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Feature Extraction For Application of Heart Abnormalities Detection Through Iris Based on Mobile Devices

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Abstract

World Health Organization (WHO) data in 2012 showed 17.5 million people worldwide died from heart disease or 31% of 56.5 million deaths and examining it by current methods in hospitals is not cheap. Iridology is an alternative medicine technique whose proponents claim that patterns, colors, and other characteristics of the iris can be examined to determine information about a patient's systemic health. One research on computer iridology is about the computer's iridology system to detect heart conditions. There are several stages such as capture eye base on target, pre-processing, cropping, segmentation, feature extraction and classification using Thresholding algorithms. In this study, feature extraction process performed using binarization method by transforming the image into black and white. In this process we compare the two approaches of binarization method, binarization based on grayscale images and binarization based on proximity. The system we proposed was tested at Mugi Barokah Clinic Surabaya. We conclude that the image grayscale approach performs better classification than using proximity.

Keywords: Iridology, Feature Extraction, Grayscale, Binarization, Thresholding.

1. INTRODUCTION

The heart is one of the human organs that play a role in the circulatory system[1]. If our heart stops beating, then we will die. And if there are abnormalities of our heart, it can cause death. Heart disease is a condition that causes the heart can't perform its duties properly. Heart disease can occur because the heart muscle is weak and there is a gap between the right and left atrium because of the imperfect formation that separating layer between the two atriums [2]. According to data from WHO, heart disease is the leading cause of death worldwide. There are 15 million deaths because heart disease in 2015 [3]. Survey of Sample Regristration System (SRS) in

2014 in Indonesia showed, Coronary Heart Disease (CHD) became the highest cause of death at all age after stroke, that is equal to 12,9%. [3].

Most people think the elderly suffer from heart disease. But in fact, any ages can suffer hearti disease, including infants. It happens because unhealthy lifestyle, stress, and heredity factors. When the patient's situation becomes severe usually newly detected heart disease. It is dangerous for patient if they get helped to late or not immediately dealt with. To detect the abnormalities immediately the patient should go to the doctor. Patient must go to the hospital to check their heart condition. They usually use Echocardiogram (Heart USG), Electrocardiography (ECG), CT Scans, and etc [4]. Checking with the devices need a lot cost.

But now, in addition to medical treatment there are alternatives. It is quite popular nowadays. With this alternative method people believe the results are the same as medical and the cost is cheaper. One of the most popular alternative medicine is Iridology. Iridology is an alternative medicine technique whose proponents claim that patterns, colors, and other characteristics of the iris can be examined to determine information about a patient's systemic health. This method believes that pattern on the iris reflects body condition [5]. Ignatz Von Peczely is Hungarian physicist who discovered iridology by examining changes of iris in some patients who are recovering from illness. He created the first Chart of Iris. Dr. Bernard Jensen revised the chart and it is used internationally as shown on Figure 1.

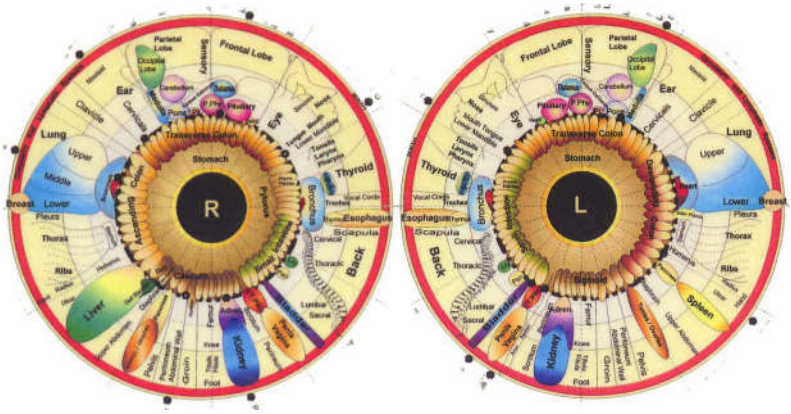

Figure 1. Iris Chart

With Iridology, iris can represent organ conditions of human [6].

