Application of Liver Disease Detection Using Iridology with Back-Propagation Neural Network

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Abstract— **Iridology is the study of iris structure as a reflection of the organ condition and system in the human's body. In this study, the organ which is detected is liver. To determine the condition of the liver through iris, texture analysis and classification process are needed to distinguish iris of eye that contains the condition of normal and abnormal liver. The purpose of this study is to detect the condition of the liver through iris using back-propagation neural network with the Gray Level Co-occurrence Matrix (GLCM) for feature extraction.**

Application to detect liver conditions was made using Matlab version 8.1.0.604 (R2013a). Inputs for this study which is used is the eye image with both normal and abnormal conditions of the liver, based on Bernard Jensen's iridology chart. The image is then carried out with iris localization process, ROI-making organ of the liver, and GLCM feature extraction. Results of feature extraction is used as input data (training data and test data) for the back-propagation neural network method, then used to diagnose liver organ conditions.

On the obtained test results, a number of hidden layer units showed a growing number of units in the hidden layer that makes Mean Square Error (MSE) value will decrease. It makes network performance is getting better. Based on the test results, 35 test data with four variations of the number of units in the hidden layer, namely, the variation of the number of hidden layer units [40 (layer 1), 20 (layer 2)], [50 (layer 1), 20 (layer 2)], [70 (layer 1), 30 (layer 2)], and [80 (layer 1), 30 (layer 2)]. Sequentially, the data show the success rate percentage of 77.14 %, 80 %, 88.57 %, and 91.42 % . Thus in this test, the best success percentage is 91.42 % .

Keywords— Iris, GLCM, Neural Network, Back-propagation

I. INTRODUCTION

Deterioration of environmental conditions, growing pollution levels, and simple-lifestyles have become common among people nowadays. Environmental conditions and lifestyles, i.e eating fast food (junk food) unwittingly has become one of the causes of the quality of health declining in humans nowaday. One of the diseases from this phenomenon is the functional reduction in human liver.

Abnormalities in liver disease are often caused by an infection by parasites (amoeba dysentery, malaria, worms, toxoplasma) and by a virus. One of the viral liver disease that attacks the liver is hepatitis. Hepatitis is a disease that causes inflammation or swelling in the liver. The disease can be caused by chemicals or drugs, or various types of viral infections. Health Minister, Nafsiah Mboi, said that Indonesia currently is the country with the three largest hepatitis among the South-East Asia Regional Office (SEARO). According to official website of the Health Ministry Republic of Indonesia, there are 30 millions of hepatitis B and hepatitis C patients and became the third largest in the world after India and China. It occurs as a result of lacking of disease knowledge in the community.

Iridology or commonly referred to as iris diagnosis is a method of medical examination and weaknesses of organs available through Iris [12]. Each organ has neurological representation in the iris, so when there is a weakness in a particular organ will be marked by changes in the nerve fibers form where it represents. Through the iris, illness can be identified. This identification process using Neural Network with iris data has undergone image processing.

II. RESEARCH PURPOSES

The goals to be achieved from the making of this research are:

1. Creating an application that can be used to determine the health condition of the human heart organ by using digital image processing and indentification using neural network back propagation method.

2. Being able to examine and analyze the system works by taking into calculate the level of accuracy and precision.

III. METHODOLOGY

The image used is the image of the right eye Indonesian's iris and came from 60 individuals who each have the image of the same size is 1280 x 800 pixels, in the form of color images, one of which is shown in Fig. 1. Of the 60 that images is composed of 34 images of normal iris and 26 images of abnormal iris, which will be used 15 images of normal iris, 10 images of abnormal iris for database (reference), and 19 images of normal iris, 16 images of abnormal iris for testing data. The reference images is used as a training in order to obtain the precentage of recognition process. While the test images are images that are not used in the training process, and is used to test the success of the presentation of the program.

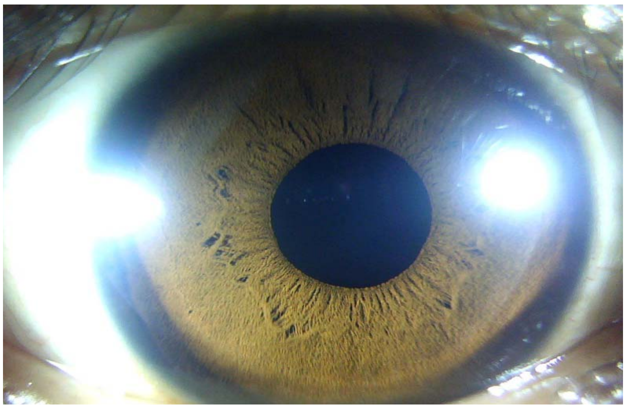

Fig. 1. Example of eye image

It has long been recognized that there is a lack of standardized procedures used in iridology and this research tries to overcome.

