Detection of the Breast Cancer from Thermal Infrared Images

Oky Dwi Nurhayati, Thomas Sri Widodo, Adhi Susanto, Maesadji Tjokronagoro

Abstract – Thermography can be used as part of an early detection tool which gives women of all ages the opportunity to increase their chances of detecting breast diseases at a very early stage. Breast thermography is a noninvasive prognostic procedure which can predict a tumor growth rate in breast cancer patients. The objective of this research is to acquire the potential of the statistical characteristics of the breast thermogram images for the detection of the breast cancer.

For this research we use thermal data images from Sardjito hospital at Yogyakarta, from normal and abnormal breast (detected breast cancer). Firstly, download the breast image thermograms from the InsideIR software of Fluke Ti20 and save them as the inputs to our image processing program. Then adjust the format of the images, convert to grayscale images, and crop them to separate the suspected objects from the background. Finally we tabulated the statistical characteristics of the objects which are the means, standard deviations, and entropy to reveal the abnormalities of breast thermograms.

The results show that the method are promising to detect the abnormality on the breast thermogram images. The normal breast thermograms have minimum entropies which differ from those abnormal thermograms in the early stage of breast cancer and thesignificantly from the more advanced of breast cancer.

Index Terms: thermogram, early breast cancer, deep breast cancer, statistical characteristics

I. INTRODUCTION

Texture are identifying features or characteristics owned object in a big region and naturally these characteristics could recur in this area. The small region when compared with elements of the available texture inside, could not show the texture itself. Actually, the same texture when saw at different scale would be seen like two different textures, when it was has big scale difference.

The other definition texture was the regularity of certain patterns that were formed from the structure pixel in the digital image. A surface had a texture information, when it region was enlarged without changing the scale, then the characteristics of the expansion surface had resemble the origin surface (regular pattern). The other word, they were emerge repeatedly in the interval of distance and certain direction. The texture information used to distinguish the surface characteristics of object in the image were connected with rough and soft, specific characteristics from coarseness and surface refinement, that completely free from the colour surface.

Texture is the important task in the visual system such as surface texture object was used for the inspection of the semiconductor material, the distribution of feature intensity from homogeneous texture was used to group the aerial photograph image, the variation in the texture pattern of the resulting from the perspective projection used to determine forms of three dimensions object. The texture analysis could be used to segment an image, patterns identificate were arranged and continued, patterns intensity, the surface object that was connected with the rough and soft characteristics. The texture characteristics were formed from the distribution of the environment intensity by image field. Texture could not be determined from one point, but must from a group of point.

The aim of the analysis texture image processing was to make the local intensity variation pattern taken repeatedly as distinguish feature, whenever the variation pattern was too small when compared with the observed object in use resolution. The simple example was the dots repeatedly pattern on the white background. The text was printed in a sheet of paper could formed a texture. In this case each intensity point formed pixels connected represent each character. The statistical method was used to extract the texture feature of an image. Image characteristics such as the arrange pixel intensity and texture feature namely contrast, entropy and homogeneity with other feature was counted from the image intensity.

Texture feature could be analysed from an image to identificate the characteristics of this image surface. Then, texture feature was count from a certain area and the values produced by the calculation was viewed or compared with the reference values. The measure of feature object was done after cropping an image to count some values such as mean, the deviation standard, entropy, energy, contrast, and homogeneity. In this

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research we were used three feature to detect the breast thermogram images.

II. Entropy and Histogram

Entropy of the image was a feature to measure the randomization of intensity distribution. An image was said perfectly if the entropy value is zero. Entropy was a measure of statistics random could be used to determine characteristics texture the grayscale image. Entropy was defined as:

$$Entropy = -\sum_{i_1}\sum_{i_2} p(i_1, i_2)\log p(i_1, i_2) \quad (1)$$

where pi was the emergence probability. The maximum entropy value was reached when all of the elements p (i_1, i_2) have the same value, namely the matrix was connected with the image and it's not available certain regular in a couple of intensity and distance of the d certain vector.

The input image could form of the multidimensional image. If there are more two dimensions input image, the function entropy was preserved as the multidimensional grayscale image and not the RGB image.

Histogram is the graph show the spreading of the pixel intensity values of an image. From a histogram we could know the emergence distribute frequency relative from the image pixel intensity. Histogram has several use show about the brightness and the contrast image.

According to the image processing procedure, the restricted equation of histogram is the following:

$$h_i = \frac{n_i}{n}, i = 0,1,..., L-1 \quad (2)$$

Where, n = total number pixel of images
n_i = number pixel with i grayscale level

The distribution hi, or ni, could provide information about the image emergence. Histogram used to give an information about pixel intensity, number of pixel, and changes of the view by image processing operation.

The number of different light intensities in an image often does not use the whole available spectrum and mostly accentuate a narrow spectrum. Images with such poor intensity distributions can be helped with a process known as histogram equalization. Histogram equalization is a method for "spreading" the histogram of pixel levels more evenly.

Histogram equalization can be used to improve the visual appearance of an image. Peaks in the image histogram (indicating commonly used grey levels) are widened, while the valleys are compressed.