Recently, there have been many researchers that do the detection of abnormalities in body. The research is identification of heart abnormalities using digital image pattern on electrocardiogram. An electrocardiogram records the electrical activity of the heart over time. How to find heart abnormalities is to analyze the pattern of the resulting line chart to determine certain crucial points on the line graph used for comparison in the system.[7]. Another a complex wave detection algorithm QRS is used in cardiac alerts warning system based on 8 bit microcontroller. It is observing the level wavelet decomposition and reconstruction to get the value of noise.

The result can be seen from the comparison of before and after the removal process wavelet noise variations in quality ECG significant gesture. The parameters of the wave Q, R, S and T cue ECG recordings can be known. [8]. Using the Bayes algorithm to generate high accuracy values to classify liver abnormalities [9]. Riyanto et.al create healthcare kiosk is used as an alternative to the health care facilities [10].

There are several studies that analyze the heart detection using a computer. Combining image processing and iridology to produce a system of body health detection through computerized iris. Using Visual C # and KNN algorithm to analyzed the condition of the kidneys through the iris of eye [11]. Present the difference auto and manual crop by dividing the iris image into 3 parts to get the iris area. The system using Visual C# to process and analysis the data [12]. And an application that has a method to cuts image automatically. Imagery series to get the iris image from the original image by automated process using desktop-based histogram projection. [13].

After presented study of automatic cropping [14], in this paper we presented feature extraction process performed using binarization method by transforming the image into black and white. In this process we compare the two approaches of binarization method, binarization based on grayscale images and binarization based on proximity.

2. RELATED WORKS

In iridology it is believed that certain positions has very close relationship with every organ in the body. Iris image segmentation is one of the most important steps in the process of the iris diagnosis, and the iris localization is a very critical step for the iris image segmentation. The quality of the iris localization directly affects the accuracy of the following operations. Different approaches have already been reported in the literature to locate the iris region and feature extraction. A 2-D Gabor filter based texture analysis and a texture fractal dimension estimation method are proposed for pathological feature extraction; and at last support vector machines are constructed to recognize[15].

This article proposed feature extraction for the heart location in Iris using binarization method by transforming the image into black and white. We will try to compare the two approaches of binarization method, binarization based on grayscale images and binarization based on proximity.

3. ORIGINALITY

For the purpose of identifying abnormal heart through mobile based iris, this study performs several stages such as capture eye base on target, pre-processing, automatic cropping, segmentation, feature extraction and Thresholding algorithms for classification. Success in feature extraction will affect success in the next process. So study it for our Application of Heart Abnormalities Detection Through Iris Based on Mobile Devices.

4. SYSTEM DESIGN

The General Design System is illustrated in Figure 2. The important phase is Pre-processing to get area of iris that required to get the position of heart. This result is impact on iris recognition process. This phase will make high quality of the original image and determine the success result of auto cropping. In this research, we use twice cropping, there are cropping image based on target and auto cropping based on histogram analysis. Then, the image will be segmented to get ROI of heart. This part is important to determine the abnormalities of heart.

