Region of Interest Detection for Pregnancy Image Processing

M. Khairudin
Mechatronics Engineering
Education Dept.
Faculty of Engineering,
Universitas Negeri Yogyakarta
Yogyakarta, Indonesia
moh_khairudin@uny.ac.id

Joko Laras B T
Electrical Engineering
Education Dept.
Faculty of Engineering,
Universitas Negeri Yogyakarta
Yogyakarta, Indonesia
djoko_laras@uny.ac.id

Dessy Irmawati
Electronics Engineering
Education Dept.
Faculty of Engineering,
Universitas Negeri Yogyakarta,
Yogyakarta, Indonesia
dessy.irmawati@uny.ac.id

***Abstract*— This study discussed on a comparison of three cropping techniques for region of interest (ROI) detection of ultrasonography (USG) image. Ultrasound images are used to provide information about fetal development in the womb. The image generated by the two-dimensional ultrasound has not been able to provide complete information. Therefore, in order get the form of fetus on ultrasound image can be clearly identified with the necessary process of image analysis that can detect the boundaries of objects ROI, so that it can differentiate between one object with another object on the ultrasound image. Comparison results between the ROI detection with cropping methods namely rectanguler, circle and ellipse shapes are expected obtaining the best technique. It can be used in the ultrasound image segmentation process to obtain the best shape of the object of USG image. Based on the available data it can be concluded that the best ROI detection with cropping methods is produced by ellipse shape. The results show that ellipse shape of ROI Detection has the best accuracy compared to other cropping shapes. Based on the results, rectanguler and circle have the similar value. Therefore, MSE of ellipse is lower than rectanguler and circle shapes.**

***Keywords*— detection, image, ROI,USG.**

I. INTRODUCTION

Ultrasound uses for measurement, detection, medical imaging, and cleaning. Most crucial roles such as blockage of urine flow, cancer, congenital anomalies, swelling, predict kidney size, position, and appearance, stones and other cases can be played by ultrasound images [1] and [2]. Processing digital image is one solution to measure the image. Computer programming is used to perform image processing on digital images. The callenging task in image processing consists of low contrast in ultrasound images, several speckle noises and kidney detection. Speckle noise give more impact to analysis the image such as fine details which limit the contrast resolution, ultrasound image affects edges and make diagnostic more difficult. Speckle noise is similary with a multiplicative noise that very difficult to remove. A technique to minimise a speckle noise with converting to additive noise [2], thus it can be cleaned from ultrasound image.

In this study presents the investigation of ultrasound carried out on pregnant women. Based on the ultrasound existed, a growth of new fetal heartbeat can be analysed on gestational the age of 16-18 weeks. Ultrasound technology development was impoved to be more sophisticated, ultrasound shown in a variety of dimensions, including ultrasound two, three, or four dimensions [3]. The advantages and disadvantages for the types of ultrasound can be concluded that more higher dimensions shown on the monitor will give impact on more expensive the price of equipments.

Shruthi [2] presented these purposes for speckle removel in medical ultrasound imaging are (1) to improve the analysis and human interpretation of ultrasound images (2) make despeckling that is the preprocessing step for many ultrasound image processing tasks such as segmentation and registration. To analyse the image, it should be accurately with the noise. Noise is an undesired information that contaminates images. Edge detection techniques allow to observe features of an image which have a more or less abrupt change in gray level or texture that indicate the end of one part of the image [4]. M. Khairudin [5] presented comparison results between the edge detection methods namely Sobel, Prewitt and Canny are expected obtaining the best technique. It can be used in the ultrasound image segmentation process to obtain the best shape of the object of USG image.

Otherways, Wan and eko [6] revealed USG image contains speckle noise, performing the segmentation methods for the kidney images has always been a very challenging task. For making segmentation purpose, deleting and removing the complicated background not only speeds up the segmentation process, but also increases accuracy. However, in previous studies, the ROI of the kidney is manually cropped. Therefore, proposed automatic region of interest (ROI) generation for kidney ultrasound images. The methods consist of the speckle noise reduction using Gaussian low-pass filter, texture analysis by calculating the local entropy of the image, threshold selection, morphological operations, object windowing, determination of seed point and last but not least the ROI generation. This algorithm has been tested to more than 200 kidney ultrasound images.

In order to make clearly the image, Das and Kundu [7] have proposed a blind, fragile and Region of Interest (ROI) lossless medical image watermarking (MIW) technique, providing an all-in-one solution tool to various medical data

978-1-5386-0549-3/17/$31.00 ©2017 IEEE

distribution and management issues like security, content authentication, safe archiving, controlled access retrieval and captioning. Other method introduces a model for the region of interest (ROI) in order to adapt the grid to the ROI. In addition, a technique based on normalized convolution is proposed for the interpolation problem [8].

This study explored the ROI method to find out the image object more clearly. In this study can find the each object for USG images. The result can be used for processing these images especially USG images to get the representative of image object in clearly and smooth.