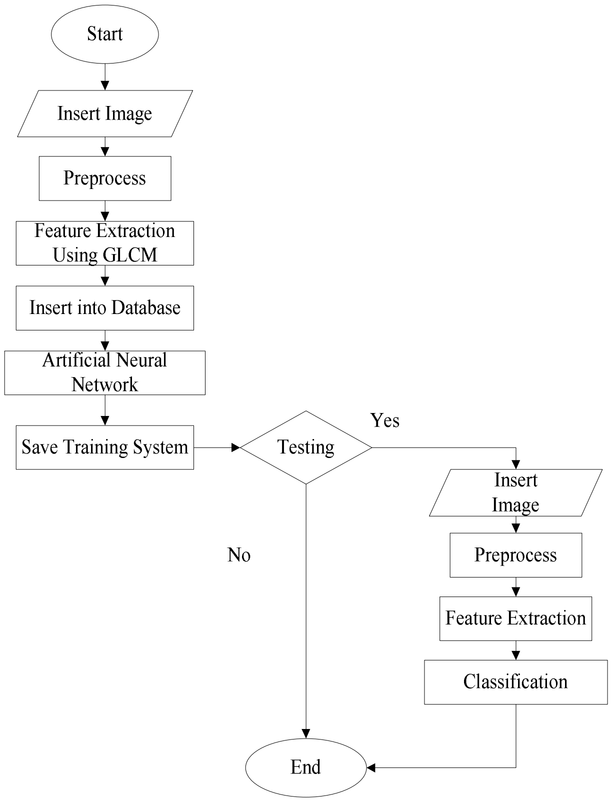

Fig. 2. Flowchat of main program

In Fig. 2. Flowchart of main program heading above test there are two processes known as preprocess. Preprocess stage before testing and during testing has several stages is same.

The scheme preprocess steps shown in Fig. 3.

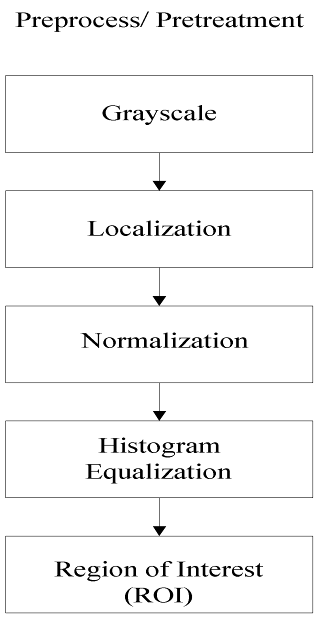

Fig. 3. Schem preprocess steps

A. Iridology

Iridology is the study of patterns and arrangement of fibers in the iris. By making the observation and the observation of the iris pattern is later we will be able to connect with particular health problems as well as strengths and weaknesses of one's physical. By observing iris can also be known to a person's body condition is weak or strong, for example status, level of health as well as the transition to the severity or the healing process. Iridology is based on iridology chart as a reference to observe the iris. Fig. 4 is a chart iridology is used as a reference in making a diagnosis using iridology.

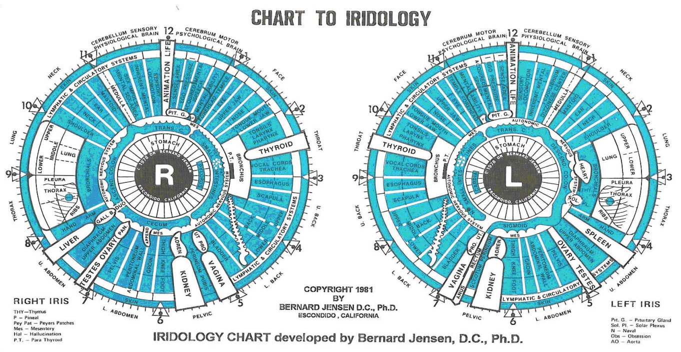

Fig. 4. Chart iridology (Bernard Jensen)

B. Image processing

The research protocol needs to separate the iris from both the pupil and the sclera and then normalize the iris to a standard dimension that can be matched with the iris charts [1]. The protocol needs to have the capability of feature extraction and a classification mechanism to infer the right diagnosis. To realize the processing needed for detecting the iris center and the pupil center, the color image was transformed from color image into a gray level image then segmented and transformed to polar coordinates.

