Brain Tumor Detection From MRI Images By Fusion of Region Growing And Edge Detection Algorithms

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Abstract: An abnormal increase in tissues is known as tumor. Brain Tumor is a mass of tissue abnormal in nature which increases uncontrollably in size and multiply irrepressibly not checked by the mechanism that functions for controlling the normal cells. In this proposed system, a brain tumor is to be detected from multiple MRI images. The process involves processing an image through edge detection algorithm i.e Canny Edge Detection. The same image is segmented using Automatic Region Growing Segmentation technique. The two segmented images from edge detection and region growing techniques are processed through fusion of two segmentation results. An image fusion is a process that combines the results from two images of same brain tumor MRI into a single image. The resultant image has more information than the segmentation by respective algorithms alone. The results obtained from the fusion method show the efficiency and performance of proposed fusion approach

Keywords: *Region Growing Segmentation, Edge Detection Segmentation, Morphological Operation, Wavelet Transform Based Image Fusion*

1. Introduction

The last two decades, there has been enormous development in the field of medical science. The progress made in the field of Artificial Intelligence and technologies like computer vision have been successfully transformed in to practices for application in medical like determination and diagnosis of different diseases such as ;cancerous cells or tumors, medical imaging etc. A tumor by definition is a growing mass without having control in its expansion. Due to increasing death cases primarily because of brain tumor, the main focus of research on the latest developments in of tumor in MR images and medical imaging has shifted to diagnosis of tumor in real time with the use of more dependable algorithms, which is currently an active area of search. Detection of tumorous cells from other contents in the image is the core problem being faced in diagnosis systems of medical imaging. The Segmentation i.e process of separation is of most importance when it comes to construction of an efficient, effective and robust diagnostic system. An input image is processed through segmentation, thereby enabling an easy and effective image analysis which leads to better and efficient detection of tumor. Hence, fundamental problem in detection of tumor can be considered as image segmentation. There have been a number of image segmentation methods that have been proposed for the detection of brain tumor in past. Christoph et.al designed a new method for vibrational segmentation due to high diversity in tumor appearance [17]. Jean et al suggested a multi scale image segmentation method using a self- organizing map for brain tumor segmentation [18]. Rajamani et al presented a Neuro Fuzzy technique based algorithm [19]. The most commonly used methods for the diagnosis of brain tumor detection today is image fusion. It overlays and merges images that provides an additional information. In image processing, image fusion is considered as the most suitable solution to many applications in it where very spectral and spatial data is needed out of a single image, more precisely in the image processing field. In 1909 in thesis by A. Haar Wavelet was first employed. Wavelet Transforms is considered as new area of technology that has replaced various technological applications specially image processing, speech recognition and analysis of ECG, DNA, heart rate etc. This paper has used Wavelet based image fusion to increase the brain tumor detection efficiency. The Fourier Transform was weak in analyzing non stationary data whereas Wavelet Transform proved to be better in analyzing the same;. Wavelet Transform allows information as complex as images and speech signals that can be

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decomposed at different scales and positions into basic forms and then those decomposed forms are reconstructed at higher precision. In this paper, the segmented images obtained from Region Growing and Edge Detection Algorithms are processed through Wavelet analyses after image enhancement and removal of noise from the source image.

3. Methodology

Fig.1 shows the stages involved in our proposed research which involves preprocessing of the input MR images. the MRI images cannot be directly fed for processing due to noises such as noise generated because of patient movement while MRI scanning, other external noises etc. Hence the image needs to be preprocessed for efficient tumor detection. In preprocessing the read image is converted into gray level image and resized to suitable size A median filter is then used to remove noise and decrease edge blurring effect. The image now is being ready to be processed using edge detection and region growing algorithms separately.