II. METHOD

In order to find the fitness data, begining from image data collection pregnancy. Thus, the images were proceed with the image processing. Image data processing is conducted with the following steps (1) converting the data of USG image to the form of digital, (2) continued by ROI analysis. In this process also conducting analysis with Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR), (3) ROI detection with various cropping shapes, (4) the final step this study is ROI analysis using with MSE and PSNR analysis. Based on MSE and PSNR analysis from the three methods, this study has compared the various shaping results to get the best performance of image. To analysis the images using ROI can be found at Fig 1.

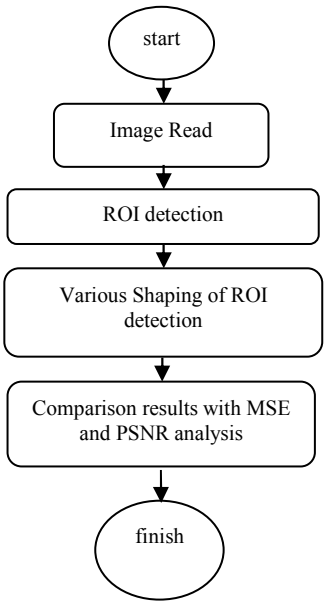

Fig.1. Image processing for ROI

These techniques in the process of fetal ultrasound image using a region of interest with various shapes of ROI can be presented in Figure 1. The image data are analysed and performed with the value of MSE and PSNR by the following equations:

$$MSE = \frac{1}{r * s} \sum_{i=0}^{r-1} \sum_{j=0}^{s-1} [T(i,j) - U(i,j)]^2 \quad (1)$$

$$PSNR = 10 * log_{10} \left(\frac{MAX_T^2}{MSE} \right) \quad (2)$$

where r and s are image dimensions while i and j are image coordinates respectively.

III. RESULTS AND DISCUSSIONS

In this study has been conducted analysis for ROI detection with varoious cropping shapes for USG image. This study to find the image crearly and more smooth in detecting the spicific part of a vetal in the womb. In this study, the image processing performed in Fig. 2 is show the age of fetal below:

Fig. 2. The Basic Image

ROI steps are conducted with various shapes of cropping. Furthermore, Fig. 3 presents the ROI detection that conducted by cropping in various forms namely as rectanguler, square, circle, ellipse and polygon. In this study analysed the USG image only in the forms of rectanguler, circle and ellipse croppings for the part of head and shoulder.

Fig. 3. ROI detection with various shapes

ROI detection for head and shoulder of vetal with cropping in rectangular shapes can be seen at Fig. 4 and 5 respectively. To analysis the performances of ROI detection process with rectanguler shape for head and shoulder parts used comparison of mean square error (MSE) and peak signal to noise ratio (PSNR) can be seen at Table 1. Table 1 presents cropping of the head and shoulder of the fetus with rectangular shape shows the greatest MSE value compared to other cropping shapes. It shows the cropping image of head and shoulder of the fetus with rectangular shapes have several errors to the observed images.

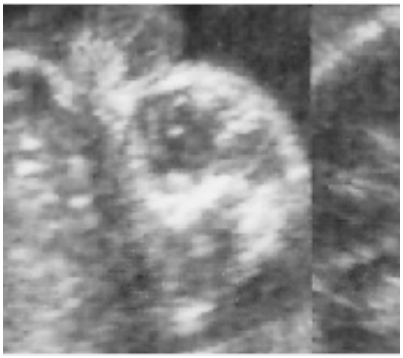

Fig. 4. ROI detection on fetal head with rectanguler shape

Fig. 5. ROI detection on fetal shoulder with rectanguler shape

Furthermore, the ROI detection for head and shoulder of vetal with cropping in circle shapes can be seen at Fig. 6 and 7 respectively. Table 1 shows the MSE and PSNR values for cropping with circle shape are both in medium values. It means the results of circle shape cropping for the head and shoulder of the fetus are not enough clear and smooth compared with ellipse shape cropping. But the performance of circle shape cropping for the head and shoulder of the fetus are more better in clearly and smooth compared with rectanguler shape cropping.

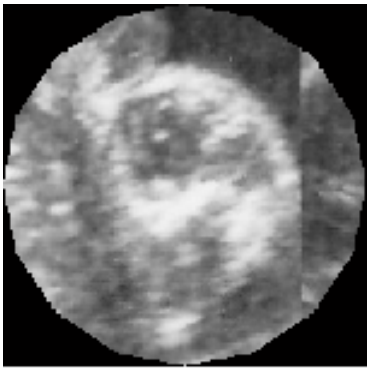

Fig. 6. ROI detection on fetal head with circle shape

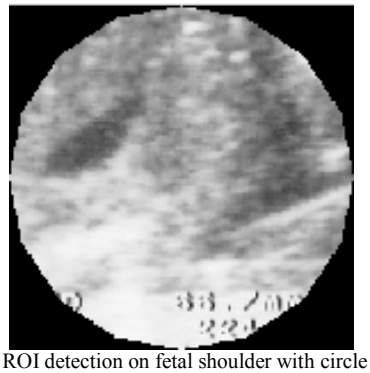

Fig. 7. ROI detection on fetal shoulder with circle shape

In order to analysis the ROI detection for head and shoulder of vetal with cropping in ellipse shapes can be seen at Fig. 8 and 9 respectively. Table 1 shows the MSE values for cropping with ellipse shape for head and shoulder of vetal are both in the smallest values. It means the cropping with the shape of ellipse can give the best performance to detect the ROI for head and shoulder of vetal. The comparison performances between the cropping with rectanguler, circle and ellipse shapes can be found in Table 1, it is found that cropping with the shape of ellipse can give more better performance compared with rectanguler and circle shapes.

