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Brain Lesion Detection, Analysis and 3D Visualization

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ABSTRACT

Today the best technology which isused for detecting Brain Lesions is Magnetic Resonance Imaging (MRI). This paper presents an analytical method to detect Lesions using MRI images. MRI images (colored/black-white) of Brain will be input to the system. Pre-processing phase is used to convert colored MRI image into grayscale image. Gaussian filter will be used to enhance the image quality by removing noise from it. Then segmentation of image is done. In this, thresholding value of an image is calculated and the image is segmented on the basis of the threshold value. After segmentation, edge detection method (Sobel and Canny) is used to detect the edges and boundaries of an object. Then features like Size, Shape, Location and Volume are extracted. Based on the feature extraction, classification of the lesion is done. Finally, 3D model is constructed.

***Index Terms*:** Brain lesion, Sobel, canny, Pre-processing, Image segmentation, 3D visualization.

1. INTRODUCTION

A Recentstudy shows that the rise of brain lesion patients outnumbered than the normal. It is hard to identify the lesion in the early stage and once identified the treatment can be done and can be cured with techniques like chemotherapy. But certainly, late detection of the lesion is deadly and it is a kind of disease in which symptoms are identified late. Computer-assisted technology plays a vital role in the detection of lesion these days like used in Neurosurgery [1].

A brain lesion results from abnormal growth of cell within the brain. They can even appear after injury or surgery to the skull. There are two types of lesion: malignant and benign lesion. The malignant lesion is cancerous. It starts from the lower body and spreads throughout the body. In benign lesions, cells do not spread to another part of the body and it is non-cancerous.

Analysis of Brain Lesions is done by doctors but the result varies from one doctor to another doctor. Therefore many computer based software have been developed to detect the brain Lesion. But they are time-consuming and are less accurate. The system describes a better and authentic approach to detect brain Lesions so that human errors can be eliminated.

2. LITERATURE SURVEY

Brain lesion detection and segmentation takes a lot of experience and image analytical knowledge. In most of the medical institution detection and segmentation of the brain lesion is done manually thus it is time-consuming and less accurate. To reduce these many computer aided brain lesion segmentation methods were proposed.

Ayse Demirhan Mustafa Toru and Inan Guler (2015) [1] presented an efficient region-based image segmentation using self-organizing map (SOM). But the determination of the correct number of regions in

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the segmented image is not possible with SOM. N. Nandha Gopal, Dr. M. Kaman (2010) [4]has discussed Diagnose brain lesion through MRI using image processing clustering algorithm such as Fuzzy C-Means Along with intelligent optimization techniques. The disadvantage of this method is it consider only image intensity values and poor in the case of time complexity.

Priyanka, Balwinder Singh (2013) [6] presented edge-based segmentation. Due to the presence of broken, stray or noise edges result of segmentation from edge based method cannot be used as partially segmented output. To obtain edge based corresponding to meaningful objects advanced processing is required.

Phooi Yee Lau, Frank C. T. Voon and Shinji Ozawa (2005) [7] which makes use of multi-parameter MRI analysis but lesion cannot be segmented in 3D unless and until we have 3D MRI image data set .So, Relatively simple method for detection of brain lesion is presented.

Ehab F. Esraa Galal Mahmoud and Nader Hamdy (2010) [10]presented Neural Network classification technique. Neural Network based brain lesion detection gives a better result, but due to training and testing phase time complexity is poor.