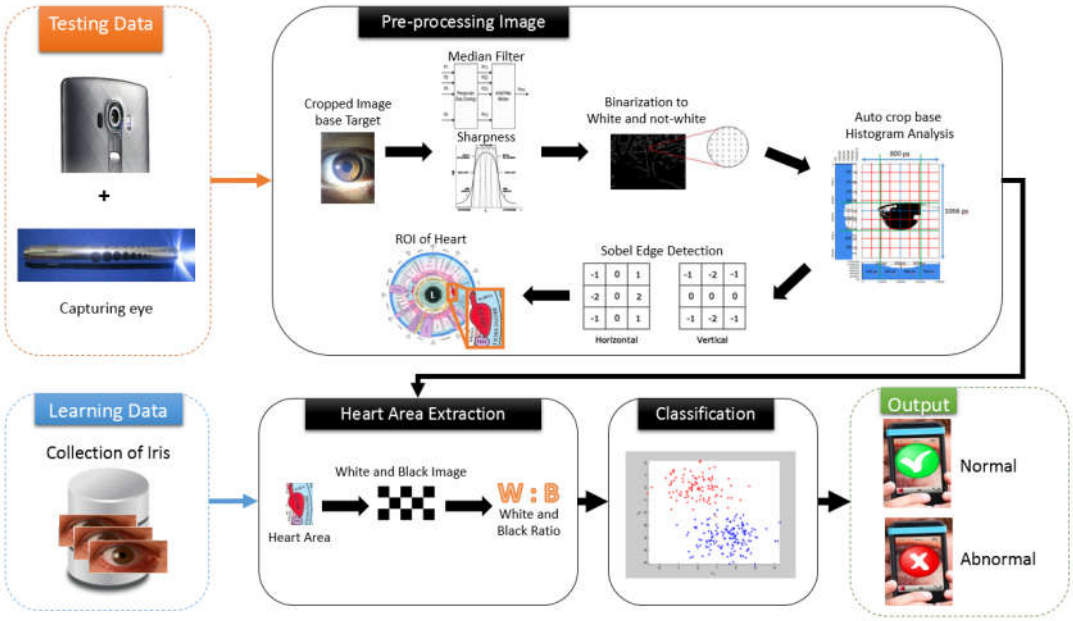

Figure 2. General Design System

4.1 Image Data

The image data that used for data training obtained from Mugi Barokah clinic patients as shown in figure 3. It takes by camera with a high resolution and supports macro technology so the image has a good quality.

(a)

(b)

Figure 3. (a) Normal Heart image (b) Abnormal Heart Image as Data Training from Mugi Barokah Clinic

And the image data that used for data test obtained from mobile device camera. The image is taken using an application that built on android devices. This application has a camera custom activity to take the iris. In the center of it, there is a target which always appears that helps us to focus on the acquisition of iris image. The iris must be exact in the center.

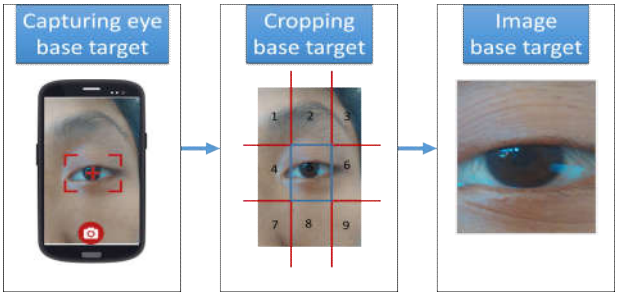

Figure 4. Illustration of cropping based on target

After getting the image, the images will be cropped using automatic cropping based on target according to Figure 4. The cropping is dividing the width and height into three. The taken image is divided into nine sections. The image will be cropped into 1/3 to 2/3 of width image and 1/3 to 2/3 of height image. The result is taken from the fifth section. After the image cropped, it will be resized into 800x1066 pixels.

When taking image need to use an additional light from health flashlight and the best lighting for the acquisition of iris image is white color. By using this health flashlight can show the details of the iris as described in Figure 5.

Figure 5. Capture eyes using additional light and not

The intensity of light given from the flashlight will impact at this process. Those three images produce different result while transforming to biner. The first image is an image with ideal lighting. The light is at the center of the image and doesn't produce any shadow. So it produces the iris area completely as Figure 6 (a). The second image is an image with over lighting. The over lighting made the image looks too white. The iris reflected the light from the light. When it convert to the biner, the iris area isn't completely

illustrated in Figure 6 (b). The third image shows an image with properly lighting but the light is too slant. The lighting makes a shadow beside the iris area. It will make the shadow turn into black when it converted to biner. The shadow looks like the addition in iris area as Figure 6 (c).

