EDGE DETECTION FOR BRAIN TUMOR PATTERN RECOGNITION

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Abstract – Brain tumor diagnosis is done by doctors. For detecting brain tumor grading always gives different conclusion between one doctor to another. For helping doctors diagnose brain tumor grading, this research made a software with edge detections method , so it could give edge pattern of brain and brain tumor itself. Edge detection of brain tumor in this research is the first step for brain tumor grading research. This research found the best edge detection method for brain tumor detecting between Robert, Prewitt, and Sobel method. From these three methods, Sobel method is suitable with case of brain tumors detecting. Sobel method had smaller deviation standard value than two others edge detection method.

Key word : edge detection, brain tumor, deviation standard

INTRODUCTION

Brain tumor diagnosis is done by doctors. Brain tumor image is resulted by MRI (Magnetic Resonance Imaging). MRIs use radio frequency and magnetic field to result image's human body without ionize radiation.

Imaging plays a central role in the diagnosis of brain tumors. On MRI, they appear either hypo (darker than brain tissue) or isointense (same intensity as brain tissue) on T1 – weighted scans, or hyperintense (brighter than brain tissue) on T2 – weighted MRI.

In medical, doctors don't have method that can be used for brain tumor detection standardization. It is still different conclusion between one doctor to another (from reference [3]). For helping doctors in this case, next research try to make a software that can detect brain tumor grading.

Before going to brain tumor grading detection, this research did image processing first. This image processing consist of image enhancement using histogram equalization and edge detection process to take edge pattern of brain tumors, so the process of making computer aided diagnosis for brain tumor grading will be easier. This research used three methods of edge detection, there are Robert, Prewitt, and Sobel. Then take the best method that already and give good result for edge pattern tumors.

METHOD

Image processing in this research is already done with these steps :

a. Grayscale

This step changes color image to grayscale image. The objective is to simply image mode. Image formerly has three matrix of layers, there are Red layer, Green layer, Blue layer. With grayscale method, image has only one value gray image by finding the mean of r, g, and b value using equation (1).

$$K_0 = \frac{R_i + G_i + B_i}{3} \qquad (1)$$

b. Histogram

Histogram is the function to find the sum of grayscale appearance. This step improves image quality in the histogram process. Histogram equalization distributed the value of grayscale, so histogram equalization needs cumulative distributed function.

c. Edge Detection

1. Robert Method

Robert method uses Kernel Filter like equation 2.

1	0
0	-1

(a)

0	1
-1	0

(b)

2. (a) Robert operator for diagonal 1
2. (b) Robert operator for diagonal 2 [2]

2. Prewitt Method

Prewitt method uses differentiation of values between neighbor points that's taken for making edge image with size mask 3x3. Focus point is in the center of mask. Prewitt operator consists of 2 masks to detect edge in horizontal and vertical direction (equation 3).

-1	0	1
-1	0	1
-1	0	1

(a)

-1	-1	-1
0	0	0
1	1	1

(b)

3. (a) operator Prewitt horisontal
3. (b) operator Prewitt vertikal [2]

3. Sobel Method

Sobel repaired Prewitt operator with giving values twice from Prewitt values. In middle raw for horizontal direction and middle column for vertical direction with assumption middle raw and column give contribution higher than another raw and column. Kernel filter for Sobel operator in equation 4.

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

(a)

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

(b)

4. (a) operator Prewitt horisontal
4. (b) operator Prewitt vertikal [3]

RESULT

This research used data of 13 patients consist of 8 patients have brain tumor and 4 patients are normal. The size of brain image that be detected is 185x185 pixels.

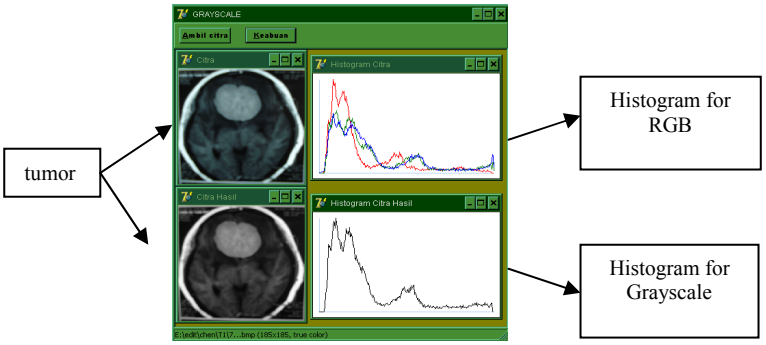
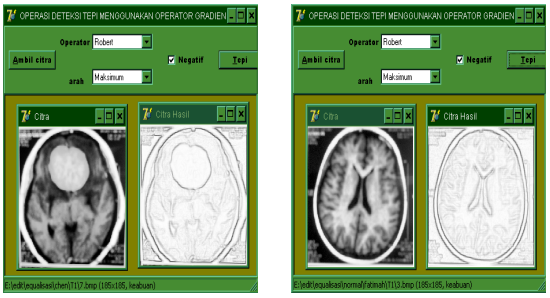