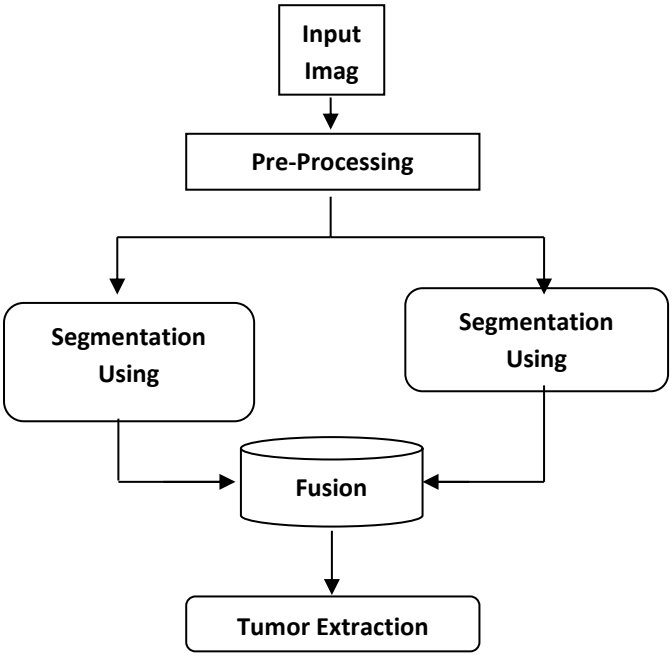

Figure 1: Proposed Methodology

2.1 Morphological Operation

A Morphological operation by definition is a tool that is used to get image components that may be useful in describing shape. Basically there are two operators that are used in morphological operation. (a) Dilation (b) Erosion. In Dilation, objects in an image are grown or thicken. The dilation is performed by function *imdilate*. This growth by the dilation function can be controlled with structuring elements. Matlab toolbox *strel* performs this function by structuring elements with different shapes and sizes etc. Its syntax is

se = strel (shape, parameters)

There are many shapes available using this function i.e disk, octagon etc. A matrix of zeros and ones can also be created that can be used as structuring element. In our proposed algorithm, the structuring element used is "disk" and morphological operator used is *Dilation.*

2.2 Edge Detection Algorithm

Edge Detection is a segmentation method that segments an image in regions of discontinuity. It is a tool in image processing that finds discontinuities in the image and can be effectively used for feature detection and extraction. This method of segmentation has a greater role in image processing. In this paper the input MR image was processed through First order edge detection and the best suitable operator was selected which in our case was Canny Edge Detection. The Edge Detection is divided in to two categories:

- First Order Edge Detection also called Gradient Based Edge Detection
- Second Order Edge Detection also called Laplacian Based Edge Detection

