A REVIEW ON EDGE DETECTION TECHNIQUES FOR MR IMAGE ANALYSIS

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Abstract-A new era of evaluation techniques and application procedures in various different fields is greatly envisioned by the advancements in the field of image processing. Image processing has been evolved basically to achieve better interpretation of images by human and for data storage, analysis and transfer. In that, Edge Detection is one of the most important and commonly used operations in image analysis and computer vision and there are probably many image processing algorithms for detecting edges. In this paper, various edge detectors like Canny, Sobel, Roberts, Log and Prewitt are compared and analyzed so as to detect the presence of tumor in MRI brain tumor images as accurately as possible.

***Keywords*: Edge Detection, MRI brain tumor image**

I. INTRODUCTION

An important process to be carried out during segmentation and detection of the tumor in MRI images is analysis of edges of the tumor. The inner details inside the body obtained in different planes is clearly provided by the MRI in such a way that it can be diagnosed properly for the detection of tumor. MRI approach is considered to be best suitable for the analysis and detection of tumor since the disease can be localized and its characteristics can be evaluated at an early stage[1]. Edge is the basic feature of an image as it forms the outline of an object. Through edge detection, the discontinuitiesin depth, discontinuities in surface orientation, changes in material properties and variations in scene illumination can be found with ease[2]. Hence, the proper edges of the tumor with free from noise can be obtained which later helps for the segmentation analysis for separating the tumor part.

II. REVIEW ON EDGE DETECTION TECHNIQUES

[1] This paper explains clearly about an investigation on different edge algorithms and also made an attempt to hybrid the existing edge algorithms to detect the boundaries more accurately and based on the time complexity, area of the tumor in pixels, PSNR and MSE, the comparison is done .

[2] This work clearly explains about a new approach to MRI edge detection which includes three stages. Firstly, using the Semi Translation Invariant Contourlet Transform (STICT) to improve quality of the original MRI. Secondly, the result of first stage is subjected to image segmentation by using Fuzzy C Means (FCM) clustering method and finally, canny edge detection method was applied to detect the fine edges and concluded that the proposed method is better than the other recent methods based on compared results.

[3]This proposed work explains about an algorithm comparing different brain tumor detection techniques in which the BrainMRI images were preprocessed using local binary pattern and segmented using different techniques like K-means, edge detection and Morphological operations like erosion and dilation. Further all these techniques were combined and observed for the segmentation results and concluded that the dimensionality reduction was achieved by using K-means algorithm.

[4] This paper discusses about an Improved version of Edge Detection algorithm for brain-tumor segmentation based on Sobel edge detection by combining the Sobel method with image dependent thresholding method, and different regions are found using closed contour algorithm. Finally tumors are extracted from the image using intensity information within the closed contours by implementing in C and its performance was measured objectively as well as subjectively which showed that the proposed algorithm gives superior performance over conventional segmentation methods.

[5]This work explains about an overview of the kernel based methods such as sobel, robert's cross, prewitt's operator and soft computing based methods such as fuzzy based approach, genetic algorithm based approach and neural network based approach along with the background required to understand the concept of edge detection methods.

[6] This paper explains about an edge detection method that computes image edges using the concept of Center of Mass with Sobel Operator (COM-SOBEL) which can be used as a template for multi-scale image edge detectors and also compared the proposed method with conventional Sobel operator.

[7] They discuss clearly about the presented contour detection using per-pixel classifications of edge point. An instructive feature vector for every pixel was extorted using convolutional neural networks (CNNs) and an SVM classifier was used to complete contour detection.

[8] The proposed workproposed a comparative analysis of existing edge detection algorithms such as the Sobel, Prewitt, Canny and the Laplacian and was found that the
performance of canny edge detection algorithm is better than other method with lesser number of detected false edges. However, false and broken edges cannot be suppressed using these techniques.

[9] The proposed work is an extension of the Sobel edge detection algorithm for image edge detection process which considers a 3x3 convolution kernel on an image and then the kernel was extended to a 5x5 convolution kernel. However, the gradient approximation produced by it was inaccurate and thus concluded that false, broken and thick edges exist in the output image.

[10]The proposed work is an advanced version of the canny edge detection algorithm to operate on color images based on quaternion weighted average filter (QWAF) with a sliding window of 9x9 to suppress the Gaussian noise present in the image, and non-maximum suppression (NMS) which is based on interpolation for edge thinning and vector analysis to deal with the weakness of the traditional canny edge detection. The Sobel
operator was used to calculate the gradient of the image. The overall performance of the algorithm is very much depended on the size
of the sliding window which leads to the more blurring and thicker edges. The outline of broken and false edges were reduced using this algorithm but the computation time is more due to the sliding window.

III. EDGE DETECTION TECHNIQUES

Edge detection is a process of identifying and locating sharp discontinuities in an image by sharp changes in color intensity (or brightness) of an image[3].

Sobel Operator:
The operator consists of a pair of 3×3 convolution kernels where one kernel is stationary and the other is rotated by 90°. These kernels respond maximally to edges running vertically and horizontally relative to the pixel grid, one kernel for each of the two perpendicular orientations.

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

Figure 1 Masks used for Sobel Operator

The gradient magnitude is given by:
$|G| = Gx^2 + Gy^2$

An approximate magnitude is computed using:
$|G| = |Gx| + |Gy|$ which is much faster to compute.

