

IMAGE ENHANCEMENT SEGMENTATION AND EDGE DETECTION IN MRI

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IMAGE ENHANCEMENT SEGMENTATION AND EDGE DETECTION IN MRI FOR MAMMOGRAM DISEASE

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Abstract-Magnetic resonance imaging (MRI) is a medical imaging technique used in radiology to visualize internal structures in detail. MRI technology is excellent for identifying cancers, in identifying breast cancer, usually doctors or radiologists analyse images of magnetic resonance stored in Digital Imaging Communication in Medicine (DICOM) format. It takes expertise and experience enough for the diagnosis given precisely and accurately, so that handling can be done visually. Image segmentation is intended to get the objects contained within the image and separate it from the background, while the edge detection is done to obtain the edges of the object. However, edge detection results are sometimes still not maximal therefore after edge detection is done to improve the image or commonly called image enhancement, to improve the image can be done in various ways tailored to the needs, in this study carried out by the High Pass Filter approach. Stages of the process consists of Gray scaling, Tresholding, Cropping, Edge Detection with Prewitt Operator, Image Enhancement then the image of the Enhancement result is done by Union Operation to fill the white pixel value which is in Edge Detection and then converted to binary value 0 and 1. This study used 4 test images consisting of 2 normal images and 2 abnormal images, 2 normal images in the mean as sampling. The test results with edge detection is not good enough so after edge detection is done enhancement to the image so as to produce the image with the appearance of the boundary line of each edge of the area is clearly visible and there is no disconnected edge

Keywords – MRI, Edge Detection, Operator Union, Image Enhancement, High Pass Filter

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1. INTRODUCTION

The development of technology in the field of increasingly sophisticated health by using tools that modern and sophisticated prove that the health of the world progress. One application of technology in the field of health that is currently widely used is Magnetic Resonance Imaging (MRI) [1]. One type of cancer that can be identified by using this MRI technology is breast cancer. Breast cancer is still the leading cause of death of the world.

In identifying breast cancer that is stored in Digital Imaging Communication in Medicine format. Research to identify breast cancer using medical images of Magnetic Resonance results is still rare, because research by utilizing medical images of MRI results more aimed at identifying brain cancers in humans [1]. In addition, based on a doctor or radiological statement that from the results of an MRI examination cannot be diagnosed with certainty the presence of breast cancer, further clinical examination is necessary to ensure the patient [1].

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Magnetic Resonance Imaging (MRI) is an advanced diagnostic tool for checking and detecting the body using large magnetic fields and radio frequency waves, without surgery, use of X-rays, or radioactive material, resulting in recording images of cross-section of the body or human organs using magnetic field strength between 0,064-, 5 tesla (1 tesla = 1000 Gauss) and resonance of vibration to nucleus of hydrogen atom

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Image segmentation is a process aimed at obtaining objects contained within the image or dividing the image into several regions with each object or region having similar attributes [2]. In an image containing only one object, the object is distinguished from its background. The image segmentation technique is based on two basic properties of gray-level values: incompatibility and similarity between pixels [3]. Edge detection serves to obtain the edge of the object [4]. Edge detection takes advantage of drastic changes in the intensity value of the boundaries of two areas [5]. The definition of the edge here is "the set of connected pixels that lie on the boundaries of two areas" (Gonzales & Woods 2002)

[12]. Need to know the real edge contains very important information. The information obtained can be either the shape or size of the object. Generally edge detection uses two kinds of detector ie detector line (Hy) and column detector (Hx) [4]. Some examples of this type are operators Robert, Prewitt, Sobel, Canny, and Frei Chen.

Edge detection can be divided into two groups [4]. The first group is called first-order edge detection, which works by using first order derivative or differential [1]. Included in this group are the operators Roberts, Prewitt, and Sobel. The second group is called second-order edge detection, which uses second-order derivatives [6]. An example belonging to this group is Laplacian of Gaussian.

In previous studies, sometimes a study refers only to segmentation and edge detection to know the regularity pattern of an object in an image, but sometimes the image we get from edge detection is not always good, sometimes there is a lack of clear image, or not connected or otherwise, for this problem we can perform image repairs in various ways tailored to the needs of one of them with High Pass Filter approach aim to revive the edge of the image that has been produced by edge detection operations, and also to reduce the analysis of human work, image results from edge detection we can do again so that we can easily take a decision from the analysis. One that can be used is a union operation.

