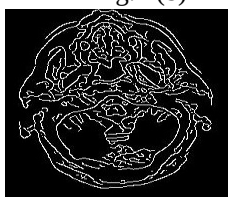


Fig. 4(d)

Fig.4 (e)

Fig. 4 (a) Log operator (b) Sobel operator (c) Canny operator (d) Prewitt operator (e) Zero cross operator

3.5 Threshold

Image threshold is a simple, effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting gray scale images into binary images. Image threshold is most effective in images with high levels of contrast. threshold technique is apply on input MRI image by changing the threshold value and the result shown in figure 5.

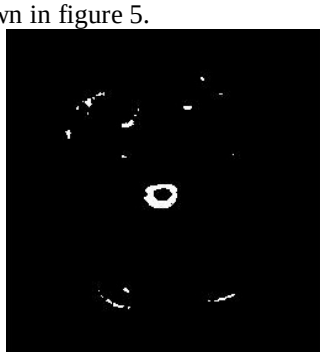


Fig. 5. Threshold applied image

3.6 Histogram

Histogram is nothing but the graphical representation of an image. The histogram of a digital image with gray levels in the range [0, L-1] is a discrete function.[9] The histogram of an image mostly represents the comparative frequency of the various gray levels in the image.[10] histogram techniques apply on input MRI image and result shown in figure

Fig. 6 (a) histogram applied image

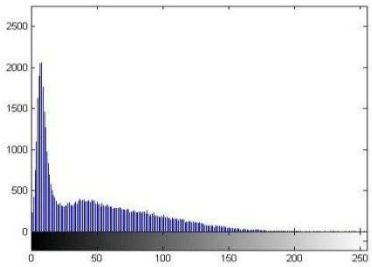


Fig. 6 (b) histogram of Fig. 6 (a)

3.7Morphological Operation

Morphological operation used as an image processing tools for sharpening the regions. [2] Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. The erosion and dilation methods are use for morphological operation.[16]

3.8 Segmentation

Image segmentation is the process of partitioning a digital image into multiple segments. Image Segmentation is typically used to locate objects and boundaries in image, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics [14]. The different segmentation techniques are shown in table 2 [2]- [15].

Table 2: Various Image Segmentation Techniques

Various Techniques	**Advantages**	**Disadvantages**
Active contour method	• Use active contour Models. • Preserves global line shapes efficiently.	• Should find strong image gradients to drive the contour. • Lacking accuracy with weak image boundaries and image noise.
Watersheds Method	•Based on mathematical morphology • Helps to improve the capture range	• Over segmentation
Threshold method	• Try to find edge pixels	• The detected edges are consisted
	while eliminate the noise influence. • Use gradient magnitude to find the potential edge pixels	of discrete pixels and may be Incomplete or discontinuous. • Computationally Expensive
Seed region growing	• correctly separate the regions that have the same properties • determine the seed points	• it requires manual interaction to obtain seed point
Marker based Watershed	• It remove the over segmentation problem, which occur in watershed segmentation	

4 CONCLUSION

MRI images are best suitable for brain tumor detection. In this study Digital Image Processing Techniques are important for brain tumor detection by MRI images. The preprocessing techniques include different methods like Filtering, Contrast enhancement, Edge detection is used for image smoothing. The preprocessed images are used for post processing operations like; threshold, histogram, segmentation and morphological, which is used to enhance the images.

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