III. Material and Method

Material used to this research was the digital breast thermogram images from the womans in normal and abnormal (the womans were detected breasts cancer in the early stage and the continued stage) that was captured by the camera thermal Fluke Ti20 with the software InsideIR 3.11. The data was taken from RSUP.Dr.Sarjito Yogyakarta. The digital thermogram images was processed use the Matlab program 7.04 by pre-processing images shown in Figure 1.

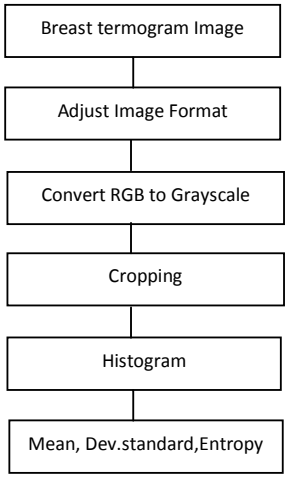

Figure 1: Steps of the breast thermogram images to detect breast cancer

IV. Results

The results of this research can show the conversion RGB breast thermogram images to grayscale thermogram images in Figure 2 below.

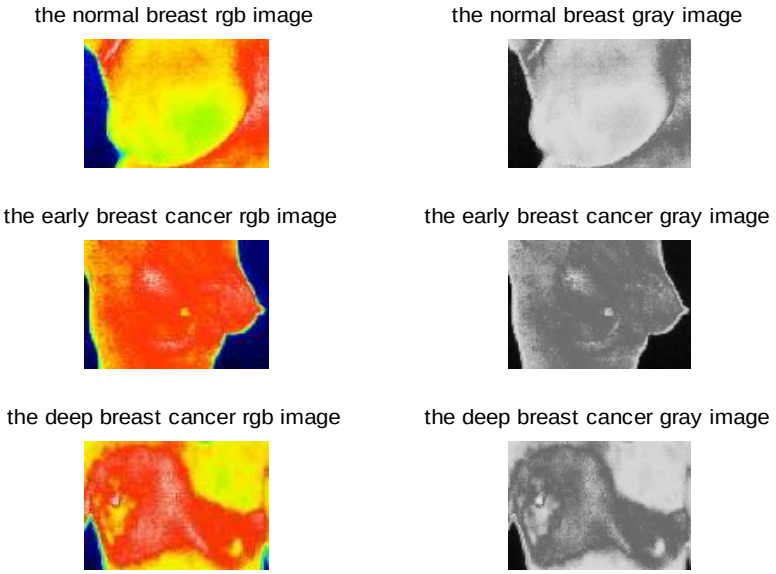

Figure 2: RGB thermogram images (left side) and they conversion to grayscale (right side) from image data N7.jpg, D3.jpg, and L2.jpg

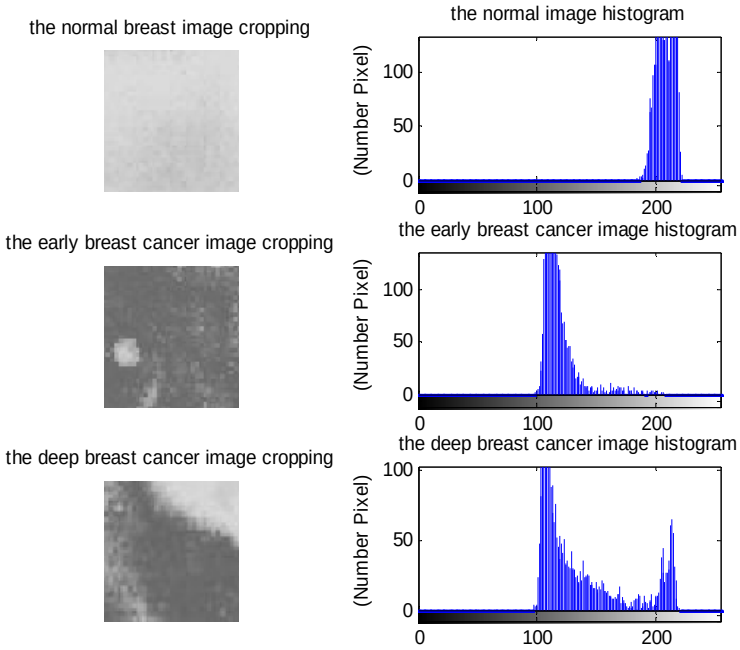

Figure 3: Cropping image grayscale (left side) and they histogram (right side) from image data N7.jpg, D3.jpg, and L2.jpg

The same manner will achieve Figure 4 and Figure 5 continued breasts cancer L1.jpg. The results are of the normal breast thermogram image from data represented in Figure 4 and Figure 5 below. N42.jpg, the early breast cancer D1.jpg, and the