3. PROPOSED SYSTEM

We present an analytical method to detect Lesions using MRI images.MRI images of different layers of Brain will be input to the system. Pre-processing phase is used to convert a color image into grayscale image and remove all the noise present in the scanned MR image in order to enhance the image quality. Gaussian filter is applied to enhance the image quality. After preprocessing there is image segmentation. In this thresholding value of an image are calculated and edge detection method is used to detect the boundaries

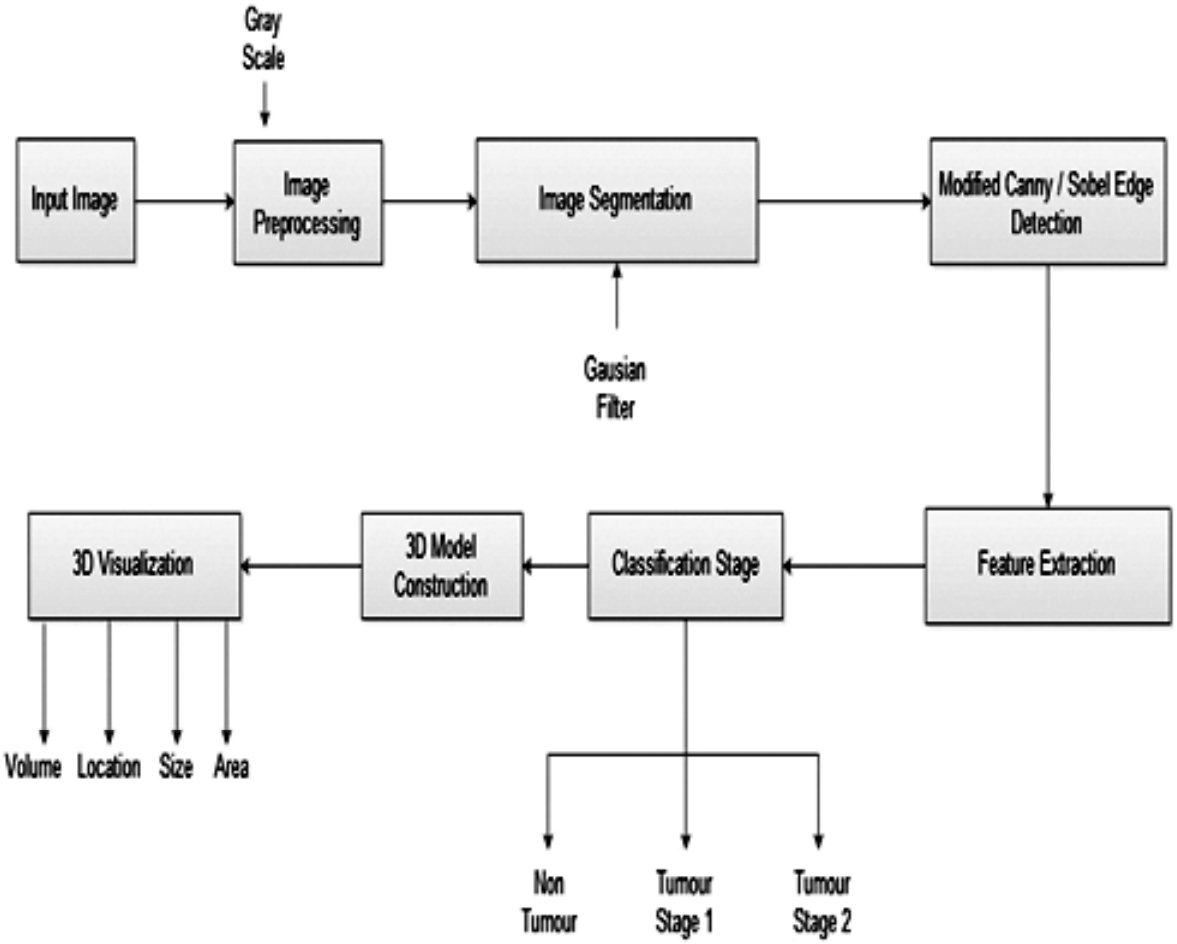


Figure 1: Architecture of Brain Lesion Detection

of an image. Comparison of Sobel and Canny edge detection method is done and we will modify Sobel or Canny edge detection method which can detect the tumor efficiently and provide more accurate results than the existing system. Performance factors like accuracy and speed are analyzed. Based on the feature extraction we will do classification on the tumor stage. In the final step,3D model is constructed.

