Application Of Mathematical Morphology Algorithm For Image Enhancement Of Breast Cancer Detection

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***Abstract*— This study aims to produce an image processing application using Mathematical Morphology to improve the quality of the digital image for breast cancer detection. Medical image is an image produced or used in the medical field. Improving medical image quality is very useful for diagnosis and advanced image processing. Breast healthy is important for women. Breast cancer is the main killer for women. Biomedical breast image data is secondary data. The next process is the initial processing, which is processing that is related to pixel size, gray scale, and so on. The improvement of medical image in this study uses the Mathematical Morphology method which consists of Dilation, Erosion, Opening (Erosion-Dilation) and Closing (Dilation-Erosion) processes. The expected results of this research are medical digital images that have improved their quality as a result of Dilation, Erosion, opening and closing processes.**

Keywords— mathematical morphology, breast healthy, image enhancement, erosion, dilation

I. INTRODUCTION

Breast cancer (Carcinoma mammae) is defined as a malignant neoplasm originating from parenchyma. Breast cancer can be divided into Benign Breast Tumors and Malignant Breast Tumors [1, 2]. This disease by the World Health Organization (WHO) is included in the International Classification of Diseases (ICD) with code number 17 [3]. The frequency of cases of this disease is relatively high in developed countries and is a type of cancer that affects many other types of cancer. According to WHO in 2005 it was reported as many as 506,000 women died due to breast cancer [3,4,5]. Early detection of breast cancer through mammography can increase the chances of survival [5, 6, 7]. Mammography is the process of examining human breasts using X-rayslow dose. Examination using mammography produces an image called mammography image. Mammography can identify cancer for several years and is the most effective breast cancer screening method today. The key to surviving breast cancer survivors is to detect breast cancer as early as possible, before the cancer has a chance to spread [6, 7, 8, 9].

The application of digital image processing in the medical field in general is to improve the quality of medical images for the purpose of analysts and further diagnosis. The quality improvement can be done by segmentation and extraction [4, 7], enhancement of morphological features [8, 9], morphological transformation (Firoz, et al, 2016), edge detection (Kaur, et al, 2015), etc. etc. Many methods to improve the quality of digital images for the purposes of analysis and further diagnosis. Mathematical Morphology is a method of processing digital images related to the shape and structure of an object / object [10, 11, 12]. Mathematical Morphology in digital images can be interpreted as a way to describe or analyze the shape of digital objects. Mathematical Morphology is widely used to improve image quality [11, 12, 13, 14].

In this study, the authors wish to further study the application of the Mathematical Morphology method, namely dilation, erosion opening and closing to improve the quality of medical images in breast cancer. The results of this study are expected to be used for further analysis both in the medical field. Further analysis of the medical field to support the diagnosis and early detection of breast cancer.

II. METHOD

This study used a research and development approach. This study used medical image. That were mammogram derived from the download from the internet. The image processing method used Mathematical Morphology.

A. Research Stages

The stages of research are shown in Fig.1 below:

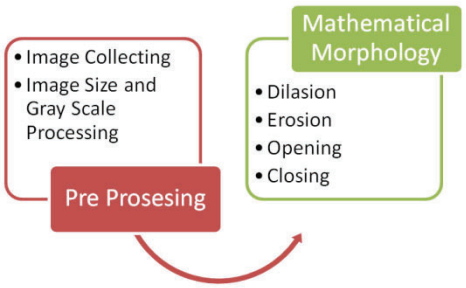

Fig.1. The Stages of Research

The research process began with pre-processing namely medical digital image is processed early with changes in pixel size or changed to bluish or binary scale. The next process is the image will be processed by the Mathematical Morphology method in the order of Dilation, Erosion, Opening (erosion - dilation) and Closing (dilation - erosion).

- Pre Processing
  At this stage consists of Image collecting and resizing and changing images to binary images.
- Mathematical Morphology
  Mathematical Morphology process consists of dilation, erosion then continued opening and closing. After the Mathematical Morphology process, the next step is to conduct a comparative analysis of the quality of the resulting output image.

B. Mathematical Morphology

Mathematical morphology is a tool for extracting image components that are useful in the representation and description of regional shapes, such as boundaries, skeletons and convex hull [10, 14]. Mathematical morphology can be applied as a first or final step in the process of digital image analysis for binary image types and binary images. can be extended to grayscale images. However, generally mathematical morphology is usually applied to binary images [13].