So simply this research is done in three stages of image edge detection will be repaired the edges, because the edge detection white pixels only at the edges only. Then proceed with morphological operations that focus only on union surgery. The goal is to fill all the black pixels that are inside the edge of the image into white pixels.

II. RELATED RESEARCH

There are several papers that discuss about segmentation and edge detection that is specifically on the medical part that detects objects in the image diagonasa as cancer of breast cancer, prostate, skin and others. For example to develop the results of research and papers by previous authors who became the development materials as follows:

Image Magnetic Resonance Image (IMR) Imaging Using Edge Detection For Breast Cancer Identification [1] .

In this research, F. Ervina, and K. Bambang performed the process¹ of Magnetic Resonance Image (IMR) image through segmentation and edge detection process, to assist doctors or radiologists in identifying breast cancer [1] .

Identification of Prostate Cell Cancer Using Segmentation Methods Based on Object Size in Image [2] .

In this study Witeti identification of prostate cancer cells contained in digital images automatically by the method⁷ segmentation based on the size of the object image pad [2]

• A Novel Approach for Breast Cancer Detection and Segmentation in a Mammogram[3]. In this study K. Anuj and G.Bhupendra have improved the

results of segmentation and edge detection with the development of methods to detect cancer areas and segment the areas covered by malignant tissue identified as cancer [3]. In this paper they focus on the malignant tissues that represent a higher intensity in comparison with the background.

III. METHODOLOGY

3.1 Computing design

In the whole stage of computing process in this study can be seen in the picture below.

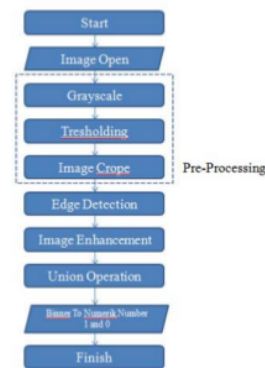


Fig. 1. Computing design process.

3.2 Stage of image processing

Pre-processing is a process used to improve the quality of the image display to have a better format so that the image becomes more easily processed further to produce the best edge detection. The stages of the pre-processing stage carried out in this study consisted of

1. Grayscale

Grayscale is the process of converting an image that has a colour to an image that has a gray colour level. This process is done by converting the pixel value from 3 RGB values to 1 value. Although the results are quite good sometimes the use of the average value has not been optimal to show the grayscale image sometimes we can make the composition change so that the optimal results the author uses the equation.

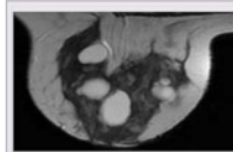
$$S = 0.42r + 0.32g + 0.28b \quad (1)$$


Fig. 2. Grayscale results

2. Thresholding

Thresholding or mining makes the image has tow gray levels of black and white, the mining process will produce binary image (7). The thresholding process follows the following rules.

$$f(x,y) = \begin{cases} 1 & \text{if } f(x,y) \geq T \\ 0 & \text{if } f(x,y) < T \end{cases} \quad (2)$$

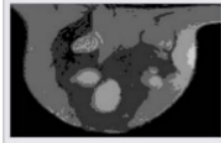


Fig. 3. Result of thresholding with threshold value (T=5)

3. Cropping

Cropping is intended to remove or eliminate unnecessary information. In the cropping process can be done after or before grayscaling and thresholding process.

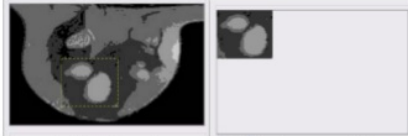


Fig. 4. Result of crop possible image objects identified

4. Edge Detection

Edge detection is a change of intensity value of a sudden large gray within a short distance [8]. edge characterizes the boundaries of the object and therefore the edge is useful for the process of segmenting and identification of objects in the image. In this process the MRI image here is done with edge detection developed from the second derivative of Robert. The filter kernel used in the edge detection is used

$$h = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix} \quad v = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix} \quad (3)$$

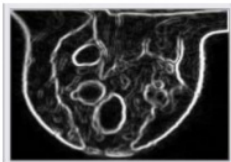


Fig. 5. Edge Detection Results

5. Image Enhancement

The image of edge detection that is still not maximal we can fix, in this peneliation with approach of High Pass Filter, with aim to generate high frequency value so as to form more prominent edge.



