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A NEW TOPOLOGY FOR TUMOUR AND EDEMA SEGMENTATION USING ARTIFICIAL NEURAL NETWORK

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ABSTRACT

Brain magnetic resonance (MR) segmentation algorithms are critical to analyze tissues and diagnose edema and tumor in a quantitative way. The primary aim of brain image segmentation is to partition a given brain image into different regions representing anatomical structures. In this paper, we present a new effective segmentation algorithm that segments brain MR images into tumor, edema, white matter (WM), gray matter (GM), and cerebrospinal fluid (CSF). The detection of the healthy tissues and the diseased tissues are performed for examining the change caused by the spread of tumor and edema on healthy tissues is very important for treatment planning. We developed an algorithm for skull stripping before the segmentation process. The segmentation is performed using feed forward backpropogation algorithm.

Keywords: Brain magnetic resonance (MR), Feed forward backpropogation, image segmentation , skull stripping

I. INTRODUCTION

Image segmentation is one of the most important tasks in medical image analysis and is often the first and the most critical step in many Image segmentation is the most important tasks in medical image analysis and is often the first and the most critical step in many clinical applications.Image segmentation is commonly used for measuring and visualizing the brain's anatomical structures, for analyzing brain changes, for pathological regions, and image-guided interventions for surgical planning .In the last few decades, various segmentation techniques of different accuracy and degree of complexity have been developed.

Computerized segmentation algorithms used to analyze and diagnose diseases of the brain by examining tissues and structures in a quantitative manner. However,segmentation of the tumor and edema is a quite difficult task because of the nonhomogeneous intensity distribution, background noise, complex shape,unclear boundaries, and low intensity contrast between adjacent brain tissues.If tumors are glial tumor, segmentation process is more complicated because of the heterogeneous form of the tumor that consists dead and active part.There have been many different techniques proposed for the segmentation of brain MR images due to the inherent difficulty of detection and quantification of the brain tissues.

T.Rajesh et al [1] represents the paper that shows that MRI image given as input & based on Rough Set Theory features are extracted from that image. Then selected features are given to the input of Feed Forward Neural Network classifier . These Feed Forward Neural Network classifier performs two functions, to differentiate between abnormal & normal and to classify that the type of abnormality is malignant or benign.A.Islam et al [2] represents model using MRI for characterizing tumor texture in brain.In this model texture feature extraction and segmentation of brain tumor are performed. For brain tumor texture formulation multiresolution-fractal model is used.The new method for tumor segmentation is proposed by extending the AdaBoost algorithm.

E.E.Ulku et al [3] demonstrate the brain tumor detection using Computer-aided detection i.e. CAD system. The system works based on morphological image processing & histogram equalization techniques. In the last stage of CAD system which is classification.Pavel Dvorak et al [4] represent the technique that determines whether the input MRI image of brain contains a tumor or not. It checks the lef tright symmetry of the brain which is considered as assumption for healthy brain.For testing the implemented algorithm the fivefold cross validation technique is used.

J.Vijay et al [5] describes K-means clustering for the brain tumor detection.The automatic segmentation of brain tumor is done for the extraction of the tumor tissues from the brain. Ishita Maiti et al [6] developed a new method for brain tumor detection using watershed method. In this method color MRI images of brain in HSV color space used. Initially the input RGB image is converted to HSV color image and it separates the image in three regions i.e. saturation, intensity and hue. Watershed algorithm is applied for each region of image contrast enhancement . After that Canny edge detector is applied for output image. The combination of all three images gives the final segmented image.NatarajanP [7] et al represents the technique with three steps i.e.histogram equalization, preprocessing, & segmentation.Preprocessing is done by using sharpening and median filters . Enhancement of image is done by histogram equalization. Image segmentation is done by thresholding . Finally subtraction method is used to obtained tumor region.

II. MATERIALS AND METHODS

2.1 Brain MR Images

It is a method that works on the radio waves and magnetic field to create detailed images of the organs and tissues within our body. MRI is used to visualize brain structures such as white matter, grey matter, and ventricles cerebrospinal fluid and to detect abnormalities. The MRI may be the usually used method for brain tumor growth imaging and location finding. It is really a medical imaging technique used to give the internal structure of the human body and offer high quality images. MRI gives a greater distinctive between different tissues of the body. It is used to improve the grade of diagnosis and treatment of brain.The data were obtained from open sources.