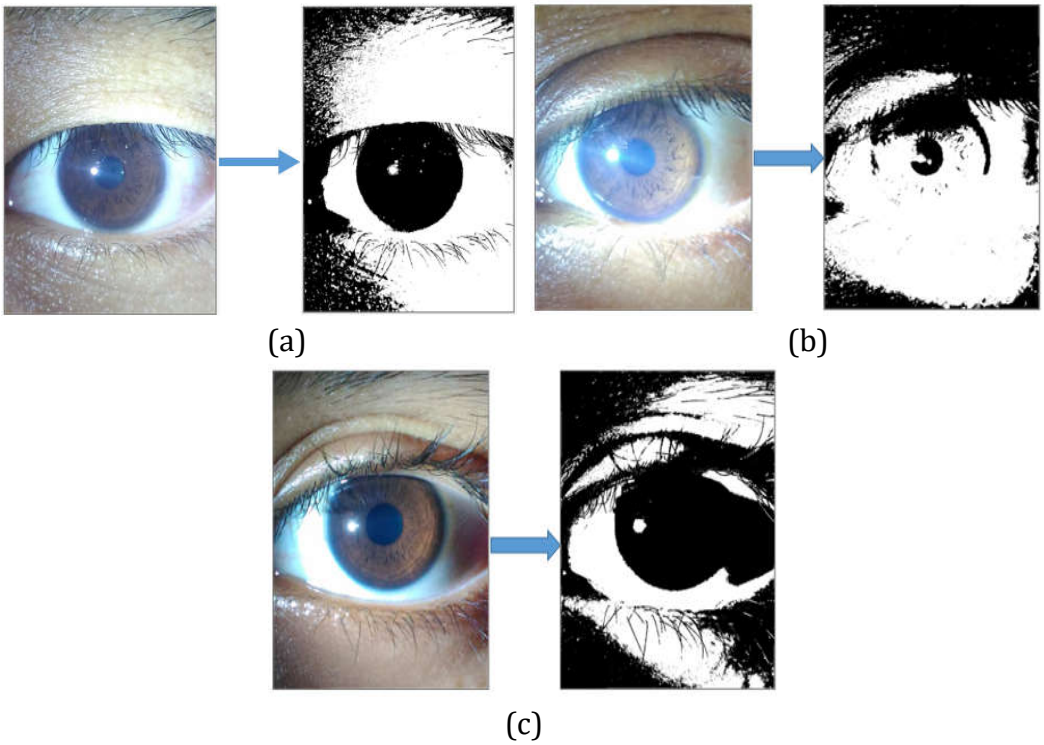

Figure 6 (a) Ideal, (b) Over, and (c) Slant of Lighting

4.2 Median Filter

We use median filter to soften and remove noise in the eye image. This filter replaces the center value in the window with the median of all the pixel values in the window such illustrated in Figure 7.

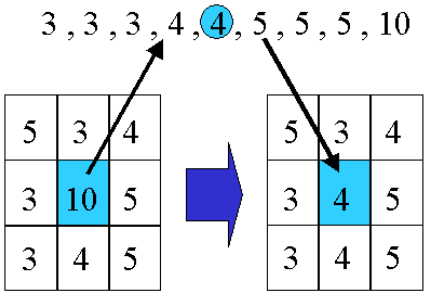

Figure 7. Median filter

4.3 Sharpness

Sharpness is a technique for increasing the *apparent* sharpness of an image. The High Pass Filter and Low Pass Filter is the most method to sum up. We used Median Filter for the Low Pass Filter and Sobel Operator for High Pass Filter.

4.4 Binarization Image

Before performing the auto-cropping to get iris image, the sharpened image should be converted to a binary image. The binary image has only two possible values for each pixel. Typically, the two colors used for a binary image are black and white. In this study image converted into white and not white. Proximity is using for conversion of the original image into a binary image. Euclidian distance formula is using for Distance calculations.

$$\text{dist}((x, y), (a, b)) = \sqrt{(x - a)^2 + (y - b)^2} \qquad (1)$$

A threshold is used to determine whether the pixel is included black or white and the value that used in this study is 175. With this threshold if the value exceeds then changed to black color, and if less than or equal then changed to white. Threshold value is derived from the average learning data and searched for each first threshold value.

