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QUALITY IMPROVEMENT OF THORAX PHOTO IMAGE PROCESSING ON TUBERCOLOSIS PATIENT TREATMENT USING LAPLACIAN OF GAUSSIAN METHOD AND IMAGE MOMENTS

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ABSTRACT

Tuberculosis is an infectious disease of the respiratory tract caused by the bacterium Mycobacterium tuberculosis (MTB). To diagnose the disease a radiographic examination of the chest is performed. In this study an image quality improvement for chest radiographs of tuberculosis patients was carried out before and after treatment, using the Laplacian method. of Gaussian (LoG) and the method of image moments (IM). The Laplacian of Gaussian operator will capture edges from all directions and produce sharper edges on chest x-ray images before and after treatment, so that the image of the process is clearly visible, the edges of the image clearly, Image moments are used to see the seven moment invariant values and the center value of mass that shows the characteristics of the photo image of the thorax. This image processing process requires a short amount of time in just seconds, for pre-treatment imagery is 41.4531 seconds and for post-treatment images 42,625 seconds, the image before treatment has a mass center value of 8,333, and after treatment image has a mass center value of 34,052.

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INTRODUCTON

Tuberculosis (TB) is an important public health problem in the world. Tuberculosis as a Global Emergency was launched in 1992 by the World Health

Organization (WHO). Indonesia is among the top five countries with the highest number of people with TB in Southeast Asia. Tuberculosis is an infection of the respiratory tract caused by bacteria. These bacteria more often infect the lung organs (90%) than other parts of the human body. Tuberculosis is a disease that is difficult to detect especially for children. Therefore doctors usually use several ways to diagnose the disease, one of which is radiographic examination of the chest. Thoracic Radiography examination is often called chest x-ray (CXR) which aims to describe radiographically the respiratory organs contained in the chest cavity. Chest radiographs are used to diagnose many conditions involving the thoracic wall, thoracic bone and structures inside the thoracic cavity including the lungs, heart and large canals (Misri, 2013). The development of technology has caused the computational speed to be no longer a focus for researchers, but has an important role in the health sector. It is hoped that it can produce accurate methods as help to make it easier for doctors to diagnose and provide the right results. The image contains a lot of information, but sometimes the image that is obtained is not in an ideal condition, experiencing a decrease in quality (degradation) For example, contains defects or noise (noise), the color is too contrax less sharp, blurred (blluring) and so on. Of course this kind of image becomes difficult to interpret because this information is reduced to the background of this research. So it is necessary to improve the quality of the image. Field of study concerning this matter is image processing (image processing). Image processing includes visual perception analysis of images, with distinctive features as input and output in the form of information packaged in the form of images. The nature of image processing lies in the frequency level. The method that is often used for frequency domains is image transformation which is a process of converting images from one area to another (Anike, 2015).In this research, the image of thaxax photographs of TB patients before and after treatment will be carried out, in the form of image quality improvement using the LoG method. With the aim to clearly see the contours or parts of the image surface. Furthermore, using the image moments method or invariant moments can be obtained the center value of the mass of the image.

METHODS

The data used in this study is the image of a chest photo of a child with tuberculosis. Data collection is carried out in two stages, namely: before treatment, where the image taken has an image dimensions of 858 x 562, with a width of 858 pixels, height 562 pixels and bit depth 24. While the second, taken after treatment with 636 x 675 image dimensions with width 636 pixels, height 675 pixels, and 24 bit depth. After data collection is complete then image processing is done, using matlab software.

Program

Design Image processing is done through the pre-processing stage followed by the edge detection process using the second derivative LoG operator then using the IM method to see the value of the mass center.

Pre-Processing

Pre-Processing is a process to improve the quality of image display so that it has a better format so that the image becomes more easily processed further resulting in the best edge detection. Pre-Processing uses grayscaling, the process of converting images that have color into images that have gray-level levels. This process is done by converting pixel values from 3 values of RGB (Red, Green, Blue) to 1 value. The percentage that is often used is 29.9% from red (Red), 58.7% from green (Green), and 11.4% from blue (Blue).