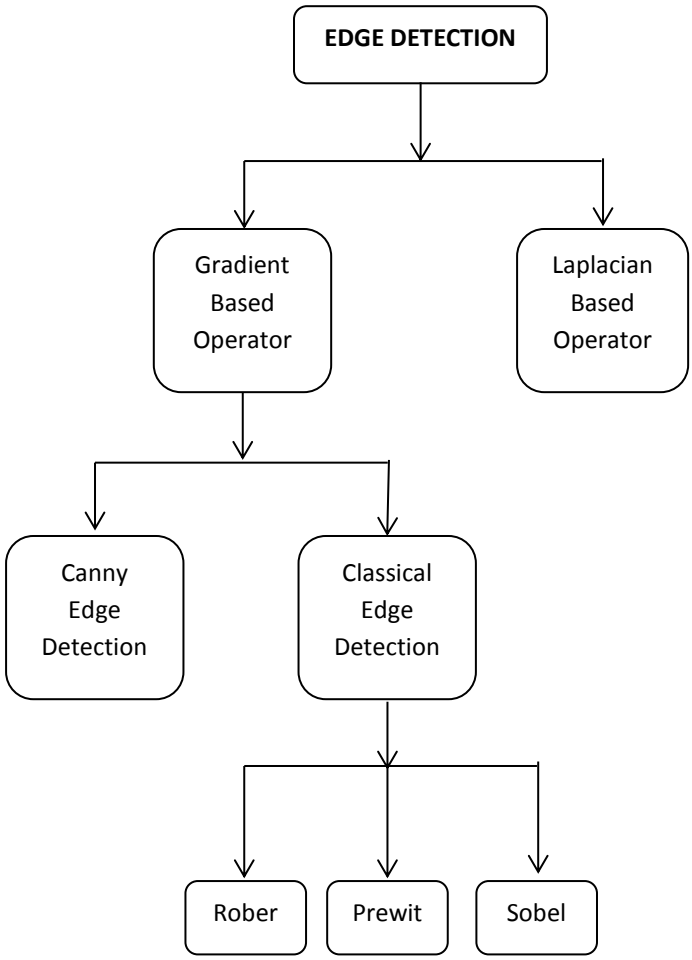

Figure 2: Types Of Edge Detection Operators

The input image was processed through all the gradient based operators first. Analysis was made to find out most suitable operator for edge detection for our brain tumor detection from MR image.

