Comparison of Retina Blood Vessel Segmentation Based on K-Means and Fuzzy C-Means

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ABSTRAK-- Hypertension is a disease of high blood pressure, and the occurrence of hypertension can cause changes in the small blood vessels of the retina, causing thickening of the walls in the hair and can narrow the blood vessels that can reduce the blood supply to the retina. In the process of diagnosis of hypertensive disease through the retinal vessels required a good algorithm to separate the blood vessels in the retina, making it easier to diagnose the process of hypertension. The segmentation in this study is to compare the retinal blood vessel segmentation by K-Means method and Fuzzy C means. The result of Peak Signal to Noise Ratio in obtaining average PSNR for K Means is 12,318,224 db and PSNR for fuzzy c means is 13,27424 db, PSNR value shows good segmentation process if value above 40db.

Keyword :K-Means, Fuzzy C Means, segmentasi

I. Introduction

Hypertension is a disease of high blood pressure, and the occurrence of hypertension can cause changes in small blood vessels in the retina, causing thickening of the walls of the pembulu and can narrow the blood vessels so as to reduce blood supply to the retina.bila happening state 4 hypertension leakage can occur in the blood vessels that can resulting in permanent blindness. The doctor will perform a diagnosis of hypertension retinopathy using ophthalmoscope to see the form of changes in the retinal blood vessels. opthalmoscope is a tool for the diagnosis of hypertension retinopathy by direct opthlamoscope and indirect opthalmoscope.

The diagnostic process of retinopathy hypertension requires a rapid detection tool to describe the shape of changes in the blood vessels so that an algorithm is needed to filter out the blood vessels with other parts of the eye. In this diagnosis will be focused on the branching points of the eye blood vessels.

The research process has been done by measuring the diameter of blood vessel that has been done that is applying segmentation process with wavelet transform method then measuring diameter by applying the function of circle in the central measurement area in the vessel pixel window [1], the process of measuring the diameter of blood vessels by applying sliding linear regression filter the segmentation process with the tracing algorithm then measures the diameter by applying the fit stripe algorithm between the edges of the blood vessels [2] and the process of measuring the diameter of the blood vessels based on the magnitude of the light reflection changes in the scanned image, the intensity value of the discrete pixel will be the Gaussian function curve [3].

Good image retinal vein segmentation process will be applied to image segmentation process with fuzzy c means, where fuzzy c means has the ability to detect abnormal retinal blood vessels as well as faster than conventional technique, and not easily affected by the image of noise [4].

In this research will do the comparison of k-means and fuzzy c-means segmentation. The result is the Peak Result Signal to Noise Ratio in the average PSNR yield for K Means is 12.318224 db and PSNR for fuzzy c means is 13,27424 db, PSNR value shows good segmentation process if value above 40db.

II. Research methods

This research method will go through step stages like figure 1, while the stages in this research is

A. Transformas RGB to *Green Channel*

The retina image is in the standard color of RGB (red, green, blue) with three channels red, green and blue. In the process of preprocessing the retina image is used RGB color transformation to green channel, because green channel color has the right saturation composition value compared to red channel which has oversaturated and blue channel which has undersaturated (Kande, 2007)

$$g = 0.2989.R + 0.5870.G + 0.1140.B$$

Where R, G and B are the red, green and blue pixel values (Marwan, 2011)

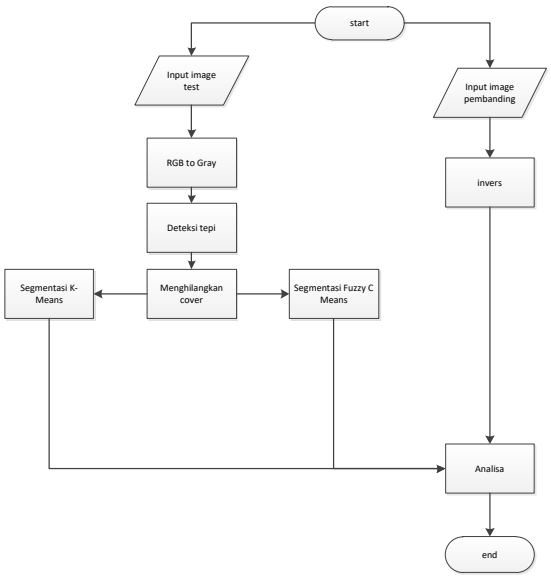

Fig 1. System Scheme

B. Eliminate Retina Cover Image

Eliminating the retinal image cover is a preprosessing process to remove the cover or barrier of the research center area