2.2 Preprocessing

In this phase image is enhanced in such a way that noise is removed from the image and finer details are improved.It is done to remove noise and blurring as well as ringing effect in order to get the enhanced and much clear image for our purpose. The intensity range of the images are normalized to [0 1] range by dividing all intensity values to the maximum intensity value.we applied anisotropic diffusion filter to the images as a preprocessing step to improve the signal-to-noise ratio.This fittering is defined as a diffusion process. Edges are preserved and inner parts of the regions are smoothed by estimating local image structure and using edge strengths and the noise degradation statistics.

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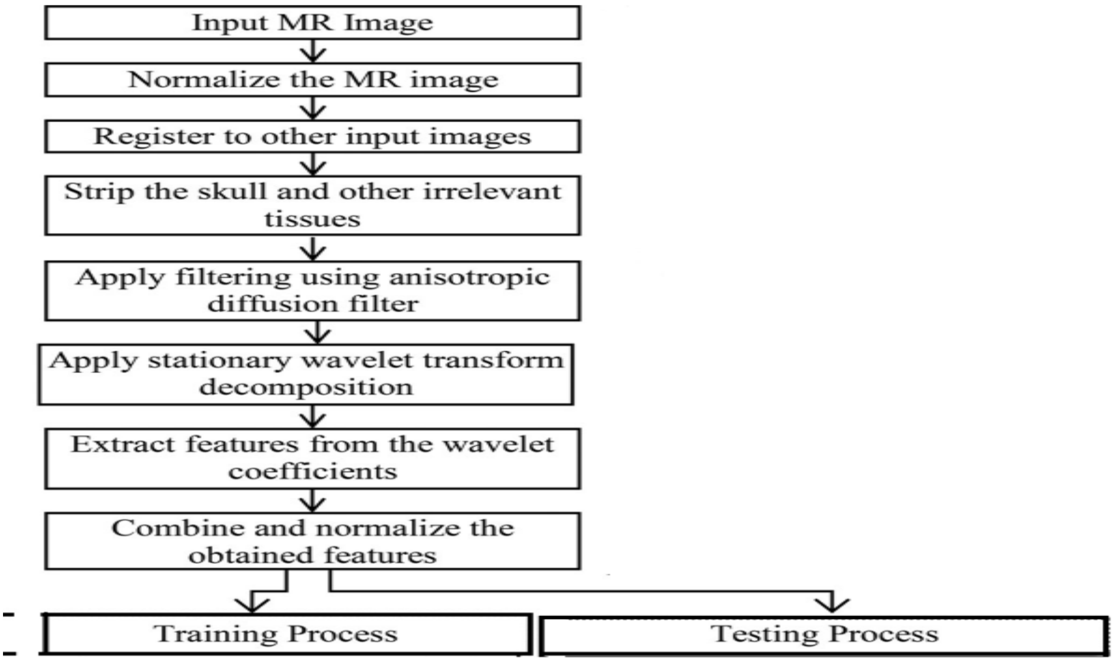

Fig. 1 Flow diagram of the segmentation algorithm.

2.3 Feature Extraction

Stationanary wavelet transforms are utilized to extract features from the MR images inaddition to this geometric and texture features are extracted that will be used as input to the NN. SWT is invariant to translation. Even if the signal is shifted SWT coefficients will not change.In traditional wavelet transform, downsampling, d convolution with a filter is applied to the signal for decomposition.

For representing the characteristics of different frequency channels wavelet coefficients are used. but insufficient in representing textural features alone, since local statistical information is absent. To define the tissues, which have similar second order statistics and brightness, nonlinear spatial filtering techniques are applied to the wavelet coefficients.We exploited four parameters such as entropy, mean absolute deviation, energy and standard deviation as textural features by sliding a 3× 3 filter on the first-level wavelet approximation coefficients obtained using Daubechies (db2) wavelet.Mean absolute deviation represents the regularity of the textures.Entropy gives the randominity of the texture and energy specifies whether the texture is broader, finer, or coarser. Entropy and energy is used to distinguish non homogeneous and homogeneous areas. Standard deviation shows the average contrast.We normalized the feature vector before using it as input to the feed forward backpropagation NN.