C. Grayscale

The color image was transformed from color image into a gray level image is shown in Fig. 5.

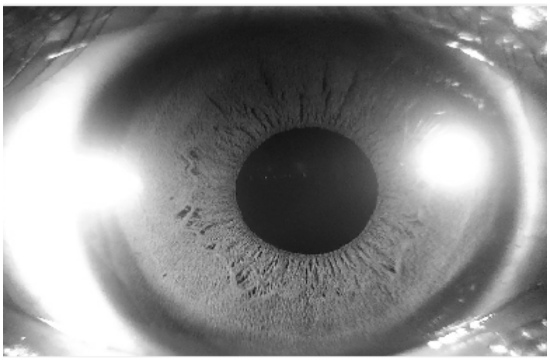

Fig. 5. Grayscale level of eye image

D. Iris localization

Iris localization is used to locate the inner and outer boundaries of an iris. The inner boundary can be found by detecting a pupil area where its perimeter designates the inner boundary of the iris [2]. The iris outer boundary is a circular edge separating the iris from the sclera zone. Iris edge detection is the locating of points on the inner and outer boundary of iris. The average gray value of the pupil is the minimum and that of sclera is the maximum, and the average value of iris is between them. Therefore, on the iris inner and outer boundaries the edge intensity of a pixel must be a maximum. Both boundaries can be located by using intensity differences among parts of the eye (pupil, iris, and sclera) and circular shape of the pupil and iris (Fig. 6).

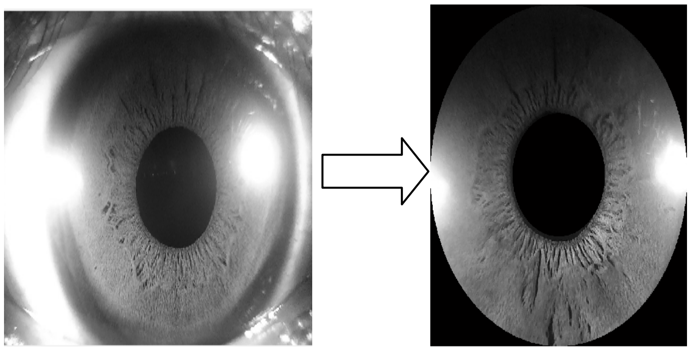

Fig. 6. Iris localization

E. Transformation from cartesian to polar coordinates

The information value of the center point, the radius of the pupil and iris radius is used to normalization iris image into polar form are exposed [13]. In this process the iris image becomes a circle with a diameter r, but was transformed into the image of a rectangle with a length is the angle θ with $0 \leq \theta \leq 360$ degrees, and the width is the radius of the iris is reduced to the radius of the pupil as shown in Fig. 7, Iris image measuring 749 x 749 pixels is converted into a polar image measuring 360 x 100 pixels. The section on the iris image that has been converted into a polar image, which is indicated by a yellow box of 10 x 100 pixels ROI is part of the liver before it is put in the process of feature extraction using GLCM.

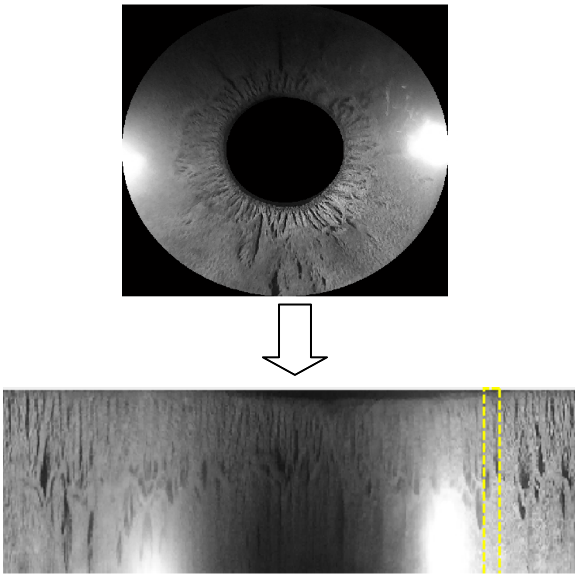

Fig. 7. Transformation from cartesian to polar coordinates

F. *Histogram equalization*

To improve the iris image contrast, a stage of histogram equalization was needed [2]. In the histogram of the normalized iris, gray levels are concentrated at the center of gray level from 0 to 255. To perform histogram equalization, we have to calculate the probability density function and the cumulative density function of the image. This involves counting the number of pixels of each color in the image, and producing a running sum of the count. Then by simply scaling the output, we could perform histogram equalization. An iris, whose pixels tend to occupy the entire range of possible gray levels and, in addition, tend to be distributed uniformly, will have an appearance of high contrast and will exhibit a large variety of gray tones as shown in Fig. 8.