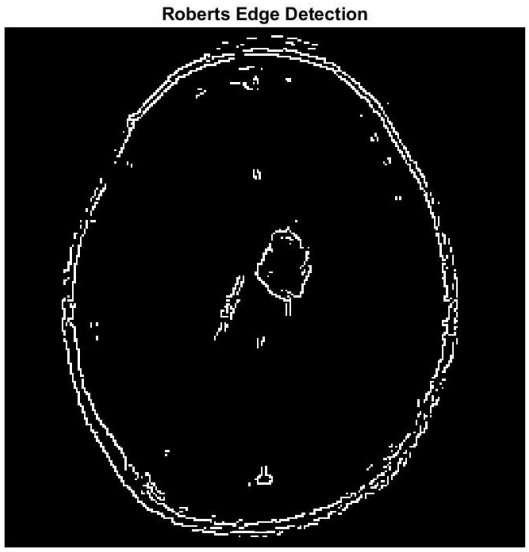

Figure 3 : Roberts Edge Detection

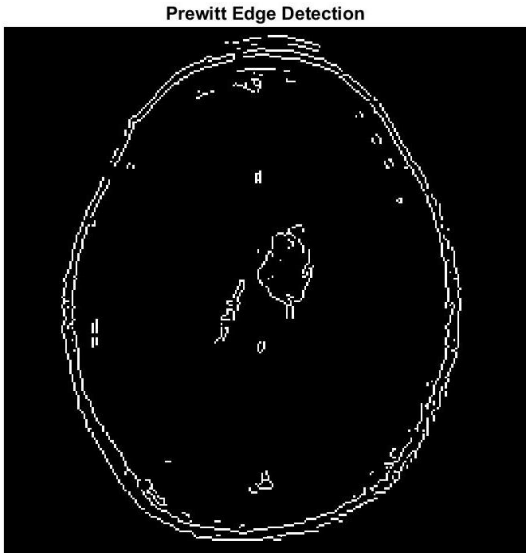

Figure 4: Prewitt Edge Detection

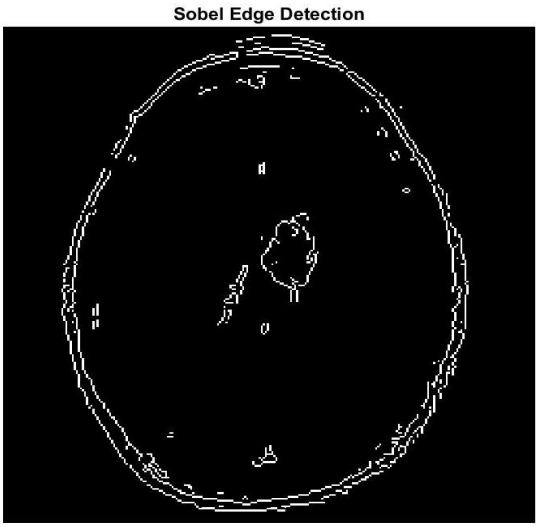

Figure 5 : Sobel Edge Detection

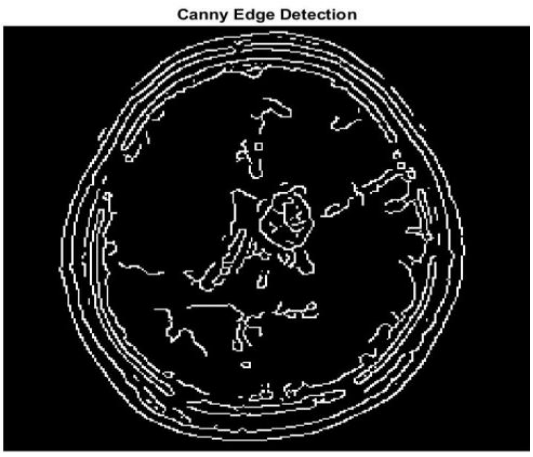

Figure 6:Canny Edge Detection

Upon analyzing the results obtained from the edge detection, it was observed that the edge detection through Canny edge detection is optimum. The canny edge detection removes noise through Gaussian filter and is less sensitive to noise. Hence, depending upon the acquired results of Canny Edge Detection, it was chosen as one of our prime segmentation algorithms for detection of brain tumor as compared to other edge detection operators. The Input image after morphological operation is processed through Canny Edge Detection algorithm

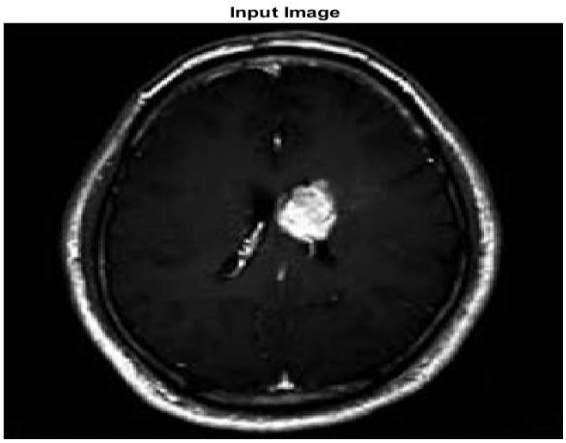

Figure 7: Input MRI Image

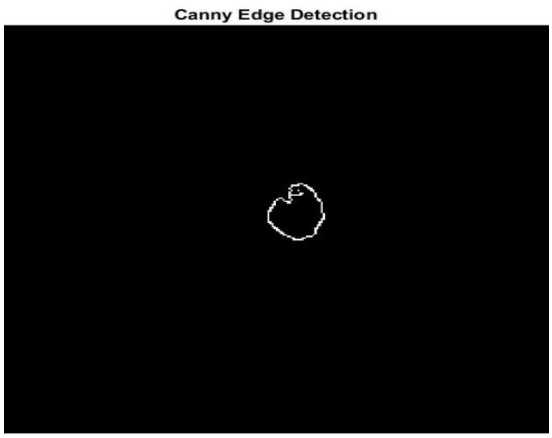

Figure 8: Tumor Detection By Canny

2.3 Region Growing Algorithm

In Region Growing method, pixels with same properties are grouped together based on homogeneity property. In this type of segmentation, initial seed points are selected first. Neighboring pixels of each seed having similar properties to the seed are appended, thus forming a single region. The selection of seeds can be manual as well as automatic. In manual approach, the placement of initial seed is done by the placement of mouse cursor on specific point of interest in the image. From the position of placement of first seed, the region starts to grow until homogeneity is achieved. The automatic selection of seed is done by finding the location of pixels of interest in the image. The function that is used to perform the region growing is :

Region growing (I,x,y,t)

In our proposed method, an automatic segmentation of an MR image is done, by which a tumor is detected without human intervention of placement of seed manually as manual intervention can generate errors and placement of initial seed may not be accurate leading to miscalculation of the tumor from MR image. In this, centroid of the affected region is calculated first so that an automatic seed placement could take place.

