BRAIN TUMOR DETECTION USING WATERSHED ALGORITHM FOR MRI BASED IMAGES

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Abstract: Medical imaging is one of the emerging field and the requirements are always emergent and challenging. MRI based brain medical imaging are used for medical diagnosis since it exhibit the inner portions of the human brain and Brain tumor is the severe life altering diseases. Watershed method is one of the typical used image segmentation technique for brain MRI and primarily useful for gray scale image segmentation applied on mathematical morphology and region detection. This paper demonstrates the improvement in brain MRI segmentation using watershed algorithm along with Detection and extraction of brain tumor from patient's MRI scan images of the brain using MATLAB.

***Index Terms* – Image Segmentation, Watershed, Detection, Extraction, MRI**

I. Introduction

Brain Tumor is hysterical expansion of cancer cells and varied with different characteristics and treatments. It is formed because of abnormal cells created within the brain and Brain Tumor is primarily classified into two types such as Benign tumors and Malignant or Cancerous tumors. Cancerous tumors further divided into two types' primary tumors that start within the brain and secondary tumors, brain metastasis which is spread from somewhere else in the body. In the field of medical, Brain Tumor grows without any control of typical forces, with the advancement of medical imaging; imaging modalities gain significant part in the Brain Tumor assessment and huge impact on patient concern. Last few years, promising imaging modalities are Computed Tomography (CT), XRay, Single-Photon Emission Computed Tomography (SPECT), Ultrasonography, Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), Magneto EncephaloGraphy (MEG), and Electro EncephaloGraphy (EEG).

MR and CT scan images can be used for detection of Brain Tumor and diagnosis of Brain Tumor with reliable algorithms is active research area in medical imaging. In medical diagnosis, segmentation of tissues and structures are key component for medical image analysis and Image segmentation plays significant role in diagnosis of brain diseases using the quantitative analysis of MR images such as measuring accurate size and volume of extracted portion of the medical imaging . Many researchers have proposed algorithms and techniques for segmentation of medical images. Therefore Image Segmentation is the basic procedure used in tumor detection in medical imaging and which partition or divides the medical image into analogous regions with a main aim to make simpler and easier to analyze visually. Medical imaging has many fuzzy factors such as grey scale, region boundary and texture etc, further medical imaging have mass medical data, hence we consider speed and effectiveness of Image Segmentation technique. The central focus of the Brain Tumor segmentation is to split the unusual tumor tissues which is active cells, edema and necrotic core from the ordinary brain tissue. For the recognition of Brain Tumor disease MRI is most popular because of non-invasive imaging and soft tissue contrast of MRI.

Pre-processing of the MR image is the primary step which removes noise and smooths the image. To prevent misclassification of brain tissue and non-brain tissues, skull stripping is done. And, Image Segmentation is carried out using marker controlled watershed segmentation. Then, the tumor region is detected from the segmented image using morphological operation and calculated the tumor region. Finally, the location of the tumor region is determined.

II. Related work :

Hiran and Doshi developed a technique for image enhancing for Brain Tumor detection. Their algorithm was based on Digital Image Segmentation. This algorithm was used to present edge pattern and segment of Brain Tumor through MRI images. Using this technique they were successful in finding the size and region of tumor. They used Pre-processing, Image enhancement, Thresholding and Morphological operation. Color image was obtained and then it was converted into gray for processing. Syed and Narayanan proposed a method for Brain Tumor Detection based on artificial neural network categorized into Multi-layer perceptron neural network. They used segmentation for feature extraction and developed a method to discriminate normal and abnormal tissues from MRI scaned images. It was helpful to doctor to analyze stage of cancer and was less time consuming. For this pupose Preprocessing, Histogram, Binarization, Thresholding, Morphological operation, GLCM based feature extraction and BPN based classifier were used. Viji and JayaKumari developed an effective modified region growing technique. Comparative analyses were made for the normal and the modified region growing using both the Feed Forward Neural Network (FFNN) and Radial Basis Function (RBF) neural network. The results were better than normal technique. Technique was applied on MRI images for tumor detection. For evaluation of the proposed method the sensitivity, specificity and accuracy values were used.