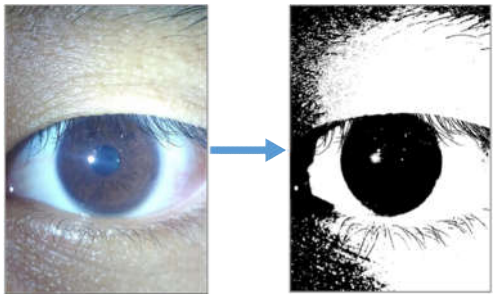

Figure 8. Binarization Image

4.5 Auto Cropping based on Histogram Analysis

After getting binary image, it will be analyzed to perform the auto cropping. This phase aims to get the area of iris. The cropping method performed by observing the pattern of the histogram. The image width will be divided into 8 sections and the image height will be decided into 10 sections.

4.5.1 Histogram

The histogram is calculating the color distribution of binary image. The cumulative value of pixel white vertically and horizontally showed by this histogram. To get the boundary of iris that used to cropping iris, the image histogram will be checked. If there is higher change in histogram pattern, it is taken to calculate the difference value change in pixel by next

pixel. The left and right point is taken from the highest changed value on the horizontal histogram. The value is seen from 1/8 to 3/8 of the total width of the image pixel for left point and from 5/8 to 7/8 of the total width of the image pixel for right point. The top and bottom point is taken from the highest changed value on the vertical histogram. It illustrates in Figure 8.

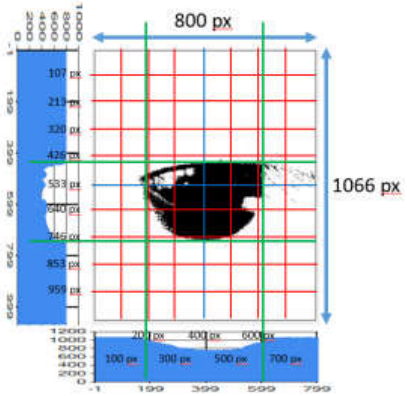

Figure 9. Histogram vertical and horizontal

The value is seen from 3/10 to 5/10 of the total width of the image pixel to get the left point and from 6/10 to 8/10 of the total width of the image pixel to get the bottom point. Then the image will be cropped in accordance with the obtained boundary before.

4.6 Edge Detection

After getting the image cropped, it will be processed in feature extraction and applying edge detection. Edge detection makes extract the lines on iris and produces a detailed and clearly iris image. Sobel method is using to perform edge detection in this study, which ia applying Sobel operator uses 3x3 kernel to calculate the gradient x and y.

4.7 Segmentation on ROI of Heart

The result of the previous process will be segmented to get ROI of heart. This process is focused on taking the part that represents the area of heart from iris image. Heart area is mapped on left eye at 02.20-03.10 o'clock on Iris Chart. The strategy to take heart area, the image of iris will be divided into 32 section as shown on Figure 10.

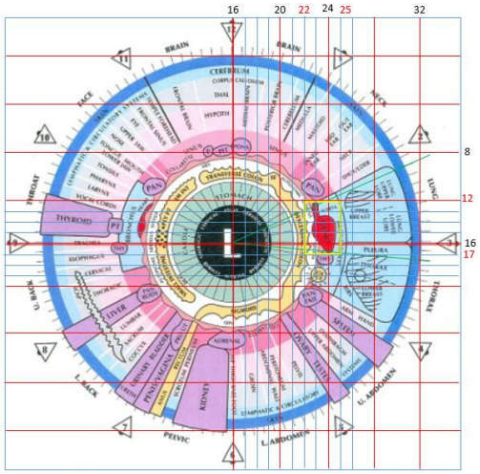

Figure 10. ROI of Heart

Based on the division of Iris in order to get the heart area, it can be seen that the boundary region as follows:

- left : 22/32 of width image
- right : 25/32 of width image
- top : 12/32 of height image
- bottom : 27/32 of height image

4.8 Feature Extraction

Aimed of Feature extraction to obtain the critical information of ROI heart. This method calculate the number of black and white pixels divide with the pixel total of the image. The ratio of white and black can be calculated by:

$$\text{Ratio of White} = \frac{Total\ White}{Total\ Pixels} \quad (2)$$

$$\text{Ratio of Black} = \frac{Total\ Black}{Total\ Pixels} \quad (3)$$

In this study, feature extraction process performed using binarization method by transforming the image into black and white. In this section will try to compare the two approaches of binarization method, binarization based on grayscale images and binarization based on proximity.