Grayscale = 0,2989R+0,5870G+0,1140B.....(1)

Edge Detection Process

The process of edge detection of radiotherapy images is carried out using the Laplacian of Gaussian (LoG) operator with the following function equation:

$$\text{LoG}(x, y) = \frac{1}{\pi\sigma^4}\left(1 - \frac{x^2+y^2}{2\sigma^2}\right)e^{\frac{x^2+y^2}{2\sigma^2}} \dots\dots(2)$$
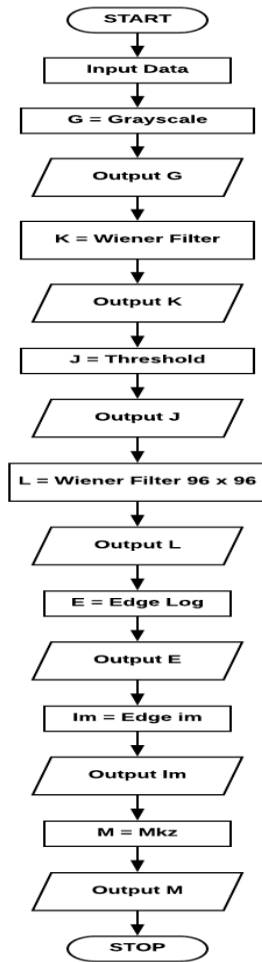
The approach with the LoG operator starts with the Wiener Filtering process with the aim of reducing noise (damage to the image signal caused by external interference) in the image in the form of variations in the intensity of a pixel that does not correlate with neighboring pixels. The next step is to do the threshold so that 50% of the intensity found in the lungs of the ronggent can be used. Followed by edge detection using the LoG operator, to find zero-crossing of Laplacian and compare local variations at this point for the threshold (threshold). If the threshold has been exceeded, it is expressed as an edge. The next step is to use the IM method to see the shift values in the image which aims to display values that represent the characteristics of the object. Digital images can be written:

$$\mu_{pq} = \sum_x \sum_y (x - \bar{x})^p (y - \bar{y})^q f(x, y) \dots\dots(3)$$

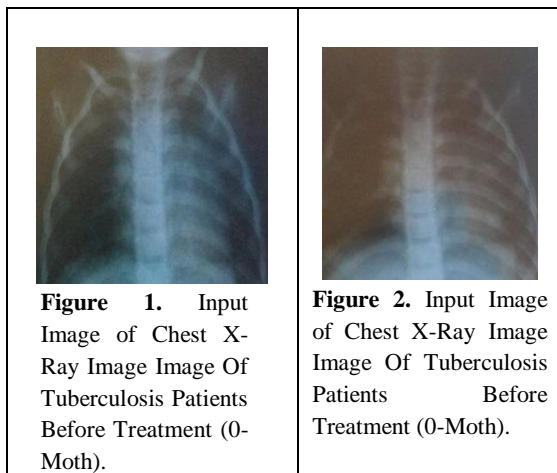While the central moment for an image is expressed as:

$$\mu_{pq} = \sum\sum \ \text{feR}(i - i)^p (j - j)^q \dots\dots\dots(4)$$

Chart of Programming Flow


```
START
  ↓
Input Data
  ↓
G = Grayscale
  ↓
Output G
  ↓
K = Wiener Filter
  ↓
Output K
  ↓
J = Threshold
  ↓
Output J
  ↓
L = Wiener Filter 96 x 96
  ↓
Output L
  ↓
E = Edge Log
  ↓
Output E
  ↓
Im = Edge im
  ↓
Output Im
  ↓
M = Mkz
  ↓
Output M
  ↓
STOP
```
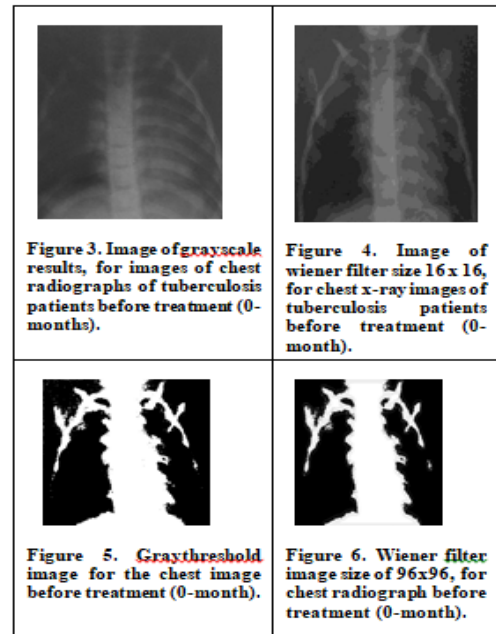
RESULTS AND DISCUSSION

The following is a picture of the images taken of chest radiographs of tuberculosis patients before and after treatment (figure 1 and figure 2)

Figure 1. Input Image of Chest X-Ray Image Image Of Tuberculosis Patients Before Treatment (0-Moth).

Figure 2. Input Image of Chest X-Ray Image Image Of Tuberculosis Patients Before Treatment (0-Moth).

1. **The quality of the chest photo images of Tuberculosis patients before and after treatment using the LoG method and the IM method**

Image of chest X-ray of tuberculosis patients before treatment, can be seen in the pictures below which are the results of processing images in the pre-processing stage to edge detection,

Figure 3. Image of grayscale results, for images of chest radiographs of tuberculosis patients before treatment (0-months).

Figure 4. Image of wiener filter size 16 x 16, for chest x-ray images of tuberculosis patients before treatment (0-month).

Figure 5. Graythreshold image for the chest image before treatment (0-month).

Figure 6. Wiener filter image size of 96x96, for chest radiograph before treatment (0-month).

Figure 7. Image Edge Detection Results Using Log Method, For Image Before Treatment (0-Month).

Detection Value *Image moments* :

Columns 1 through 6

8.833	10.23	29.919
40.026	1385.1	-34.904

Column 7

-10.686

Figure 8. Result Imafe Mkz, Merging The Image Above (Gray, Wiener, and Edge Detection) For Chest X-Ray Image Before Treatment.

After inputting a 0-month image (Figure 1), in matlab, the image will be displayed in the form of a matrix m x n according to the image size (858 x 562 pixels). After the process of reading the 0-month image

matrix, then through the grayscale stage it will produce a digital image matrix on a gray scale (conversion of RGB images to grayscale), thus facilitating the next process. The results of processing in the grayscale stage can be seen in Figure 3. Seen in the image has been contaminated noise (noise) or the form of damage to the image signal caused by external interference, (Yuwono, 2010).

This noise is caused because when taking or taking pictures using a camera it turns out that this can affect image quality. Therefore, using the 16 x 16 wiener filter technique, the noise reduction process will be carried out on the image. And the results of the Wiener filter with a size of 16 x 16 can be seen in Figure 4. The next step is as seen in Figure 5, where the gray-threshold image results to change the dimensions of the image into binary images so that it can distinguish between objects and backgrounds in that image. Wiener filter technique with a size of 16 x 16 has not eliminated the noise maximally, there is still noise in the image, therefore the Wiener filter technique is done with a size of 96 x 96 so that noise becomes reduced and can simplify the image processing process. The result is in figure 6. Furthermore, the edge detection stage is carried out using the LoG method, the results can be seen in Figure 7. For detection using the image moment method the results are shown in the form of values, where the values show the characteristic of the image. Values from Column 1 to Column 7 (figure 7) show the seven values of image moments or moment invariant of the image before treatment. The center value of mass is usually found in the first coulomn, which is 8,833 which shows the center value of mass that is owned by the image before treatment, and the other values can be ignored.