Fig. 6. Results of Image Enhancement

6. Union Operation

Union is an amalgamation of two sets of purposes in use in this research that is the image forming process which initially only shows the white pixels at the edge of the result of the edge detection, then we fill all the images with white pixels, the purpose is to compare the number of biner values 0 and 1. The set notation for union operation can be written.

$$C = A \cup B \quad (4)$$



Fig. 7. Edge Detection Result Modified to Binary Image Union Operation

7. Binaryzation

Binary process is a process that allows each pixel of an image to be expressed with a value of two possibilities. In this study, the binary algorithm is determined by the value of the image change to grayscale or called intensity, which if the intensity < 128 is automatically expressed by 0 and if not worth 255 or 1. As for the rules of the equation as below.

$$f(x,y) = \begin{cases} 1 & \text{if } f(x,y) \geq 128 \\ 0 & \text{if } f(x,y) < 128 \end{cases} \quad (5)$$

As for the conversion of binary images to numerical values 0 and 1

$$f(x,y) = \begin{cases} 1 & \text{if } r \neq 255 \text{ and } g \neq 255 \text{ and } b \neq 255 \\ 0 & \text{if } r = 255 \text{ and } g = 255 \text{ and } b = 255 \end{cases} \quad (6)$$

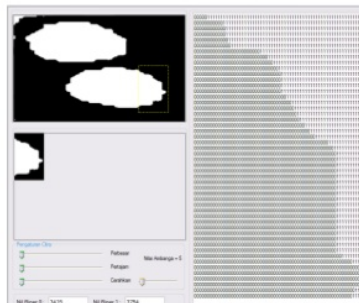


Fig. 8. Results Binary Process

8. Anastasia image to make decision

Analyze the ratio of the results of binary analysis to conclude whether the image concerned is likely to suffer from breast cancer or not. The rules in use when the binary value $0 >$ binary value 1 with a very neat edge pattern and analysis of experts who have understood this field. It means that most patients diagnosed with breast cancer. If the binary value is $0 <$ binary value 1 with irregular edge pattern then vice versa.

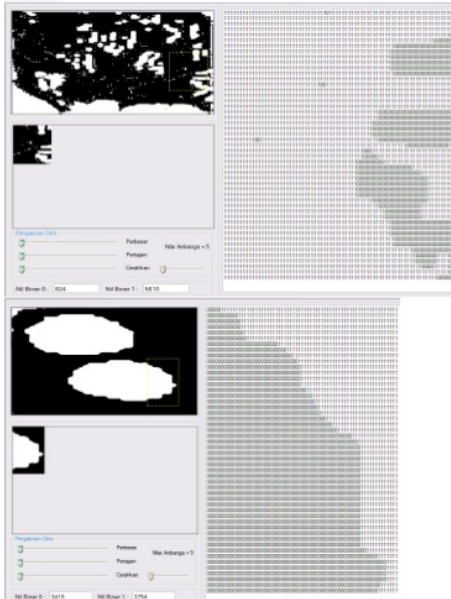


Fig. 9. Analysis Binary Pattern And Comparison Of The Number Of Values 0 And Value 1

IV. RESULT AND DISCUSSION

4.1 Program Testing

The test is based on the quality of the resulting edges then converted into union process and tested by comparison of small values of 0 and 1 from binary with a regular pattern or not. In the table below the author uses 4 sample images 2 normal images and 2 abnormal images with the same image position. With the aim as a comparison material to be able to determine the final value of whether the patient contracted breast cancer or not.

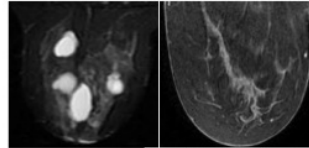
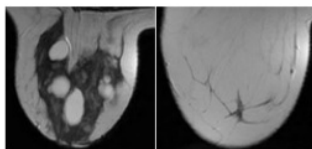


Fig. 10. Testing Image

1. Grayscale process

The grayscale process is performed on all 4 test images, since the overall MRI image with high tesla has a depth of 16 bits, so it needs to be converted into an image with a depth of 8 bits, to be easily processed for subsequent processes. For example, following one of the grayscale process image results for norm and abnormal images.