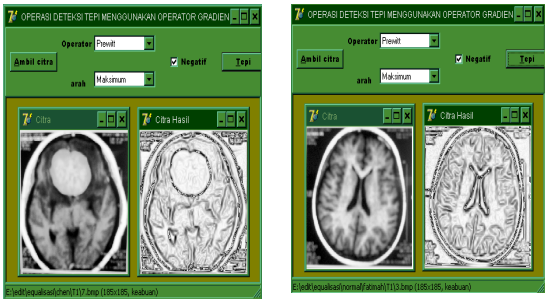
Fig 1. Brain tumor image and its histogram

The results of edge detection are in the figure 2 up to figure 4.



(a) (b)

Fig 2. Image with Robert operator
(a) Brain tumor (b) Normal



(a) (b)

Fig 3. Image with Prewitt operator
(a) Brain tumor (b) Normal

(a) (b)

Fig 4. Image with Sobel operator
(a) Brain tumor (b) Normal

After edge detection process, can be known about histogram distribution in figure 5, 6, and 7. From this histogram has been got deviation standard values for each image like table 1 and 2.

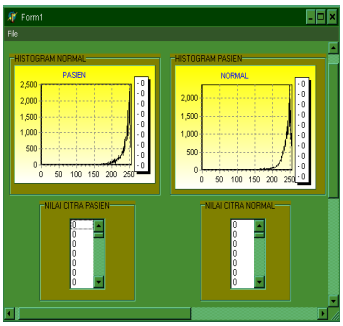


Fig 5. Histogram for Robert operator

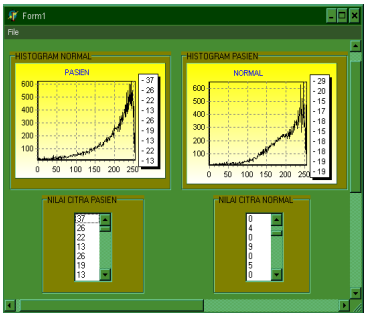


Fig 6. Histogram for Prewitt operator

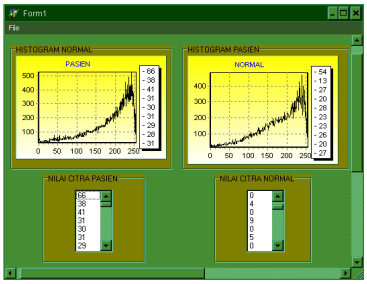


Fig 7. Histogram for Sobel operator

Table 1. Mean and Deviation Standard Result for Normal Brain

PASIEN	OPRT. ROBERT		OPERT.PREWITT		OPERT.SOBEL	
	standart dev.		standart dev.		standart dev.	
	T1	T2	T1	T2	T1	T2
1	43.261	43.242	20.67	20.754	17.745	17.547
2	38.773	43.397	17.879	19.667	15.389	16.747
3	15.147	41.576	17.836	18.917	15.147	16.391
4	40.969	42.240	19.094	19.45	16.352	16.740
5	42.868	45.978	19.951	22.343	17.167	19.227
6	38.829	45.978	17.635	21.279	15.231	18.388
7	42.370	43.925	20.446	21.279	17.671	18.382
8	39.050	41.552	18.335	19.507	15.700	16.434
9	40.816	42.846	19.258	19.507	16.631	16.886

Table 2. Mean and Deviation Standard Result for Brain with Tumor

PASIEN	OPRT. ROBERT		OPERT.PREWITT		OPERT.SOBEL	
	standart dev.		standart dev.		standart dev.	
	T1	T2	T1	T2	T1	T2
1	40.916	41.617	18.778	18.77	16.109	16.467
2	39.59	39.701	17.824	17.885	15.143	15.374
3	38.819	39.075	17.674	17.652	15.288	15.267
4	39.479	39.51	17.782	18.438	15.078	16.105

From those results, know about best image from edge detection process. Sobel operator give best image performance with good pattern of brain tumor and from table 1 and 2 Sobel operator has standard deviation values lower than others, there are T1 = 176.759 ± 16.337; T2 = 181.163 ± 17.418 for images with brain tumor and T1 = 173.946 ± 15.405; T2 = 172,552 ± 15.803 for normal brain images.

CONCLUSION

1. From the three methods edge detection, Robert, Prewitt, and Sobel, Sobel method is more suitable for edge detection of brain tumor because it has a little mean and standard deviation value.
2. Sobel operator gives good performance image, with edge line between brain tissues and tumor tissues are sharper than other three methods edge detection.

ACKNOWLEDGEMNTS

We would like to thank to our goverment that provided us with Research Grant from Departement Physics PHK A2.

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