III. Implementation :

The Detection of BRAIN TUMOR includes the following steps:

1. Pre-Processing
2. Watershed Method
3. Morphological Operation.

Step 1 : Pre-processing : In this stage image is improved in the way that better points of interest are enhanced and noise is expelled from the image. Most ordinarily utilized enhancement and noise reduction techniques are conversion to gray scale image and skull stripping. RGB to gray scale: MRI scan may have some RGB content in the image, so it has to be converted into 2d or a gray scale image.

Step 2 : Watershed Method : It is one of the best routines to gathering pixels of a image on the premise of their intensities. Pixels falling under comparative intensities are assembled together. It is a decent segmentation system for separating a image to partition a tumor from the image. Watershed is a numerical morphological working device. Watershed is regularly utilized for checking yield as opposed to utilizing as an information segmentation method on the grounds that it typically experiences over segmentation and under segmentation.

Step 3 : Morphological Operation : The morphological operator is to discrete the tumor part of the image .After applying the morphological operation the tumor segment of the image is visible, which is shown with white color. Tumor region has the highest intensity than the other regions of the image

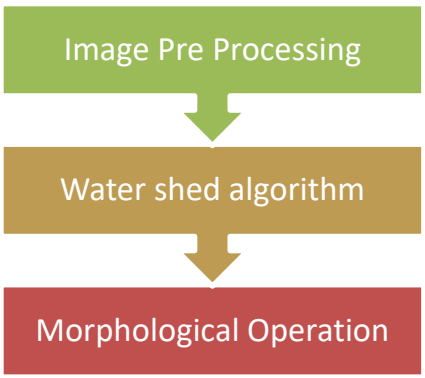

Figure 1 : steps to implement

Watershed algorithm

1. Find the Min and Max pixel value of f(x,y) and Min coordinate is assigned to R_i. The topographywill be flooded in integer flood increments to n=Min+1. The coordinate $C(R_i)$ in the catchment basin associated with Min R_i that are flooded at point n , where

   $J[n]=\{(s,j) \mid f(s,j)<n$ (1)

2. Calculate $C_n(R_i)=C(R_i)\cap J[n]$, $C_n(R_i)=1$ (2)

   If $(x,y) \in C(R_i)$ and $(x,y) \in J[n]$, $C_n(R_i)=1$ at location (x,y); otherwise $C_n(R_i)=0$.Let C[n] represents the union of the flooded catchment basin at point n

   $C[n]=\bigcup_{i=1}^{a} C_n(R_i)$ (3)

   Set n=n+1

3. Obtain the set of connected components in J[n] defined as M. Here three situations for every connected component $m \in M[n]$

   a) If m $\cap$ C[n-1] is empty and m is connected component added to C[n-1] to form C[n] since it dfeins new minimum is come across

   b) If m $\cap$ C[n-1] holds one connected component of C[n-1]to form C[n] since it means m lies with in the catchment basin of some regional minimum

   c) If m $\cap$ C[n-1] hold more than one connected component of C[n-1],it represents all or part of a ridge separating two or catchment .Basin is encountered to find the points of ridges and presented as dam

4. Create C[n] as per equation (2) and (3) set n=n+1
5. Repeat step 3 and 4 until n reaches Max+1 .

Henceforth with the Min and Max pixel value and edges presently the watershed method can recursively recognize the segments in the image

Results :