The angle of orientation of the edge which is relative to the pixel grid
giving rise to the spatial gradient is given by:

θ = arctan (Gy/Gx)

Robert's Cross Operator:
The Robert's Cross operator computes 2-D spatial gradient measurement on an image. The estimated absolute magnitude of the spatial gradient of the input image at a point is represented by pixel values at each point in the output .The operator consists of a pair of 2×2 convolution which is very similar to the
sobel operator.

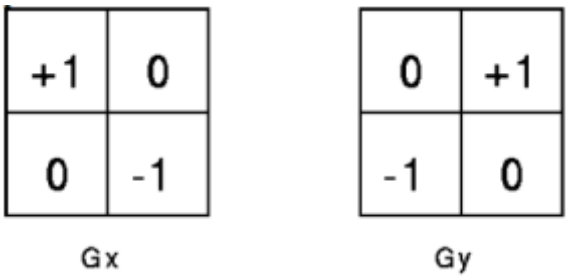

Figure 2 Masks used for Robert's operator

The gradient magnitude is given by:
$|G| = Gx^2 + Gy^2$

An approximate magnitude is computed using:
$|G| = |Gx| + |Gy|$ which is much faster to compute.
The angle of orientation of the edge giving rise to the spatial gradient is given by:

$\theta = \arctan(Gy/Gx) - 3\pi/4$

Prewitt's Operator:
The Prewitt's operator is used for detecting vertical and horizontal edges in images.

$$G_x = \begin{pmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{pmatrix} \quad G_y = \begin{pmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{pmatrix}$$

Figure 3 Masks used for Prewitt's Operator

Canny Operator:
Based on an one-dimensional continuous domain model of a step edge of amplitudes plus additive white Gaussian noise with standard deviation σn. It is assumed that edge detection is performed by convolving a one-dimensional continuous domain noisy edge signal f(x) with an anti-symmetric impulse response function h(x), which is of zero amplitude outside the range [-W,W]. An edge is marked at the local maximum of the convolved gradient,

$$f(x) \circledast h(x)$$

Laplacian Of Gaussian (LOG):
The Laplacian is a 2-D isotropic measure of the 2nd spatial derivative of an image. The regions of rapid intensity change is highlighted and hence often used for edge detection. The Laplacian is often applied to
an image that has first been smoothed with something approximating a Gaussian Smoothing filter in order to
reduce its sensitivity to noise. It takes
a single gray level image as input and produces another gray level image as output. The Laplacian *L(x,y)* of an
image with pixel intensity values *I(x,y)* is given by:

$$\mathbf{L(x,y)} = \frac{\partial^2 I}{\partial x^2} + \frac{\partial^2 I}{\partial y^2}$$

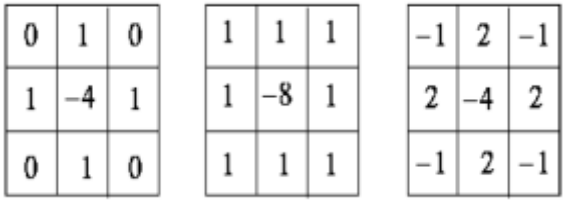

Figure 4 Masks used for Log operator

IV. CONCLUSION

Edge detected image helps doctors during diagnosis. Therefore, edge detection techniques must be high. This paper describes various edge detection techniques and it has been found that Canny operator provides better results in obtaining the edges of the tumor region in MRI brain images.

REFERENCES

[1] Akshath M J and H. S. Sheshadri.2017.Hybrid edge detection techniques for MR image analysis.*International Research Journal of Advanced Engineering and Science*, Volume 2, Issue 1, pp. 79-83.

[2] Nguyen Mong Hien, Nguyen Thanh Binh, and Ngo Quoe Viet .2017.Edge Detection based on Fuzzy C Means in Medical Image Processing System. *International Conference on System Science and Engineering (ICSSE),* 978-1-5386-3422.

[3] D. Haritha,Comparative study on Brain tumor detection Techniques.2016.*International conference on Signal Processing, Communication, Power and Embedded System (SCOPES)*, 978-1-5090-4620.

[4] Asra Aslam, Ekram Khan, M.M. Sufyan Beg.2015.Improved Edge Detection Algorithm for Brain Tumor Segmentation.*Second International Symposium on Computer Vision and the Internet (VisionNet'15),*Procedia Computer Science 58 430 – 437.

[5] Dr. Krishna Raj, Pragya Gautam , Kapil Dev Tiwari , Vipul Goel.2017.A Review Paper: On Various Edge Detection Techniques.*International Journal for Research in Applied Science & Engineering Technology (IJRASET)*,ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887,Volume 5 Issue VIII.

[6] Jena, Kalyan Kumar.2015.Application of COM-SOBEL operator for edge detection of images.IJISET, Engineering & Technology 2.4 : 48-51

[7] J.-J. Hwang and T.-L. Liu.2015.Pixel-wise deep learning for contour detection. In ICLR.

[8] Katiyar, & Arun.(2014).Comparative analysis of common edge detection techniques in context of object extraction". IEEE Transactions of Geoscience and Remote Sensing, 50(11), pp.68-79.

[9] Gupta S., & Mazumdar S. G. (2013).Sobel edge detection