Detection of Brain Tumor by Clustering Technique

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Abstract—It is considered that manual diagnosis of tumor detection is both expensive and time consuming and also includes a lot of human errors. Hence Requirements for robust and efficient tumor detection methodologies are necessitated. Therefore, In this paper, the development of a robust tumor detection technique by also performing denoising along with binarization and thresholding method is performed. The work was carried out by considering Noise such as Gaussian and averaging filtering method is used for denoising process. Experiment result shows the area of tumor was successfully identified and segmented for which an improved performance considering the image quality assessment such as PSNR and SNR was observed.

Keywords—*tumor detection; binarization; thresholding; denoising; Gaussian and averaging filtering; PSNR and SNR*

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I. INTRODUCTION

Brain is a highly complex nervous tissue which is the main organ of the central nervous system and the prime cognitive and metabolic center. However, due to the subjective nature of today's diagnosis, there have been cases of improper diagnosis, and even misdiagnosis of tumor in certain cases. Also, due to the slight intensity gradient in early staged tumors, a subjective eye would misclassify it to be a healthy brain, which is why metastatic brain tumor is over six times more common. This paper deals with the concept of automatic brain tumor segmentation. Normally, the anatomy of brain can be viewed by the MRI scan or CT scan. In this paper, MRI scanned image is taken for the entire process as it is best for imaging of soft tissues and is a non-invasive imaging technique with no biological hazards overall.[1] Tumors may be primary (if the part of the tumor is spread to another place and metastasizes thereafter) or secondary (self growth). Brain tumor affects cerebral fluid which causes strokes, which is why most of the tumors go undetected and untreated due to treatment for stroke prescribed to the patient, rather than treatment for tumor. Hence, proper detection of tumor is important for that treatment. The longevity of the patient affected by the tumor will increase by a considerable amount, if detected at the right stage. Tumor cells can be benign or malignant, which can be generically classified only after biopsy of the tumor cells.

Most of the existing methods merely work on immediate thresholding and region growing without any robust segmentation methods. Thresholding methods ignore the Spatial characteristics and it is not possible to correlate parameters such a mean, standard deviation with different types of tumors after thresholding. In direct thresholding, the grayscale image is binarized and has only two values - either black (0) or white (1). But any grayscale MRI image contains 256 gray values ranging from 0 to 255. This will result in loss of contours and edges of tumor and reaction area due to direct threshold.

II. METHODOLOGY

After acquisition of MRI Image, the raw data needs to be pre-processed for noise removal and deletion of unwanted data. For example, the skull lining in MRI is free from tumor and should be removed beforehand to reduce processing time of algorithms on skull area [2]. Moreover, smoothening of image is preferred to suppress background information and make the active area stand out from the entire image. Gaussian and High pass filtering cause sharpening of edges and are not desired for extraction of a homogeneous region. Mean and median filtering are widely used for this process. The averaging or mean filter uses a 3x3 mask for smoothing of image which is moved laterally throughout the image and the center pixel is replaced by mean of values in the window. The proposed system is described as follows (Fig. 1)

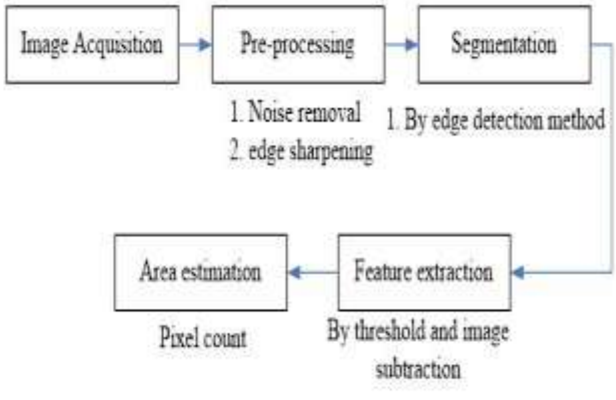


Fig.1. Proposed methodology

This is applied through setting two types of thresholds namely lower threshold and upper threshold. The lower threshold is used for detecting the finer edges whereas the upper threshold is used for detecting the coarser edges. The feature extraction is performed by threshold and image subtraction method along with using pixel count for estimating the segmented area.