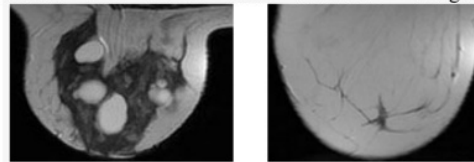


Fig. 11. Abnormal Image and Normal Image

2. Thresholding

In this study the threshold value used for the entire test image is $T = 5$. The determination of this threshold value is based on the results of trials conducted with some normal and abnormal breast images, this is adjusted to the needs as a step before entering on binary. Therefore the determination of the threshold value must be appropriate and appropriate. The results of testing thresholding against some normal and abnormal images can be seen in the picture below 1 $T = 5$ and Figure 2 $T = 100$.

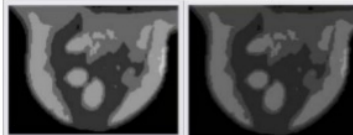


Fig. 12. thresholding results with threshold values of 5 and 100

3. Cropping

Before doing image edge detection we first cropping, in this research cropping process is done in addition to maintaining the rights and privacy of patients, patient data information contained in the image of trials obtained from the Family Hope Hospital needs to be removed. Also the size of the image used as test data is very large and varied, it affects the process of image processing, therefore the cropping process is needed. As an example :



Fig. 13. Cropping And Cropping Results

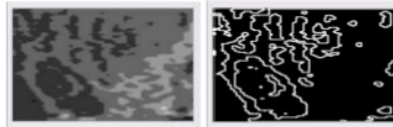
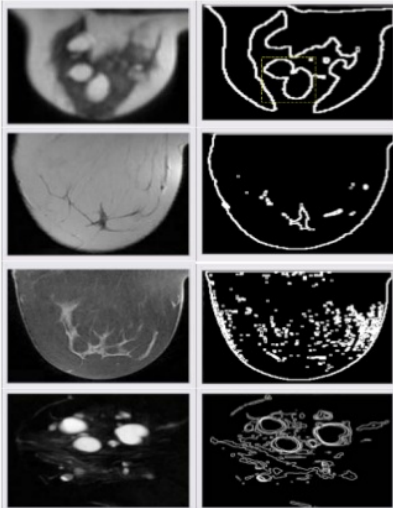


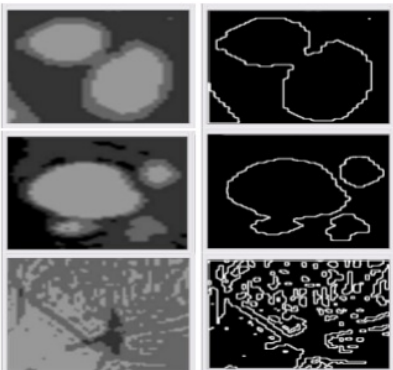
Fig. 14. Process Edge Detection Image large and crop result

4.2 Edge Detection Testing

After we do crop we will do edge detection. The edge detection process using the Prewitt operator of the 4 sample imagery samples consisting of 2 abnormal images and 2 normal images produces an image with borderline sightings of each region or clearly visible objects and no discontinuous edges. As for one of the results of edge detection testing of some image of preprocessing result can be seen in the following picture:



The preprocessing image that has been in crop first



4.3 Testing Binary and Union Operations

In converting the image into binary image form in this study using the method that is by binerisasi and thresholding [9]. If in thresholding the determination of threshold value is done manually, ie by shifting the trackbar to give the threshold value if the intensity value < 128 then the pixel value is expressed with 0 and if it is not then 1 [10] [11]. However, in this study the authors prescribe the threshold value $T = 5$. In addition the value of 0 and 1 are generated after we perform union operations from the image results from edge detection is displayed in a memo text in order to calculate the total occurrence of values 0 and 1 partial reference to compare the magnitude of values 0 and 1.