2.4 Feed forward back propagation NN

Feed forward back propagation NN artificial neural network model shown in Fig. 2. consists of input, hidden and output layers.For learning these networks back propagation learning algorithm was used. During training this network, calculations were carried out from input layer of network toward output layer, and error values were then propagated to prior layers. Feed forward networks often have one or more hidden layers of sigmoid

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neurons followed by an output layer of linear neurons. Multiple layers of neurons with nonlinear transfer functions allow the network to learn linear and nonlinear relationships between input and output vectors.The output layer should use a sigmoid transfer function ie outputs of a network are between 0 and 1.

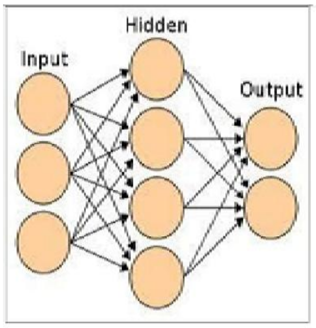

Fig.2 Feed Forward Back propagation Network

III. RESULT AND DISCUSSION

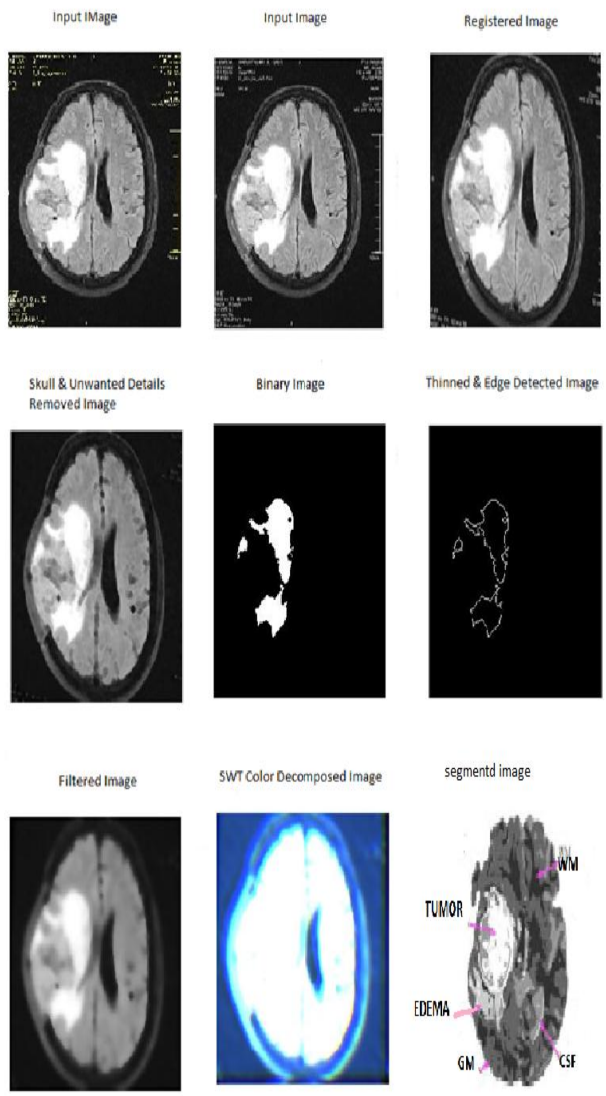

Fig.3 Various stages of segmentation

IV. CONCLUSION

Segmentation based on a backpropagation network(BPN) has been implemented and tested on MR brain images. This new application of BPN results in better segmentation of images. The segmentation helps in detection of tumour in brain MR images. This is primarily due to the additional spatial information that the PCNN is capable of incorporating.A mapping of each segmented region's new pixel intensities to original image intensities shows that the method developed by this research performs more than just simple thresholding.This paper clearly demonstrates that BPN can be used as an effective image analysis tool.In this study, we segmented brain MR images into healthy tissues along with the diseased tissues,tumor, and edema.

We developed an algorithm that combines threshold and morphological operations for skull stripping. We used SWT to decompose images into subbands. We performed spatial filtering methods on these subbands to obtain feature vector ie additional features such as geometric and texture features that will be used as input to the FFBPN. Segmentation operation is performed by a supervised FFBPN.

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