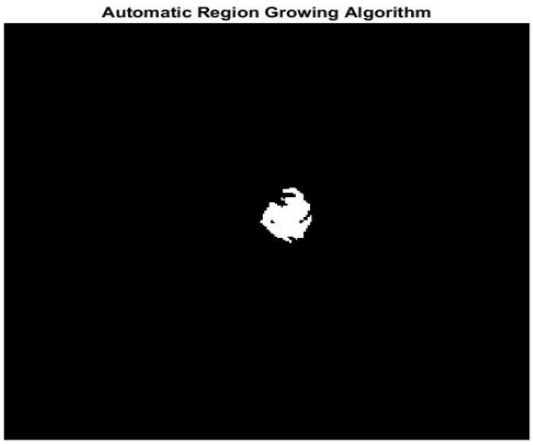

Figure 9: Tumor Detection By Region Growing

2.4 Wavelet Transform based Image Fusion

It is an effective methodology through which different aspects of data can be revealed where other techniques of signal analysis fail. Apart from this, wavelet analysis is good in de-noising and compressing signal without any degradation. Hence, wavelet analysis holds great importance when delicate information is to be processed i.e medical imaging. In this algorithm, the input images are divided and decomposed into sub-images by the use of forward wavelet transform. This decomposition is applied on 2D images and is carried layer by layer resulting four frequencies: (1) Low-Low (2) Low-High (3) High-Low (4) High-High which results in level-1 decomposition. The fused image is extracted by Inverse Wavelet Transform. This fusion method allows us to get better results as compared to other fusion techniques like laplacian based methods. Hence, due to better availability of information due to Wavelet Based resultant image, salient features of input image can be extracted efficiently.

In this paper presented, the performance efficiency of wavelet based image fusion of two segmented images under separate algorithms of Region Growing and Edge Detection is evaluated.

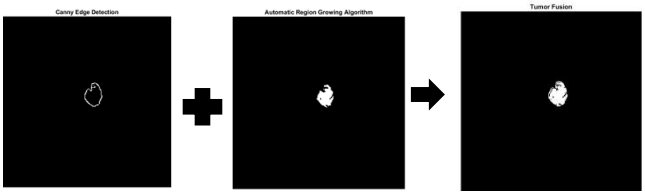

Fig 10: Fusion By Wavelet Transform Method

3. Results and Discussion

In this section the obtained results from detected brain tumor using wavelet based image fusion are discussed and analyzed. These results will enable us to analyze the potential of image fusion algorithm compared to brain tumor detection from Edge Detection and Region Growing Algorithms alone. The tests were done using MATLAB MRI images were obtained from Harvard Medical School (URL:http://med.harvard.edu). A dataset of 200 MRI images was tested on this fusion method. The Wavelet based image fusion was applied on multiple MRI images. The fusion method produced better results compared to the individual results of segmentation and proved to be highly efficient. An input MRI image after preprocessing was segmented using Region Growing and Edge Detection Algorithms. The resultant segmented results were then fused by Wavelet Transform and area of tumor was calculated.

Table 01: Performance Analysis Based On Area Of Tumor

Input MRI Image	**SEGMENTATION METHOD**		
	Region Growing	**Edge Detection**	**Fusion Method**
MRI Image 01	3.6244e+03	3.9713e+03	4.8323e+03
MRI Image 02	5.3604e+03	5.8461e+03	6.8928e+03
MRI Image 03	4.3736e+03	4.8439e+03	5.9388e+03
MRI Image 04	1.0134e+03	1.2966e+03	1.8363e+03
MRI Image 05	976.2500	1.1868e+03	1.7045e+03

MRI Image 06	1.3389e+03	1.5924e+03	2.1973e+03
MRI Image 07	1.7082e+04	2.2899e+04	2.5186e+04
MRI Image 08	162	459.8750	772.7500
MRI Image 09	1.2821e+03	6.9759e+03	5.3913e+03
MRI Image 10	4.6296e+04	5.3320e+04	5.6490e+04

5. Conclusion

In this research work we have created model to detect brain tumor detection based on fusion of two algorithms i.e region growing and edge detection algorithms. The performance of individual segmentation technique is compared with fusion method. Results show that fusion based segmentation holds an edge over direct segmentation in tumor detection

This INVESTIOGATION will be carried out on other image processing and hardware analysis may be analyzed on FPGA upon ARM controllers for functional verification area performance power utilization calculation

This work should be compared with other related works for development of prototypes

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