Identification Of Diabetes In Pancreatic Organs Using Iridology

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***Abstract* — Diabetes is a general disease often infected in humans. Many ways to detect diabetes, one of them is checking blood pressure, but this way is not effective, because it takes blood first and take a lot of time. Iridology is one way analysis health based on the iris. Therefore we need a tool used to identify pancreatic damage as an indication of diabetes through iridology. Load image is the first step to identify pancreatic organs based on the iris. The eye image that we used as the input system comes from the eye clinic database. The next step is adaptive median filtering used in the process preprocessing to reduce the noise on the image. After that the next step is segmentation process using hough circle transform method. The results of segmentation will be normalized and take the Region of interest. ROI will be done feature extraction by using GLCM (Gray Level Co-Occurrence Matrix). To know the condition of pancreas organ using backpropagation method.**

Keywords — iridology, image processing, diabetes

I. INTRODUCTION

Diabetics occur because of the function of pancreas organs that do not run normally. Many diabetics are not aware of their diabetes, causing complications of some diseases.

Diabetes mellitus disease has been detected by doing medical checkup, blood sugar check, and so on. These methods take time and less efficient because a blood stab should be stabbed first to detect a person with diabetes Therefore, a tool used to detect diabetes in a more convenient and effective way. Detection of diabetes mellitus disease in this tool using image processing on the human eye iris [1][2]. Organ that is detected as an indication of the occurrence of diabetes is a pancreas that works to produce insulin. Eye images obtained database will be processed to distinguish between normal eye pictures and eye pictures of diabetics.

Iris is used as input material of the system and it can be used to see the condition of our internal organs [3].

In this paper will be discussed about detecting the state of the pancreas organ through the iris of the eye. According to iris charts, the location of the pancreas organ lies at 7-15-7.45 in the right eye [4].

II. RELATED WORK

Escaprianda A, detects pancreatic organ conditions using iridology. This study uses artificial backpropagation neural network with Gray level co-occurance matrix to determine feature extraction. In this study the condition of the eye is defined to be two normal and abnormal

M Rochmad conducted a study using iris to identify pancreatic damage using iridology as the introduction of diabetes mellitus. Bayes method is a good method in learning data training engine, using conditional probability as its base. Bayes methods can be used for inconsistent data and biased data. In this study the surrounding parts of the eye such as the skin of the eye are detected that affect the outcome of the program. Uncertain position of the eyes in this study causes the position of the eye direction of 7 hours is not always right at 7 o'clock. Bayes method used in this study is less precise, because the determination of conditions 0 and 1 caused more and more errors.

I Putu D L undertook a study of iris to make a diagnosis of the state of the pancreas organ. This study performed an iris diagnosis with the condition of pancreatic organs using ANMBP method based on quantitative features ie texture measurement used as a decision model for diagnosis.

III. METHODOLOGY

On projects of the last of these , there are several stages to find the area that represent an organ pancreas in the iris of the eye so that in the end can be classified into normal and abnormal .The following is a diagram of the stages of design system:

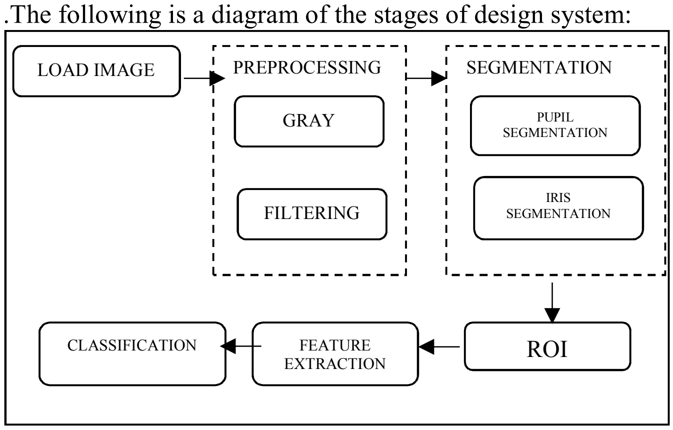

Fig 1. Schematic Diagram of the Algorithm

Iridology is the science that studies the pattern and arrangement of fibers in the human eye iris [1]. Iridology is also commonly referred to as a diagnosis of iris which in the medical world states that each part of the body can be represented by the region contained in the iris of the eye. Iridology can reveal inflammation (inflammation), accumulation of tissue toxins, conguestion dams, where it is located and how it is [2]. The originator of iridology is a Hungarian physicist named Ignatz von Peczely