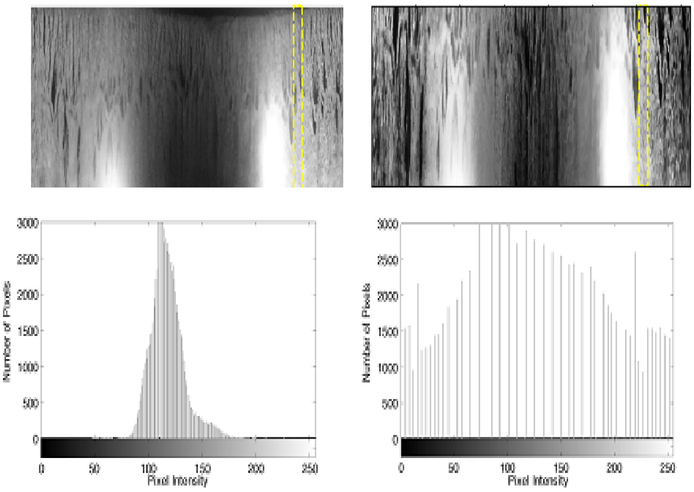

Fig. 8. The iris histogram equalization. Top left, original iris image. Bottom left, original iris image histogram. Top right, the histogram equalized iris image. Bottom right, it's histogram.

G. *Gray-Level Co-Occurrence Matrix (GLCM)*

Feature extraction aims to obtain important information on the texture of the iris. The extraction process is done by pressing the button on the display GLCM Feature Extraction main program. GLCM matrix derived from the characteristics that are statistically representing the image in the form of surface texture. The characteristics of texture is then used as input data, either in the form of training data and test data, for the neural network to be studied further. In this program, the traits that characterize the texture is used as a contrast, correlation, energy, and homogenity.

Energy

Indicates the size of the image homogeneity properties

$$ASM = \sum_i \sum_j p_d^2(i, j) \tag{1}$$

p (i, j) is declared value in row i and column j in the matrix kookurensi. The larger the image is homogenous, then the value of ASM will be even greater.

Contrast

Indicates the size of the deployment (moment of inertia) elements of the image matrix. If located far from the main diagonal, then the greater the contrast value. Visually, the contrast value is a measure of the degree of gray variation between an image area.

$$Con = \sum_i \sum_j (i - j)^2 p_d(i, j) \tag{2}$$

Correlation

Indicates the size of the linear dependence of the degree of gray image so as to provide guidance for linear structures in the image.

$$Cor = \sum_i \sum_j \frac{ijp_d(i, j) - \mu_x \mu_y}{\sigma_x \sigma_y} \tag{3}$$

whereas μ_x, μ_y, σ_x^2, and σ_y^2 expressed by the following equation

$$\mu_x = \sum_i i \sum_j p_d(i, j) \tag{4}$$

$$\mu_y = \sum_j j \sum_i p_d(i, j) \tag{5}$$

$$\sigma_x^2 = \sum_i (i - \mu_x)^2 \sum_j p_d(i, j) \tag{6}$$

$$\sigma_y^2 = \sum_j (j - \mu_y)^2 \sum_i p_d(i, j) \tag{7}$$

Informations:

- μ_x is the average value of the columns from matrix elements $p_{d\theta}(i, j)$.
- μ_y is the average value of the matrix element row $p_{d\theta}(i, j)$.
- σ_x is the standard deviation value column on the matrix elements $p_{d\theta}(i, j)$.

- σ_y is the standard deviation value of the matrix element row pdθ(i ,j).