The algorithm has two stages, first is pre-processing of given MRI image and after that segmentation and then perform morphological operations. Steps of algorithm are as following:-

Step 1: Give MRI image of brain as input.
Step 2: Convert it to gray scale image.
Step 3: Apply high pass filter for noise removal.
Step 4: Apply median filter to enhance the quality of image.
Step 5: Compute threshold segmentation.

A. Image Acquisition Images are obtained by MRI scan of brain and the output of MRI provides gray level images. A gray scale image is a data matrix whose value represents shades of gray. The elements of gray scale matrix have integer values or intensity values in range [0 255]. For applying different techniques, the digital images obtained from MRI are stored in matrix form in MATLAB. The MRI scan of patient suffering from tumor shows some region having high intensity. The objective of the algorithm is to detect the exact the location and size of this high intensity region. MRI images can involve some noise also. So the next step is to remove this noise and get enhance image for better detection.

B. High Pass Filter A high-pass filter is a filter that passes high frequencies well, but attenuates frequencies lower than the cut-off frequency [9]After that image is given as an input to high pass filter. A high pass filter is the basis for most sharpening methods. An image is sharpened when contrast is enhanced between adjoining areas with little variation in brightness or darkness. A high pass filter tends to retain the high frequency information within an image while reducing the low frequency information. The kernel of the high pass filter is designed to increase the brightness of the center pixel relative to neighboring pixels.

C. Median filter Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal. This filter enhance the quality of the MRI image.

D. Threshold Segmentation Segmentation refers to the process of partitioning a digital image into multiple regions (sets of pixels). The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. The result of image segmentation is a set of regions that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s). Segmentation is mainly used in medical imaging, Face recognition, Fingerprint recognition, Traffic control systems, Brake light detection, and Machine vision Thresholding technique can be used for MRI brain tumor segmentation. According to intensity/brightness is a simple technique for images which contain solid objects on a background of different, but uniform, brightness. Each pixel is compared to the threshold: if its value is higher than the threshold, the pixel is considered to be “foreground” and is set to white, and if it is less than or equal to the threshold it is considered “background” and set to black . Various versions of thresholding technique have been introduced that segments MRI images by using the information based on local intensities and connectivity [3].

Most of the existing thresholding methods are bi-level, which use two levels to categorize the image into background and object segments. However, MRI images have many different parts which make these methods non-applicable. Thus, the loss of information from the image may occur and diagnosis system may mislead physicians in their clinical task. Therefore, multi-level thresholding algorithms have been developed to ensure that all important information from MR images are retained, but they become computationally expensive, because a large no. of iterations would be required for computing the optimum threshold. Otsu’s global thresholding method is the most suitable image segmentation method to segment a brain tumor from a Magnetic Resonance Image. It selects that gray level value as threshold for which between-class variance is maximised. In general, thresholding algorithms do not use spatial information of an image and they usually fail to segment objects with low contrast or noisy images with varying background [4]. The simplest method of image segmentation is called the thresholding method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image. The key of this method is to select the threshold value (or values when multiplelevels are selected). A zero matrix of same size of original image matrix is considered. Each pixel value of the image matrix is compared with the threshold point. If the value of pixel is greater than threshold, coordinate of c matrix is assigned a value 255 otherwise 0 is assigned to that. This process is repeated till all the pixel values are compared to threshold point A greyscale image is turned into a binary (black and white) image by first choosing a grey level T in the original image, and then turning every pixel black or white according to whether its grey value is greater than or less than T:

$$A\ pixel\ = \begin{cases} white\ if\ its\ grey\ level\ is > T \\ black\ if\ its\ grey\ level\ is \leq\ T \end{cases}$$

The Otsu’s thresholding method is viewed as a statistical decision theory concept. The main goal of this method is to minimize the average error incurred in assigning pixels to classes.