4.9 Classification

This research is using thresholding algorithm to perform classification phase. The ratio obtained in each of image data after the extraction process will be classified. The results of this process will be used as training data to

examine the data captured by the camera smartphone. Here is a classification thresholding algorithm.

1. Determine threshold for analyze the test data.
2. Categorize label for the data that is less than the threshold and over threshold.
3. Label the data according to its category, namely normal and abnormal.

5. EXPERIMENT AND ANALYSIS

Binarization Based on Grayscale Images changes the grayscale image into a binary image with a threshold. The threshold used in this study is 50. According to the Table 1 and 2, it can be taken the average ratio of black and white pixels in the images normal and abnormal heart. The average ratio of black and white pixels to the normal heart image are 0.855 and 0.145. While the average ratio of black and white pixels to abnormal heart image are 0.594 and 0.406.

Table 1. Results of Feature Extraction Binarization with Grayscale Image to The Training Data of Normal Heart

No	Img	Black Ratio	White Ratio	Pixel Total
1	IMG_2018	0.934	0.066	273
2	IMG_2119	0.838	0.162	198
3	IMG_2143	0.846	0.154	273
4	IMG_2178	0.93	0.07	187
5	IMG_2212	0.838	0.162	160
6	IMG_2223	0.737	0.263	209
7	IMG_2246	0.942	0.058	240
8	IMG_2282	0.764	0.236	209
9	IMG_3032	0.748	0.252	286
10	IMG_3077	0.965	0.035	198
11	IMG_3088	0.762	0.238	240
12	IMG_3111	0.843	0.157	286
13	IMG_3338	0.88	0.12	109
14	IMG_3376	0.984	0.016	190
15	IMG_3600	0.82	0.18	228

Table 2. Results of Feature Extraction Binarization with Grayscale Image to The Training Data of Abnormal Heart

No	Img	Black Ratio	White Ratio	Pixel Total
1	IMG_2235	0.649	0.351	308
2	IMG_2364	0.601	0.399	228
3	IMG_2409	0.627	0.373	209
4	IMG_2862	0.679	0.321	209
5	IMG_2873	0.574	0.426	209
6	IMG_2921	0.659	0.341	273
7	IMG_3044	0.667	0.333	336
8	IMG_3099	0.506	0.494	170
9	IMG_3122	0.519	0.481	160
10	IMG_3178	0.556	0.444	198
11	IMG_3543	0.393	0.607	308
12	IMG_3633	0.596	0.404	198
13	IMG_3872	0.542	0.458	286
14	IMG_3998	0.702	0.298	198
15	IMG_4164	0.711	0.298	273
16	IMG_4839	0.612	0.388	209
17	IMG_7833	0.506	0.494	405

From the graph shown in Figure 11, white and black ratio of the normal and abnormal image plotted and it could be seen that between them are separated. For normal is in the lower-right axis and the value of the black ratio is more than white ratio. While the abnormal is in the upper-left axis and the value of the white ratio is more than black ratio.