The last step is to clearly see the difference between the original image and the image after processing is to use the Mkz function, where the function combined with the image above means the image is a grayscale image, combined with the Wiener filter image and the detection image, so that the results what is obtained is as shown in figure 8.Furthermore, the process of processing chest radiographs of tuberculosis patients after 8-month treatment is shown in the pictures below:

Figure 9. Image of grayscale results, for images of chest radiographs of tuberculosis patients after treatment (8 months).

Figure 10. Image size 16 x 16, for chest x-ray images of tuberculosis patients after treatment (8-months).

Figure 11. Image of gray-threshold results, for chest x-ray image after treatment (8-months).

Figure 12. Wiener filter image size of 96x96, for thorax image after treatment (8-months).

Nilai deteksi *Image moments* :

Columns 1 *through* 6

34.052   191.91   14178
1148.4 3.8326e+006 12739

Column 7

-2.6051e+006

Figure 13. Image of edge detection results using the LoG method, for post-treatment images (8-months).

Figure 14. MKZ image results, Merging images above images (gray, wiener, and edge detection). for chest x-ray image after treatment.
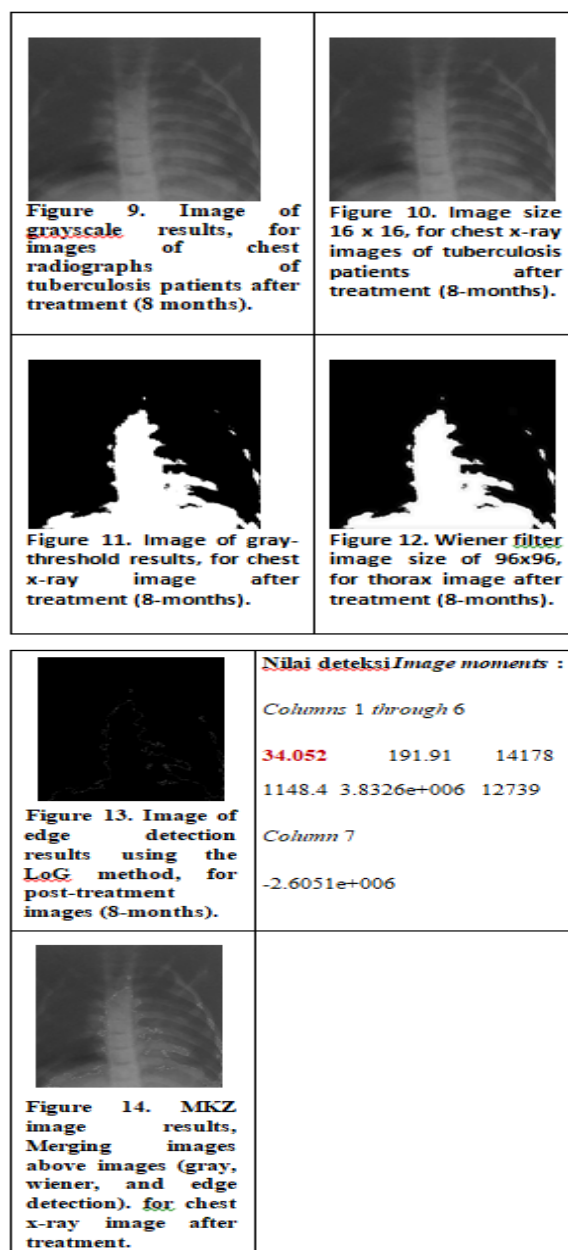
Figure 9, up to Figure 14, is the stage of processing the chest image after 8 months of treatment. After inputting the 8-month image (Figure 2) in matlab, the image will be displayed in the form of a matrix m x n, according to the size of the image (636 x 675 pixels). The process of reading the 8-month image matrix, then through the grayscale stage and produce a digital image matrix on a gray scale (conversion of RGB images to grayscale), thus facilitating the next process. The results

of processing in the grayscale stage can be seen in Figure 9. It turns out that the image has been contaminated with noise. Noise in the image is caused when taking or shooting images using a camera or mobile phone. Therefore, using the 16 x 16 wiener filter technique, the noise reduction process will be carried out. Wiener filter results with a size of 16 x 16 can be seen in Figure 10. The next step is as seen in Figure 11, which is a gray-threshold image that aims to change the dimensions of the image into binary images so that it can distinguish between objects and backgrounds in the image. The Wiener filter technique with a size of 16 x 16 has not eliminated the noise maximally, there is still noise in the image, therefore the Wiener filter technique is done with a size of 96 x 96 so that the noise decreases and can facilitate the next process, the results can be seen in Figure 12 Next step is edge detection using the LoG method and the results obtained as shown in Figure 13.