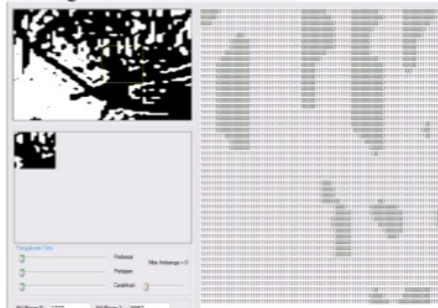


Fig. 15. Binary Process Image Crop Normal 1



Fig. 16. Image Abnormal Image Crop Binaryzation Process 1

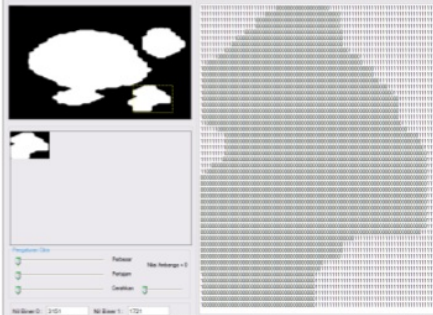


Fig. 17. Image Abnormal Image Crope Binaryzation Process With Union Operation

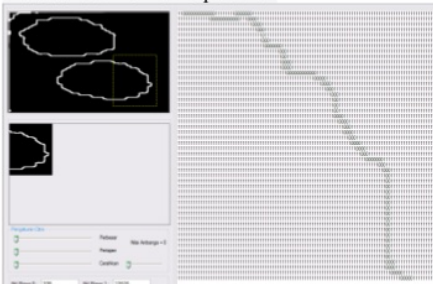


Fig. 18. Image Abnormal Image Crope Binaryzation Process 2

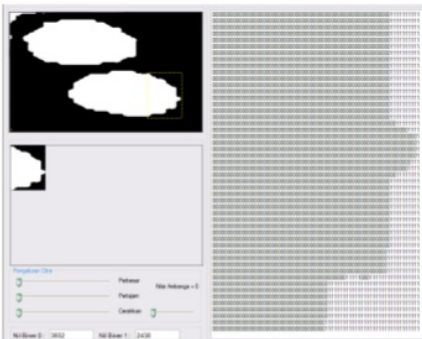


Fig. 19. Image Abnormal Image Crope Binerization Process 2 with Union

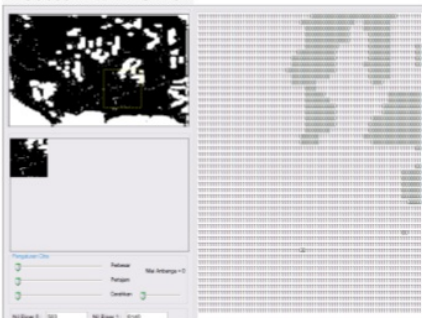


Fig. 20. Image Normal Image Crope Binerization Process 2

Finally we can see the comparison of the reference value in this case the author uses a sample of images that are interrelated between abnormal and normal images as in the table below.

Tabel I Final Score Comparison

Name	Crope Abnormal image	Crope Normal image
Image		
Binary		
Value	0 = 4168 1 = 2264	0 = 251 1 = 2609
Pattern	Regular	Irregular

The equations are in use

$$f(x,y) = \sum_{i,j} \begin{cases} 1 & \text{if } b = 255 \text{ and } g = 255 \text{ and } b = 255 \\ 0 & \text{if } b < 255 \text{ and } g < 255 \text{ and } b < 255 \end{cases} \quad (7)$$

Information:

i = Variable that holds the total value 0.

j = Variables that hold a total of 1.

V.CONCLUSION

1. To determine whether the patient is likely to develop breast cancer or can not see the comparison of binary values 0 and 1 if the value 0 > of value 1 with a regular edge pattern of puncture then the possibility of breast cancer and if the value 0 < of the value 1 with the edge determination pattern which is messy and irregular then it is likely not to suffer from breast cancer.
2. Image MRI when in though must pass through grayscale and tresholding first so that the edge detection process can determine the edge well, besides we can make edge detection improvements with shorter on High Pass Filter to improve the image to have a very good edge
3. Edge edge detection value 0 for white color and value 1 for black color without us using union image operation then automatically if calculated clearly value 0 will be smaller than 1 so we have to use union image operation to fill black color in circle edge and become all white, so the value 0 will be greater than value 1.
4. In the previous study only reached the segmentation stage and the conversion of binary images to numeric values of 1 and 0, while in this study there was an image improvement process after edge detection and the addition of union

operations to make numerical values more precise. And this value is also displayed. While previous research values are only displayed without calculating.

5. For the next development, it is expected to be able to do clusters of the binary image values that have been produced.

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