3.1. MRI Image

MRI is one type of scanning device that uses amagnetic field and radio waves. The system will take the MRI images(black-white/color) of size 256×256 of .png or .jpeg format. The coloredimage will be converted into grayscale images.

3.2. Image preprocessing

Here conversion of RGB image into grayscale is done. Image preprocessing includes noise removal and image sharpening.

Gaussian filter is used to reduce noise and unwanted details and textures.

$$g(m, n) = G_{\sigma}(m, n) * f(m, n)$$

Where,

$$G_{\sigma} = \frac{1}{\sqrt{2}\pi\sigma^2} \exp\left(-\frac{m^2 + n^2}{2\sigma^2} \right)$$

3.2.1. Image segmentation

Image segmentation divides the image into segments. There are many different ways to perform image segmentation but our system uses threshold and edge detection method.

3.3. Threshold

The threshold is one of the steps of image segmentation. It takes filtered image as input. It provides an easy and the most convenient way to separate the foreground and background of the image. We set the certain threshold value. The pixels which are having intensity value more then the threshold is set as white and rest are assigned as black.

3.4. Edge detection methods

It is one of the most vital part of the system. It is used for finding the boundaries of objects. This method divides an image on the basis of boundaries.

Methods likeSobel, Prewitt, Roberts and Canny are some popular edge detection method. In this paper, we make a comparison between Sobel and Canny edge detection method and also we have modified Sobel edge detection method which can detect the lesion efficiently and provide a more accurate result.

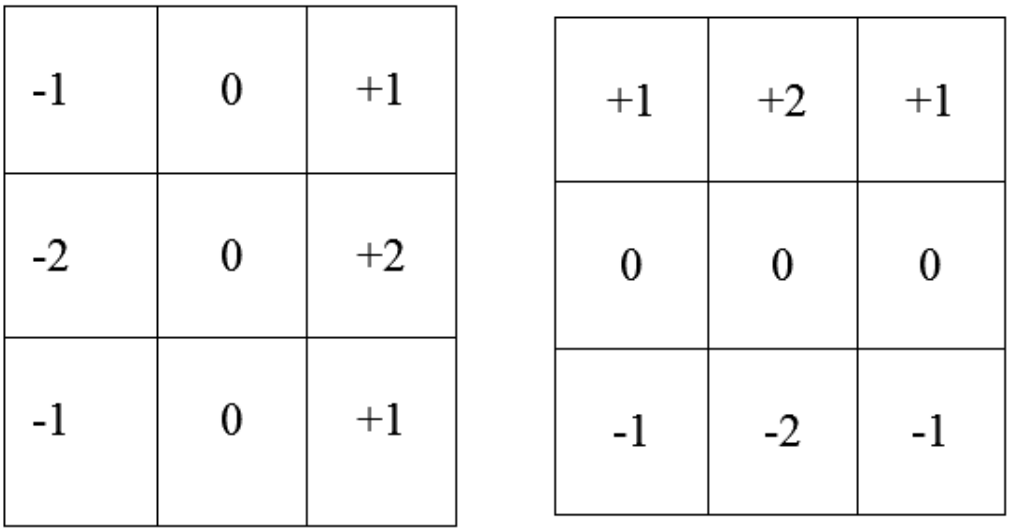
3.4.1. Sobel edge Detection

Sobel operator is used to detecting two kinds of edges in an image:

- Vertical direction
- Horizontal direction

In Sobel operator, the coefficient of the mask is not fixed and it can be adjusted according to our requirement unless it does not violate any property of derivative masks.

The Sobel operator consists of a pair of 3×3 convolution kernels .Convolution kernel masks estimating the gradient in the x and y-direction.



Gx **Gy**

Figure 2: Sobel Mask

The convolutionmask is appliedto the input image.Then gradient component is obtained in both x and y-direction. Then both are combined to find out the magnitude of the gradient.