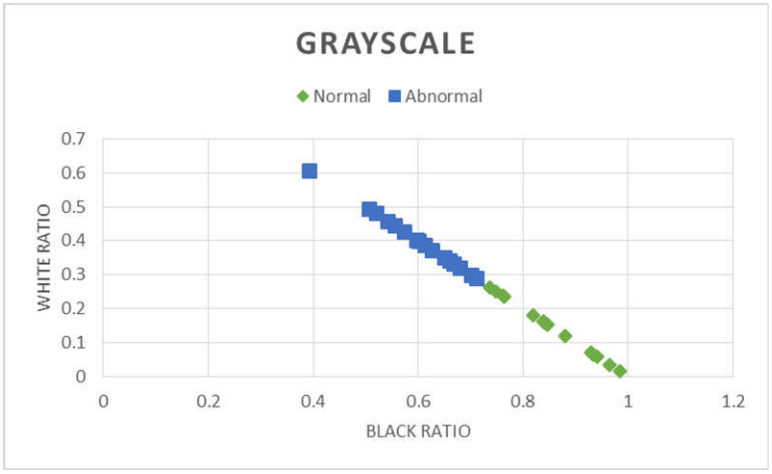

Figure 11. Graph Feature of Black and White Pixel Ratio

Binarization Based on Proximity is the same technique to the stage of binarization to white and not-white. The proximity in every pixel of the ROI

image will calculate with the white color (255,255,255). The proximity that used as the threshold is 350.

Table 3. Results of Feature Extraction Binarization with Proximity to The Training Data of Normal Heart

No	Img	Black Ratio	White Ratio	Pixel Total
1	IMG_2018	0.938	0.062	240
2	IMG_2119	0.848	0.152	170
3	IMG_2143	0.861	0.139	240
4	IMG_2178	0.947	0.053	160
5	IMG_2212	0.856	0.144	160
6	IMG_2223	0.756	0.244	180
7	IMG_2246	0.942	0.058	209
8	IMG_2282	0.766	0.234	180
9	IMG_3032	0.78	0.22	252
10	IMG_3077	0.97	0.03	170
11	IMG_3088	0.783	0.217	209
12	IMG_3111	0.85	0.15	252
13	IMG_3338	0.89	0.11	180
14	IMG_3376	0.989	0.011	162
15	IMG_3600	0.829	0.171	228

Table 4. Results of Feature Extraction Binarization with Proximity to The Training Data of Abnormal Heart

No	**Img**	**Black Ratio**	**White Ratio**	**Pixel Total**
1	IMG_2235	0.679	70.321	273
2	IMG_2364	0.601	0.399	198
3	IMG_2409	0.656	0.344	180
4	IMG_2862	0.684	0.316	180
5	IMG_2873	0.579	0.421	209
6	IMG_2921	0.667	0.333	240
7	IMG_3044	0.682	0.318	336
8	IMG_3099	0.535	0.465	144
9	IMG_3122	0.538	0.462	135
10	IMG_3178	0.571	0.429	170
11	IMG_3543	0.412	0.588	273
12	IMG_3633	0.626	0.374	170
13	IMG_3872	0.549	0.451	252
14	IMG_3998	0.742	0.258	170
15	IMG_4164	0.729	0.271	273

16	IMG_4839	0.632	0.368	209
17	IMG_7833	0.523	0.477	405

From the graph shown in Figure 12, white and black ratio of the normal and abnormal image plotted and it could be seen that between them are separated. For normal is in the lower-right axis and the value of the black ratio is more than white ratio. While the abnormal is in the upper-left axis and the value of the white ratio is more than black ratio.