III. BINARIZATION INTERPRETATION

Binarization is the processes of translating a gray-scale image to a binary image by choosing threshold selection method to categorize the pixels of an image into either one of the two classes. Most of the technique are divided into two category global thresholding and local thresholding techniques, in the global thresholding method threshold of the entire image is unique and local thresholding method choose threshold value locally and binarization also local.

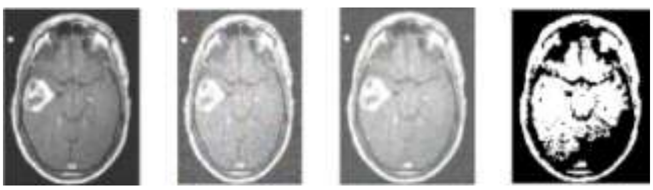
Otsu and Kapur are two very popular method for global thresholding method and Savala , Niblack, Bernsen are most popular local thresholding methods. Soharab Hossain Shaikh proposed a iterative partitioning method as a framework which produce good results for degradead, graphic documents.

The proposed method is a new binarization technique of MRI of brain that so MRI of brain is used as an input. As the binarization technique can be applied only to grayscale images
[5]. We convert RGB image to its corresponding grayscale image. A RGB image has three components red, green and blue and converts it into on component i.e. gray value which lies between 0 to 255 intensity values. Then we calculate the standard deviation of the matrix elements (image pixels).

Thus by using standard deviation we select the random intensity values as the standard deviation values will be less than 100 and hence we multiplied the deviated value by a constant value. Here we choose this constant value H=3. Although H=3 is choosen, in few images H= 2.5 also produce good results .Here we also gives a comparative study why we choose constant H equal to 3. Here we use visual inspection as well as quantative measurement to choose the constant.

Thus after getting the threshold intensity we compare each pixel of the gray image to find out whether it is greater than or less than the threshold intensity value [6]. If the pixel intensity is greater than the threshold value then that pixel value is set to 1 otherwise it is set to 0. Thus the whole image is transformed into 0 or 1 i.e. a binary image is generated from the gray image where the foregrounds are marked as 1 and backgrounds are marked as 0.

IV. RESULTS



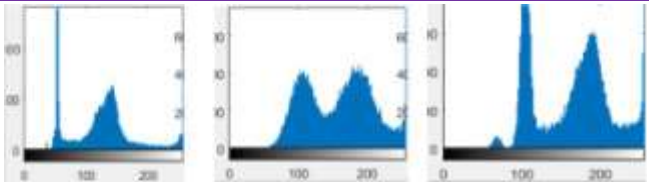


Fig.2. Output for images

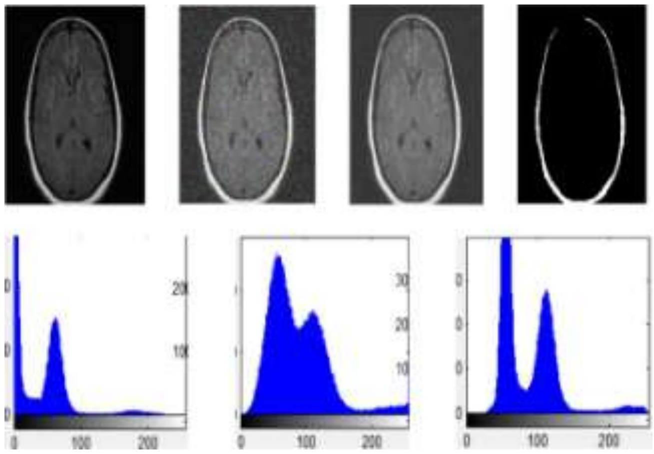


Fig 3. Output for Normal image

V. CONCLUSION

In the proposed method, the identification of brain tumor is performed using OTSU method followed by binarization method. The pre-processing method is applied which performs image denoising considering median based filtering method to address Gaussian noise. By considering the spatial resolution of the image data, the location of the tumor is subsequently identified. Image quality assessment is performed in terms of signal to noise ratio and other parameters which has yielded improved results in terms of image quality and brain tumor identification process. In further experiments, the spatial and textural features would be identified which could represent more of the brain tumor region.

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