The magnitude of gradient is calculated by,

$$|G| = \left(Gx^2 + Gy^2\right)^{1/2}$$

$\theta = \arctan(Gy/Gx)$

Where, θ = angle of orientation

3.4.2. Canny edge Detection

Canny edge detector applies Gaussian filter to smooth the image in order toremove the noise and compute the gradient magnitude using a derivative mask. Applying-maxima suppression to the gradient magnitude and detect edges by a double threshold.

3.5. Feature extraction

Feature extraction is done to reduce the dimensions of an image. Features like Size, Shape, Location and Volume are extracted. Extracted features are represented in the feature vector.

3.6. Classification

After feature extraction, classification of brain lesion in thestage is done. To classify tumor stages we are using different classification stages such as Non-tumor, tumor stage 1 and tumor stage 2.

3.7. Model Construction and Visualization

For better localization of the Lesion in brain 3D Model is constructed. To gain a better insight of lesion, the 3-dimensional display is preferred over the 2-dimensional display. Hence to visualize the lesion properly 2D MR image is converted into a 3D image. Marching cube algorithm is used for constructing 3D model.

After 3D model construction, next step is to visualize it. Therefore, for visualizing purpose, software named "processing" is used. In processing software, Phong lighting model is applied on the surface of 3D model to give area effect.

4. CONCLUSION

The system detects brain lesion using image processing techniques. The system detects and analyzes the correct size, shape, location and volume oflesion in MR image. The Brain Lesion will not only be analyzed but also 3D visualized for the better localization.

REFERENCES

[1] Ayse Demirhan, Mustafa Toru and Inan Guler,"Segmentation of Lesion and Edema Along With Healthy Tissues of Brain Using Wavelets and Neural Networks", IEEE Journal of Biomedical and Health Informatics, vol. 19, no. 4, pp. 1451-1457, July 201).

[2] Atiq Islam, Syed M. S. Reza, and Khan M. Iftekharuddin , "Multifractal Texture Estimation for Detection and Segmentation of Brain Tumor", IEEE Transaction on Biomedical Engineering vol. 60, no. 11, pp. 3204-3215, November 201).

[3] Dr. M. Karnan, K. Selvanayaki , "Improved Implementation of Brain MR Image Segmentation Using Meta-Heuristic Algorithm", IEEE, 2010.

[4] N. Nanda Gopal, Dr. M. Karnan, "Diagnose Brain TumorThrough MRI Using Image Processing Clustering Algorithms Such As Fuzzy C-Means Along With Intelligent Optimization Techniques", IEEE, 2010.

[5] Nandita Pradhan, A.K. Sinha, "Intelligent Computing for the Analysis of Brain Magnetic Resonance Images", IEEE First International conference on Integrated intelligent Computing, 2010.

[6] Priyanka, Balwinder Singh, "A REVIEW ON BRAIN TUMOR DETECTION USING SEGMENTATION", IJCSMC (International Journal of Computer Science and Mobile Computing), Vol. 2, Issue 7, July 2013.

[7] Phooi Yee Lau, Frank C. T. Voonand Shinji Ozawa, "The Detection and visualization of brain Tumor on T2-weighted MRI images using multiparameter feature blocks", IEEE , (2005).

[8] Sushma Laxman Wakchaure, Ganesh Dynadev Gauge, Dyandev S. Muscle , "The Detection and Visualization of Brain Tumor on T2-weighted MRI Image Using Multiparameter Feature Blocks, International Journal of Emerging Technology and advanced Engineering", Vol. 4, Issue 2, (2014).

[9] Simran Arora, Gurjit Singh, "A Study of Brain Tumor Detection Techniques", IJARCSSE (International Journal of Advanced Research in Computer Science and Software Engineering), vol. 5, Issue 5, 2015.

[10] Ehab F. Badran, EsraaGalal Mahmoud, and Nander Hamdy , "An Algorithm for Detecting BrainTumor in MRI Images", IEEE, 2010.