C. Image Edge Detection

Image edge detection is to obtain a sudden change in the intensity of the gray intensity within a short distance, located at the boundary between two regions of the image and can be oriented in a different direction depending on the intensity change

D. Image Segmentation With Fuzzy C-Means

Image segmentation with Fuzzy C-means is the process of grouping the data (clustering) of image objects into segments, areas or regions, where each segment has characteristics of different characteristics or characteristics with its respective segments. Retinal image data grouping based on channel gray feature. The stages of the Fuzzy C-Means algorithm are

1. specify the data matrix $U = [u_{ij}]$, where $U^{(0)}$
2. on k-step: count the center vector $C^{(k)} = [c_j]$ with $U^{(k)}$

$$c_j = \frac{\sum_{j=1}^{N} u_{ij}^{m} x_i}{\sum_{i=1}^{N} u_{ij}^{m}} \quad (1)$$

3. Update $U^{(k)}$, $U^{(k+1)}$

$$u_{ij} = \frac{1}{\sum_{k=1}^{c} \left(\frac{\|x_i - c_j\|}{\|x_i - c_k\|} \right)^{\frac{2}{m-1}}} \quad (2)$$

4. If $\|U^{(k+1)} - U^{(k)}\| < \varepsilon$, then STOP, after back to step 2. (Bezdek, 1981)

E. Segmentasi Citra Dengan K-Means

Image segmentation with K-means is the process of grouping the data (clustering) of image objects into segments, areas or regions, where each segment has characteristics of characteristics or characteristics different from its respective segments. Retinal image data groupings based on gray channel features, and clusters based on k values. as for the K-mean algorithm is

1. Determine the number of clusters k
2. Calculate the closest distance between data, X is data, c is a cluster

$$J = \sum_{j=1}^{k} \sum_{i=1}^{n} \left\| X_i^{(j)} - c_j \right\|^2 \quad (3)$$

3. Recalculate with new cluster center position
4. Repeat steps 2 and 3 to the unchanged cluster position [5].

F. Testing results of Image Segmentation With Peak Signal to Noise Ratio

In comparison the image is in use signal to noise ratio (SNR) and Peak Signal to Noise Ratio (PSNR), where the greater the value SNR then the value of similarity is getting the same, while PSNR would be well worth it if over 40db

$$PNSR = 10 log_{10} \left(\frac{C_{max}^2}{MSE} \right) \quad (4)$$

where mean squared error (MSE) is

$$MSE = \frac{1}{MN} \sum_{x=1}^{M} \sum_{y=1}^{N} \left(S_{xy} - C_{xy} \right)^2 \quad (5)$$

And value

$$C_{max}^2 \leq \begin{cases} 1, double - precision \\ 255, uint8\ bit \end{cases}$$

III. Result And Discussion

From the results of the retinal vessel segmentation experiments with the method of k means and fuzzy c means will be compared with the way Peak Signal to Noise Ratio in get the average PSNR for K Means is 12.318224 db and PSNR for fuzzy c means is 13,27424 db, PSNR value shows good segmentation process if value above 40db, but FCM result is better than k means

IV. Resume and Suggestion

Application of segmentation in blood vessels with k-means and fuzzy c-means the result of Peak Signal to Noise Ratio better FCM than K means.

Suggestion to the development of this research that is using better segmentation method

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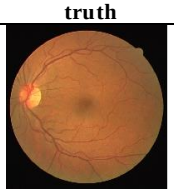
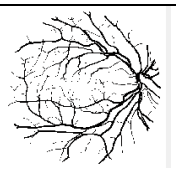
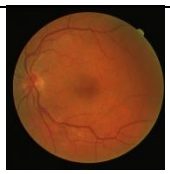
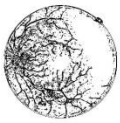
TABEL 1 SAMPLE OF COMPARATIVE SEGMENTATION OF BLOOD VESSES

No	Retina/ Ground truth	Segmentasi K-means	Segmentasi FCM	Segmentasi Manual
1		PSNR = 12.2591 SNR = 12.0182 	PSNR = 13.8773 SNR = 13.6364 	
2		PSNR = 13.4937 SNR = 13.2186 	PSNR = 13.9637 SNR = 13.6886 	
3		PSNR = 10.8399 SNR = 10.5717 	PSNR = 11.9976 SNR = 11.7294 	
4		PSNR = 14.6129 SNR = 14.3658 	PSNR = 14.5755 SNR = 14.3284 	
5		PSNR = 11.5993 SNR = 11.3532 	PSNR = 13.2345 SNR = 12.9884