For detection using the image moment method the result is values (figure 13), which shows the characteristic of the image. Values from Column 1 to Column 7 show the seven moments value images of images after treatment. The center value of mass is usually found in the first coulomn, which is 34,052 after treatment, whereas other values can be ignored. The last step that is done to clearly see the difference between the original image and the image after processing is to use the mkz function, where the function is combined with grayscale, wiener filter and edge detection images so that the results obtained are as shown in the picture 14.

2. Differences in chest photo images of tuberculosis patients before and after treatment using the LoG method and the IM method
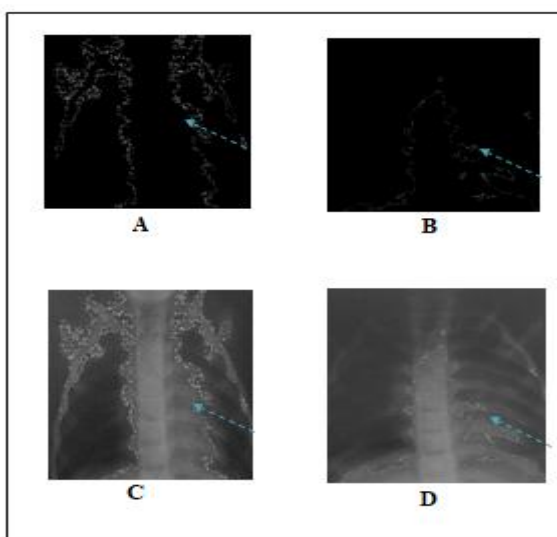
Figure 15. The results of image processing using the LoG method. (a). Results of edge detection of chest radiograph before treatment, (b). Results of edge detection of chest radiograph after treatment, (c). The results of combining grayscale images, Wiener filters and edge detection in pre-treatment images, (d). The results of combining grayscale, wiener filter images and edge detection in images after treatment.

Figure 15 clearly shows the difference in the results of edge detection image processing using the Laplacian of Gaussian method. The chest photo image before treatment in figure (a) still appears to have many white dots, or call it a contour which is a condition caused by changes in the intensity of neighboring pixels, because there is a change in the intensity of the image then the edge- the edge of the object in the image can be detected. For more details, the Mkz function is used in figure (c) with the aim to clearly see the difference between the original image and the image after processing, where the function is combined between grayscale, wiener filter and edge detection images so that the results can distinguish the image before and after processing, in contrast to figure (a) picture (b) it is clearly seen that there has been a change in the white dots called the contour, it seems to have been reduced when compared to figure (a) and for more details it is used Mkz function in figure (d) with the aim to be able to clearly see the difference between the original image and the image after processing, where the function is combined between the grayscale image, wiener filter and edge detection, and the results can distinguish before and after images processing.

Table 1. Comparison of the value of image moment detection for chest x-ray images before and after treatment.

| The value of image moments detection for images before treatment			The value of image moments detection for images after treatment		
Columns 1 through 6			Columns 1 through		
8.833	10.23	29.919	**34.052**	191.91	14178
40.026	1385.1	-34.904	1148.4 3.8326e+006		12739
Column 7			*Column* 7		
-10.686			-2.6051e+006		

Based on the table above, the image before treatment of the moment invariant detection value or the 7 invariant moments is as follows:

Columns 1 through 6					
8.833	10.23	29.919	40.026	1385.1	-34.904
Column 7					
-10.686					