A digital image can be viewed as a 2D amplitude function with discrete coordinates. In mathematical morphology, a digital image is expressed as a set of discrete coordinates [12, 14]). In this case, the set is related to the point or pixel of an object in a digital image. The object is considered as a set, so mathematical-mathematical sets such as union, intersection, complement, etc. can be used. The basic basic operations of Mathematical Morphology are dilation, erosion, opening and closing. If f (x, y) is a representation of a gray scale, s (x, y) is a representation of a structural element and Df and Ds are the functions of f (x, y) and s (x, y) .

Dilation is used to expand objects in an image (Belaroussi and Milgram, 2012). If an object (input image) is stated with A and SE is stated by B and Bx represents translation B so that the center of B lies at x and is an empty set. Dilation A with B is stated as follows:

$$D(A, B) = A \; B = \{x: Bx \; A\} \quad (1)$$

The mathematical dilation process is done by comparing each pixel of the input image with the central SE value by superimposing the SE with the input image so that the center of the SE corresponds to the pixel position of the processed image. If there are at least 1 pixel in the same SE as the value of the object's pixel (foreground) of the image, then the input pixel is set to the value of the foreground pixel. However, if all related pixels are background, then the pixel input is set to the background value. A similar process is continued by moving (translating) SE pixel by pixel in the input image Figure 2. below shows an image before and after the dilation process using 3x3 SE with each element having a value of 1.

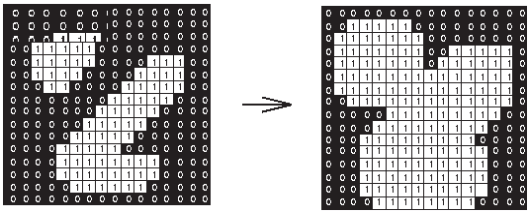

Fig.2. Dilation Using SE 3x3

The greater the size of the SE, the greater the changes that occur. The effect of dilation on binary images is to enlarge the boundaries of existing objects so that objects appear larger. This causes the holes in the middle of the object will appear smaller. Erosion is used to reduce objects in the image (Belaroussi and Milgram, 2012). Erosion can be stated as follows.

$$E(A,B) = A \; B = \{x: Bx \; X\} \quad (2)$$

Just like dilation, the erosion process is done by comparing each pixel of the input image with the center value of SE by superimposing the SE with the image so that the center of the SE is exactly the position of the pixel of the image being processed. If all the pixels in the SE match with all the value of the object's pixel (foreground) of the image then the input pixel is set to the value of the foreground pixel. If not, then the pixel input is given a background pixel value. A similar process is continued by moving the SE pixel by pixel in the input image.

The erosion process is different from the dilation process. If the dilation produces a wider object, then the erosion process will produce a smaller object. The hole in the object will appear to be enlarged as the object's boundary becomes smaller. Fig. 3 below shows the picture before and after the erosion process with SE measuring 3x3 with all SE elements valued 1.

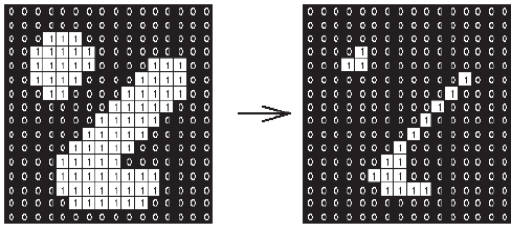

Fig.3. Erosiom Using SE 3x3

An opening operation is an operation on Mathematica Morphology which is a joint operation starting with erosion first followed by dilation. Openng formulation as follows:

$$f \circ s = (f \ominus s) \oplus \quad (3)$$

A closing operation is a joint operation that begins with dilation followed by erosion.

$$f \bullet s = (f \oplus s) \ominus s \quad (4)$$

III. RESULT

Data input in this study was medical image. It was consisting of mammogram, which is the result of x-ray irradiation in the breast. The original medical image is then made preliminary to size and made on a gray scale. Results from pre processing such as fig. 4 below:

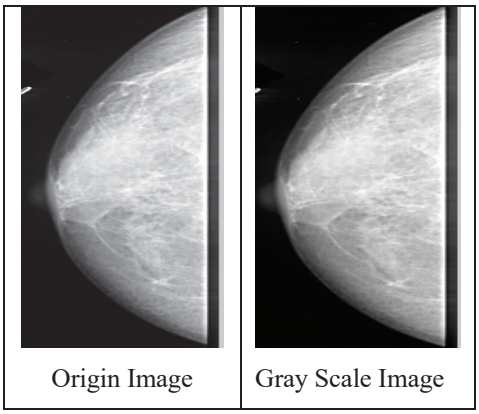

Fig. 4. Result of Pre Processing

The next process was the image that has been changed to gray scale were processed further with Mathematical Morphology. The process with Mathematical Morphology began with dilation, erosion, opening and closing. Processing with Mathematical Morphology used 3 strel, namely:

Strel1 = ([0 1 0; 1 1 1 ; 0 1 0)]
Strel 2 = ('square', 5)
Strel3 = ('disk', 10)

The results of processing with strel1 ([0 1 0; 1 1 1; 0 1 0]), for dilation, erosion, opening and closing are shown in Fig. 5 below:

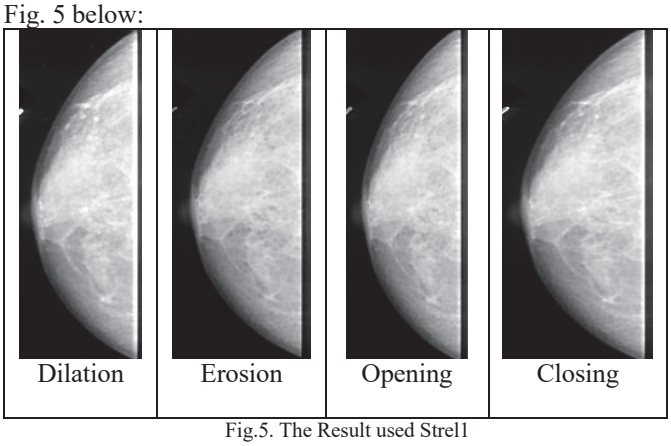

Fig.5. The Result used Strel1

The results of processing with strel2 ('square', 5), for dilation, erosion, opening and closing are shown in Fig. 6 below:

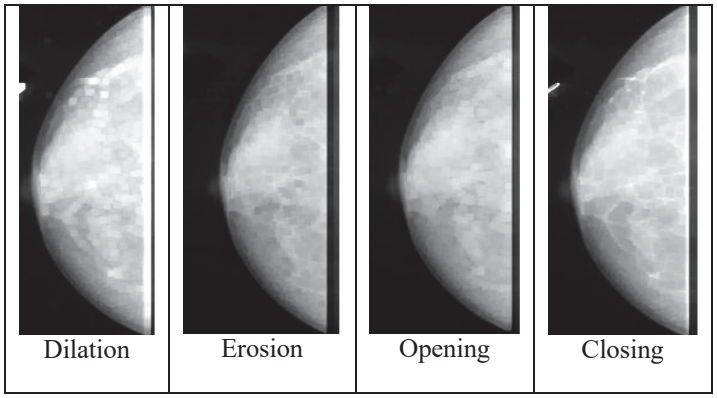

Fig.6. The Result used Strel2

The results of processing with strel2 ('disk', 10), for dilation, erosion, opening and closing are shown in Fig. 7 below:

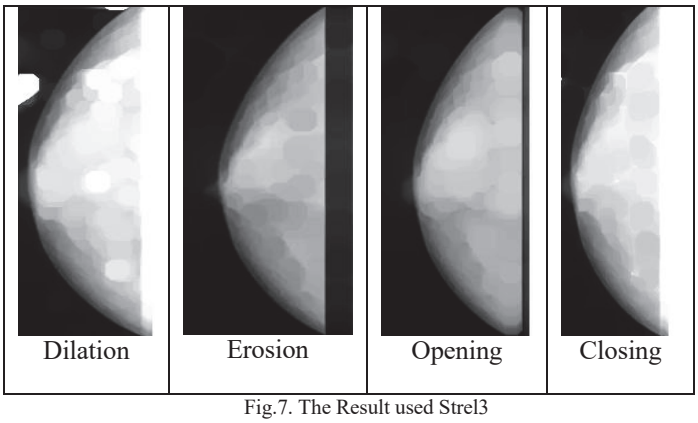

Fig.7. The Result used Strel3

The results of processing with Mathematical Morphology consisting of dilation, erosion, openig and closing can be used for enhancement of medical images. This mammogram medical image processing is used for identification and early detection of breast cancer. From processing with 3 strings obtained a different output image. Strel 3 ('disk', 10) results in a significant difference in processing.

IV. CONCLUSION

The mammogram image required image improvement process. The image collection process started with resizing and changed the image to gray scale. Mathematical Morphology can be used for image enhancement with the processed of dilation, erosion, opening and closing. The process of improving medical image mammograms in this study used 3 strings namely strel1 ([0 1 0; 1 1 1; 0 1 0]), strel2 ('square', 5) and strel3 ('disk', 10). The results of the process showed significant changes. The results of image processing will be used next process for identification and early detection of breast cancer.

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