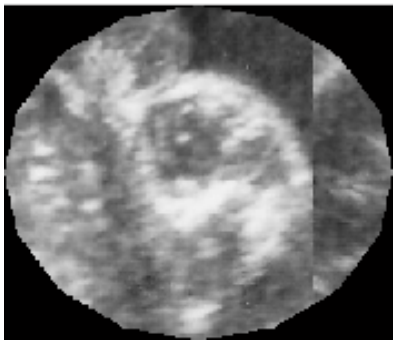

Fig. 8. ROI detection on fetal head with ellipse shape

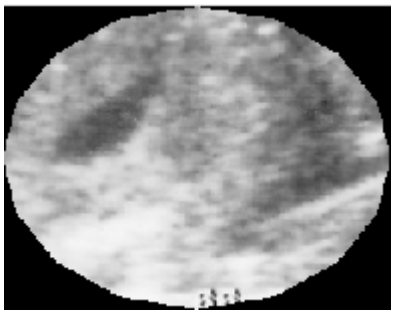

Fig. 9. ROI detection on fetal shoulder with ellipse shape

To analysis the performances of ROI detection process used comparison of mean square error (MSE) and peak signal to noise ratio (PSNR) can be seen at Table 1.

TABLE I. COMPARISON MSE AND PSNR FOR ROI DETECTION ON HEAD AND SHOULDER PARTS.

No	ROI Shape	Kepala		Shoulder	
		MSE	PSNR	MSE	PSNR
1	Rectanguler	1.5216e+003	16.3077	433.9539	21.7564
2	Circle	1.0407e+003	17.9573	280.2270	23.6557
3	Elips	1.1182e+003	17.6454	313.7387	23.1651

Based on experiments that have been carried out, the image of the ROI on the path of head and shoulder with the three shapes namely rectanguler, circle and ellipse then compared. The results of ellipse shape detection method produces better output than the methods of rectanguler and circle shapes. The ellipse shape method looks more detail, compared to others. The rectanguler and circle shapes has a value of MSE are more similar, with a value greater than the ellipse shape. The PSNR of image that detected by ellipse shape can reach a more higher value for head and shoulder of vetal images. The ROI detection produced by the method of ellipse detection is more perfect compared to others, because the resulting lines of ROI detection with ellipse shape with morphology's are more smooth and clearly.

IV. CONCLUSSION

In this study has generated ROI detection in three shapes, namely rectanguler, circle and ellipse. Based on the available data it can be concluded that ROI detection can reach the best results through ellipse shape detection. With ellipse shape detection showed a morphology lines generated is more smooth and clearly. In this study most of the segmentation process ultrasound images using ellipse reached the smallest and more higher value for MSE and PSNR values respectively.

Acknowledgment

The authors will express the gratitude to PIU-IDB Project Universitas Negeri Yogyakarta and ministry of research, technology and higher education of Republic of Indonesia for the research funding.

References

[1] Wan M. Hafizah, Eko Supriyanto, (2012), Automatic generation of region of interest for kidney ultrasound images using texture analysis, International Journal Of Biology And Biomedical Engineering, issue 1,Volume 6, 2012.

[2] B. Shruthi, "Detection of Kidney Abnormalities in Noisy Ultrasound Images," vol. 120, no. 13, pp. 27–32, 2015.

[3] M. Khairudin and D. Irmawati, "Comparison Methods of Noise Elimination for Pregnancy Image Processing," in Int. Conference on Information Technology, Computer and Electrical Engineering (ICITACEE), 2015, pp. 262–265.

[4] Rashmi, Mukesh Kumar and Rohini Saxena, "Algorithm And Technique On Various Edge Detection: A Survey", Signal & Image Processing : An International Journal (SIPIJ) Vol.4, No.3, June 2013

[5] M. Khairudin and I. Dessy, "Comparison Methods of Edge Detection for USG Images," in Int. Conf. on Information Tech., Computer, and Electrical Engineering, 2016, pp. 85–88.

[6] Wan M. Hafizah and E. K. O. Supriyanto, "Automatic Region of Interest Generation for Kidney Ultrasound Images," Recent Res. Appl. Informatics Remote Sens., pp. 70–75.

[7] S. Das and M. K. Kundu, "Effective Management of Medical Information through ROI-Lossless Fragile Image Watermarking Technique," Comput. Methods Programs Biomed., vol. XXX, pp. 1–19, 2013.

[8] J. Ellsmere, R. Kikinis, and C. Westin, "Freehand Ultrasound Reconstruction Based on ROI Prior Modeling and Normalized," MICCAI 2003, pp. 382–390, 2003.