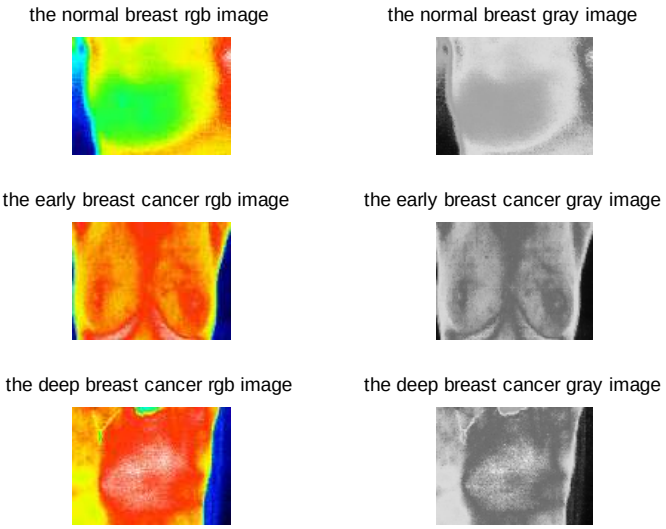

Figure 4: RGB thermogram images (left side) and they conversion to grayscale (right side) from image data N42.jpg, D1.jpg, and L1.jpg

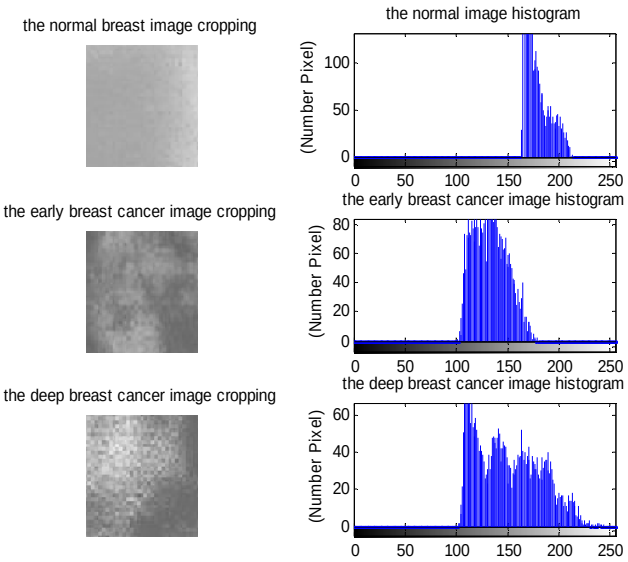

Figure 5: Cropping image grayscale (left side) and they histogram (right side) from image data N42.jpg, D1.jpg, and L1.jpg

The classification process of the cropped breast thermogram images were carried out with the calculation of image statistics. Some values were used to analyse such as mean value, deviation standard, and entropi. Mean value was pointed out with MN, MD, and ML that means mean normal, mean early, and mean deep. The value of standard deviation was shown with StdN, StdD, and StdL that means deviation standard normal, early, and deep. Entropy value was pointed out with Ecn, Ecd, and Ecljt that means entropy normal, early, and deep. The results value of their respective normal thermogram images and abnormal thermogram images shown in Table 1 below.

Table 1
The measurement result of the object

File Name	MN	MD	ML	StdN	StdD	StdL	Ecn	Ecd	Ecljt
N7D3L2	209.3743	117.6758	151.2781	7.6477	15.2059	47.3277	4.7113	5.0622	6.0098
N42D1L1	177.0737	135.8362	149.865	11.5593	19.4822	31.5598	5.029	5.9615	6.7212
N45D2L4	216.2097	129.2283	141.522	3.4367	20.7278	30.4763	3.4211	5.9678	6.4372
N1D4L3	189.1672	132.9753	145.5908	17.8177	24.4036	40.257	5.6886	6.178	6.2872
N4D1L1	122.3296	135.8362	149.865	15.884	19.4822	31.5598	5.5472	5.9615	6.7212
N5D2L3	204.5427	129.2283	145.5908	19.928	20.7278	40.257	5.3068	5.9678	6.2872
N6D3L3	168.0474	117.6758	145.5908	4.5323	15.2059	40.257	3.6008	5.0622	6.2872
N8D5L5	210.0051	124.6545	136.3259	4.0599	14.3699	19.743	3.9811	5.6377	6.2187
N9D6L6	211.5405	110.2483	173.9851	4.8794	40.2214	23.0688	4.1346	5.8196	6.5022
N10D6L7	211.8877	110.2483	175.6428	4.7675	40.2214	25.6367	4.0635	5.8196	6.6677
Mean	192.0178	124.3607	151.5256	9.45125	23.0048	33.0143	4.5484	5.74379	6.414

From the Table 1 above we could see the biggest mean value founded in breast thermograms, and the smallest mean value was gotten in the thermogram that was detected early breasts cancer. On the other hand the smallest deviation standard value was found in the breast normal thermogram and the biggest value was found in the advance breasts cancer. The last measurement showed that the smallest entropy found in the breast normal thermogram, on the contrary the biggest value entropy was found in the advance breast cancer thermogram.

V.Conclusion

There are several methods in breast thermogram images viz :

1. first is pre-processing image of the breast thermogram images were done by adjusting format images, converted the RGB images to grayscale images;
2. Statistical characteristics of the breast thermogram images were carried out by extracting information of the image. These characteristics could be used to distinguish the thermogram images and the abnormal thermogram images so it could be use to detect breast cancer of breast thermogram images.

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