For the value in the first column it usually shows the center value of mass of an image, so that the image of the chest before treatment has a mass center value of 8,333, and for the absolute difference the moment invariant value from the smallest to the results of this experiment is in column number 6 which is -34,904 and the biggest moment invariant value is column number 5 which is 1385.1, moment invariant value on the image of the chest before treatment is relatively small when compared with the chest image after treatment where the mass center value is 34,052, for absolute difference the moment invariant value of the smallest for this experiment is column number 7 which is 2.6051e + 006, and the largest value is column number 3 which is worth 14178. Based on the invariant moment value possessed by the image of the chest before and after treatment it can be said that the chest photo image of the tuberculosis patient before treatment is able The moment invariant value is relatively small when compared with the chest x-ray image after treatment with a relatively large value. The part of the film that has more particles in this case bacteria, will have a very large part or region of white due to low penetrating power. The size of the white color on the rotgen image before treatment causes a shift in the center point of mass approaching the center, or can be said because the number of bacteria in the image before treatment, the value of the center decreases because it shifts closer to the center of mass, while the image after treatment the number of bacteria has decreased, the shift value is greater, because it does not approach the center of mass, and has higher penetrating power and causes the film portion the lung will be darker, so that the whiter area is only dominated by the spine and leg bones. The value of the center point will shift on one side, because it is whiter the collarbone so that the value of the center point shifts away from the center of mass and approaches the edge in this case approaching the collarbone. The value of the moment image is very dependent on the region that has the weight, for example it has been explained about shifting the value of the center point from the center of the mass approaching one side, the intended side is the leg bone. So that the further the center point of the center of mass,

the bacteria will decrease. That is the reason why the image after treatment the center point value is relatively large compared to the image before treatment.

Figure 16 shows the results of the comparison of the value of the image moment in the image before and after treatment.
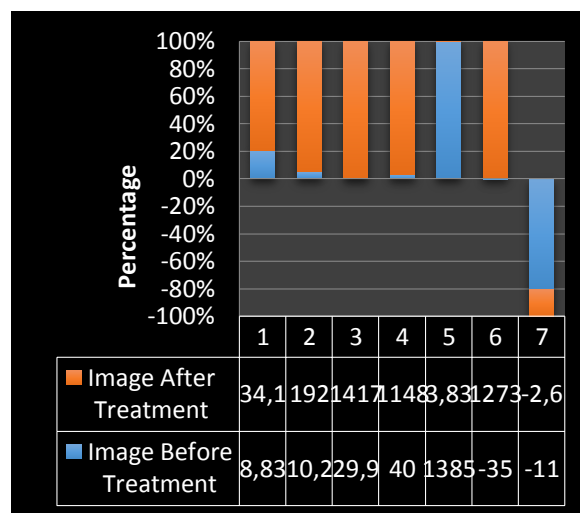
Figure 16. Histogram graph shows the difference in the value of the image moment in the image before and after treatment

Based on Figure 16, it can be shown that there is a difference between the invariant moment value on the chest image of the tuberculosis patient before and after treatment where the IM value of the image before treatment is relatively small compared to the IM value for the post-treatment (relatively large) image. Image processing in order to obtain good quality images, in this case it is easy to interpret by humans, as well as computers, and can reinforce suspicions about medical images. By using the LoG method, and the IM method as one of the comparison methods. In addition to testing the results of edge detection whether in accordance with the algorithm that has been made, also calculated the time needed from pre-processing to completion of edge detection. This time calculation is done to find out whether the edge detection process based on LoG and IM is effective to do. Based on the research that has been done to get the time needed to run the program for the image before treatment was 41.4531 seconds and for the post-treatment image 42,625 seconds.

CONCLUSIONS

1. Improving the quality of chest radiographs of TB patients can be done using the Laplacian of Gaussian method, and as a comparison method, the image moment method is used.

2. The LoG method can display the edges of the image clearly, and the IM method can show the center value of mass possessed by the two images of the thorax, the farther the value of the center point of the center of mass, the bacteria will decrease.

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