Homogenity

Shows the degree of homogenity image similar gray.

$$IDM = \sum_i \sum_j \frac{1}{1+(i-j)^2} p_d(i,j) \quad (8)$$

IV. RESULTS AND ANALYSIS

Based on test results influence the number of units in the hidden layer neural network training process, obtained four variations of the number of hidden layer units are best. Results of these tests. The analysis below is the result of the test with variations of the number of neurons lining used is 10 to 80 on layer 1 and 10 to 30 on layer 2. As for the value of the learning rate of 0.001 and a maximum epoch (the number of iterations) 5000. below are the test results:

TABLE I. COMPARISON OF FOUR DIFFERENT VARIATIONS OF THE NUMBER OF NEURONS

No	Number of Neuron		Time (second)	MSE	Success Rate (%)
	Layer 1	*Layer* 2			
1	40	20	5	$1.36e^{-08}$	77.14 %
2	50	20	4	$1.13e^{-08}$	80%
3	70	30	12	$9.64e^{-11}$	88.57%
4	80	30	15	$9.15e^{-13}$	91.42%.

Table I. shows four variations of the number from neuron units having the largest success rate is 91.42%. The time shown in Table I. is a time during the training process.

V. CONCLUSION

From the simulations that have been carried out, along with the discussion that has been created, it can be some conclusions: GLCM (Gray Level Co-occurrence Matrix) method combined with back-propagation neural network can be used to diagnose liver disorder using the image of iris with percentage from test is large enough that the smallest presentation is 77.14% based on test.

On the test results influence the number of hidden layer units showed a growing number of units in the hidden layer meal MSE value will decrease. This makes network performance is getting better.

Based on the results of feature extraction is performed on training data obtained by the average value of the four characteristic textures that are contrast, homogenity, energy, and correlation. Sequentially image of normal liver condition 1.2516, 0.974488, 0.12491, 0.752995 and 1.4182 image of abnormal liver conditions, 0.803685, 0.098269, 0.734445.

Based on test results 35 test data with four variations of the number of units in the hidden layer, the variation of the number of hidden layer units [40 (layer 1), 20 (layer 2)], [50 (layer 1), 20 (layer 2)], [70 (layer 1), 30 (layer 2)], and [80 (layer 1), 30 (layer 2)]. Sequentially shows the percentage success rate are 77.14%, 80%, 88.57%, and 91.42%.

The test results showed that the variation of the number of hidden layer units [80 (layer 1), 30 (layer 2)] gave a presentation of the most successful high as 91.42%.

References

[1] U. Ahmad. Digital Image Processing and Programming. 1st Edition. Yogyakarta:Graha Ilmu, 2005.

[2] A. K. Jain, Fundamentals of Digital Image Processing, Prentice-Hall International, 1989.

[3] R. R. Isnanto, “Iris identification using wavelet gabor filters and neural network learning vector quantization (LVQ)”, Computer System Engineering Department Diponegoro University, Semarang, 2009.

[4] M. Rochmad, “Osteoporosis diagnosis detection through the iris with image clustering”, PENS-ITS journal, Surabaya, 2009.

[5] T. D. Prihartono, “Iris identification using wavelet haar transformation”, Electrical Engineering Department Diponegoro University, Transient journal, April 2011.

[6] J. Daugman, How Iris Recognition Works, IEEE Transaction on Circuits and system for Video Technology, vol 14, no.1, January 2004.

[7] R. Munir, “Digital image processing with algorithmic approach”, Erlangga, Bandung, 2004.

[8] A. D. Hartanto, “The introduction of iris imagery using wavelet daubechies transformation order 4”, Electrical Engineering Department Diponegoro University, Transient journal, Semarang, January 2012.

[9] N. R. Rosna, “Applications for diagnosis liver organ cells through iris imagery using principal component analysis with neural networks”, Electrical Engineering Department Diponegoro University, Transient journal, Semarang, June 2013.

[10] R. Apriyani, “Implementation of neural network method back-propagation in predicting stock price pt. indosat using matlab 7.1”, Thesis S-2, Gunadarma University, Jakarta, 2010.

[11] A. Eskaprianda, “Detection of pancreas organ condition through the iris using back-propagation neural network with gray-level co-occurrence matrix (GLCM)”, Electrical Engineering Department Diponegoro University, Transient journal, Semarang, August 2011.

[12] E. H. Sherif, A. H. Osama, H. G. Malcolm, “Assessment of the potential iridology for diagnosing kidney disease using wavelet analysis and neural networks”, Biomedical Signal Processing and Control 8 (2013) 534– 541, Elsevier Journal.

[13] Y. Du, B. Boney, R. Ives, D. Etter, and R. Schultz, 2005, Analysis of Partial Iris Recognition using a 1-D Approach, IEEE ICASSP 2005, pp. II-961 – II-964

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