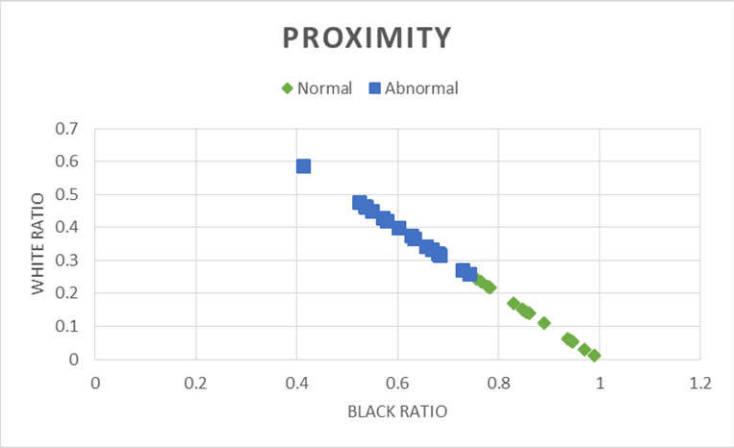

Figure12. Graph Feature of Black & White Pixel Ratio

Table 5. Result of Classification to Training Data

Img	Target	Classification Result	
		Grayscale	Proximity
IMG_2018	Normal	N	N
IMG_2119	Normal	N	N
IMG_2143	Normal	N	N
IMG_2178	Normal	N	N
IMG_2212	Normal	N	N
IMG_2223	Normal	N	N
IMG_2246	Normal	N	N
IMG_2282	Normal	N	N
IMG_3032	Normal	N	N
IMG_3077	Normal	N	N
IMG_3088	Normal	N	N
IMG_3111	Normal	N	N
IMG_3338	Normal	N	N
IMG_3376	Normal	N	N
IMG_3600	Normal	N	N
IMG_2235	Abnormal	AN	AN
IMG_2364	Abnormal	AN	AN

IMG_2409	Abnormal	AN	AN
IMG_2862	Abnormal	AN	AN
IMG_2873	Abnormal	AN	AN
IMG_2921	Abnormal	AN	AN
IMG_3044	Abnormal	AN	AN
IMG_3099	Abnormal	AN	AN
IMG_3122	Abnormal	AN	AN
IMG_3178	Abnormal	AN	AN
IMG_3543	Abnormal	AN	AN
IMG_3633	Abnormal	AN	AN
IMG_3872	Abnormal	AN	AN
IMG_3998	Abnormal	AN	N
IMG_4164	Abnormal	AN	AN
IMG_4839	Abnormal	AN	AN

Table 6. Result of Classification to Testing Data

Img	**Target**	**Classification Result**	
		Grayscale	**Proximity**
IMG_3566	Normal	AN	AN
IMG_3010	Normal	N	N
IMG_3465	Normal	AN	AN
IMG_3644	Normal	N	N
IMG_3700	Normal	N	N
IMG_3917	Normal	N	N
IMG_3055	Normal	N	N
IMG_2189	Normal	N	N
IMG_3144	Normal	N	AN
IMG_2315	Abnormal	AN	AN
IMG_4963	Abnormal	AN	AN
IMG_8012	Abnormal	AN	AN
IMG_9267	Abnormal	AN	AN
IMG_2376	Abnormal	AN	AN
IMG_4828	Abnormal	AN	AN
IMG_2154	Abnormal	AN	AN
IMG_2166	Abnormal	N	N

The classification result of test data which also taken from Mugi Barokah is shown in Table 6. This experiment is done to test the performance of classification method that built. The table shows that the proximity approach produce more incorrect classification than image grayscale

approach. The performance of those approaches are calculated using formula in Figure 11 and 12, here is the calculation detail:

- Performance of Training Data
  - Grayscale
    - Accuracy : (32/32) * 100% = 100%
    - Error : (0/32) * 100% = 0%
  - Proximity
    - Accuracy : (31/32) * 100% = 96.8%
    - Error : (1/32) * 100% = 3.2%
- Performance of Testing Data
  - Grayscale
    - Accuracy : (14/17) * 100% = 82.3%
    - Error : (3/17) * 100% = 17.7%
  - Proximity
    - Accuracy : (13/17) * 100% = 76.5%
    - Error : (4/17) * 100% = 23.5%

We conclude that the image grayscale approach performs better classification than using proximity.

6. CONCLUSION

The heart is our organ that controls the blood circulation. The heart disease leading to death. It can affect everyone, both young and old. Iridology is an alternative medicine technique to detect heart abnormalities. Needs a process in feature extraction in an iris image to perform iridology and computation process. The mobile device is one of the applications platforms which is very popular right now. It could do a lot of computing that used to be only on the computer. So we can perform every computation in anywhere and anytime. This research is proposed a new method of iridology and computation process in order to check the heart condition. By applying the mobile devices, everyone can check their heart regularly.

The feature extraction method produces a high result of right classification while it performs on success image cropping. From that experiment, the black threshold used is 0.725 and the white threshold used is 0.275.

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