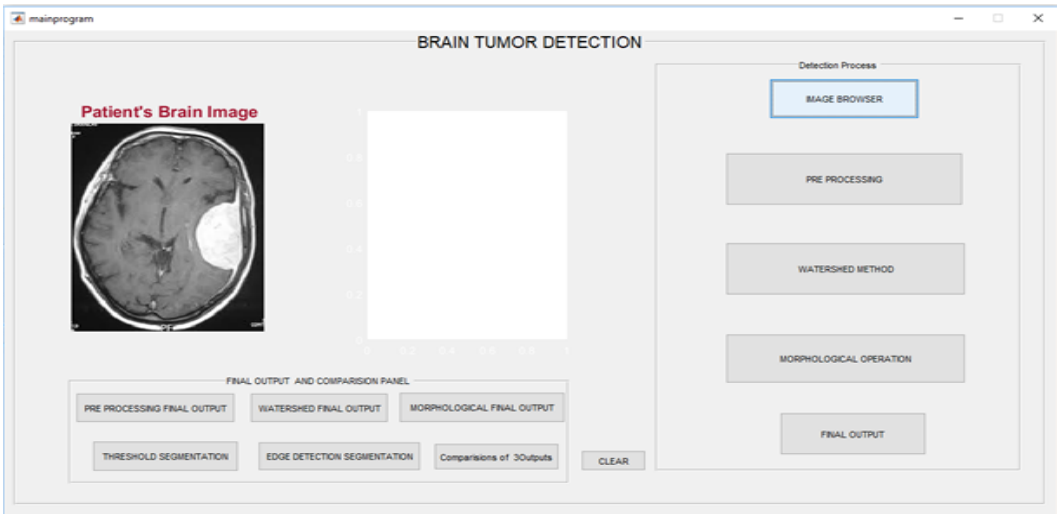

Figure 2.Image Uploading Screen

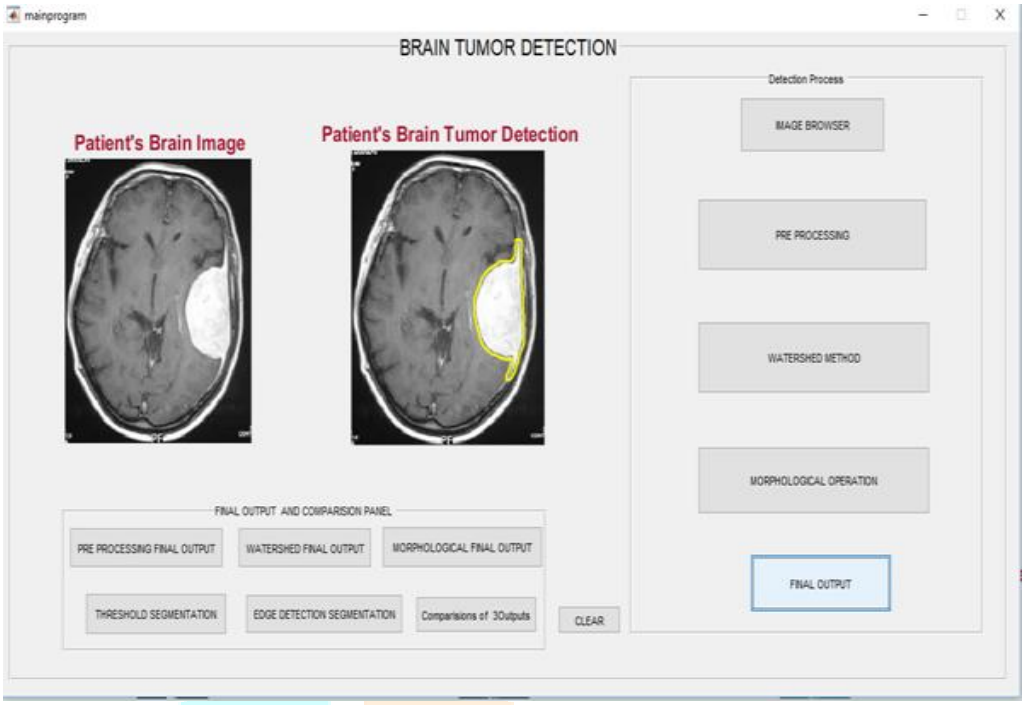

Figure 3 . Brain tumor detection

IV .CONCLUSION

In medical field, the use of computer science plays an important role for analyzing various diseases. Magnetic resonance image (MRI) is a critical part in many researches. So the MRI brain image is used to implement the system. And morphological operation is used to detect the tumor region. It is easy to implement and reasonably fast. In this work, the brain image testing process has been done. This method is given the reliable result for the brain image. If the brain image has the tumor region, the further processing steps are needed to be done. The preprocessing step is important to segment the brain image. After the preprocessing, the brain image is free from noise and this smoothed image is ready to be used in further processing. In this system, a skull stripping based on threshold value has been done. This method is able to remove the skull tissues from the brain image and give the suitable result. And then, marker controlled watershed segmentation has been done. Therefore, the intensity of normal brain tissues and that of tumor region is split up into groups. After segmentation, this resulted image is divided into the normal brain region and the tumor region to get the final segmentation map. After that, the tumor region is detected from the final segmentation map using morphological operation. And the tumor region is calculated according to the equation.

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