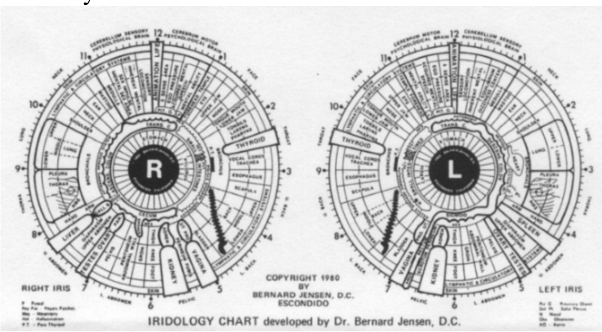

Fig 2. Iridology Chart

A. Load Image

Preprocessing is the process of image repair before the next process. the first preprocessing process is to change the color image into a grayscale image and the next process is to filter the image

Images that have lots of color information are simplified into grayscale images. The grayscale process is intended to simplify the information contained in the image, so it is easy to process. Grayscale process is the sum of 3 basic colors red, green, and blue or commonly called RGB. These three colors then divided by 3, so as to obtain the average value of the three colors. The results obtained from this grayscale process is an image that has a gray color.

The next stage in the preprocessing process is filtering. The filtering process aims to reduce the noise on the image. The filter that I used is a Gaussian filter

B. Segmentation

Eye image segmentation aims to separate the iris part from the whole image. Eye image segmentation is done because the iris is the part that represents the pancreas organ. According to the iridology chart the pancreas organ parts are in the hour segment up to 7.15- 7.45.

1) Pupil detection

The process of segmentation has several stages. The first process to do is to detect the pupil's circle to get the midpoint of the iris. This is because the pupil always in the middle of the iris. Hough Circle Transform is used to detect pupils in this process.

The logic of Hough Circle Transform is described like this:

1. For every A [a, b. R] = 0
2. Change the image to grayscale. Do filtering Using Gussian filtering. Use the canny operator to get the edge of the image.
3. Calculate all possible circles on the accumulator
4. Maximum local circle of accumulator gives Hough room
5. Maximum vote for accumulator circle specify circle

2) Iris detection

Iris detection is a core part of the segmentation process. The iris of the human eye contains information to be examined at this stage.

C. Normalization

Normalization is a process that changes the shape of iris, from polar shape into square shapes. This process will make the iris area to be the same size. So that multiple images of irises with different sizes, will be have the same size and will have the same characteristics with the same location

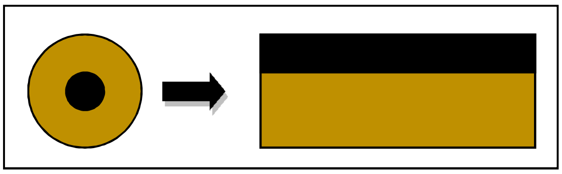

Fig 3. Illustration of the normalization process

$$r^2 = (x-a)^2 + (y-b)^2; x = r\cos\theta; y = r\sin\theta + b \qquad (1)$$

D. ROI

After normalization process, we find the region of interest. This process aims to find the part to be examined by separating the section.

ROI examined in the study lies at 7.15 - 7.45 on iris. This section represents the pancreas organ on the iridology chart.

E. Feature Extraction

Eyes that have diabetes disease with the normal eyes have a differences characteristic. To find out the difference between these two eyes we need to extract its special features using feature extraction process. Gray Level Co-Occurance is used as a method for this process. Gray level co-occurance is useful to get a gray level of the eye image. Each eye has a different grayish value.

The steps taken to create the GLCM are as follows:

1. Initialization matrix area

0	0	1	1
0	0	1	1
0	2	2	2
2	2	3	3

2. Determine the spatial relationship between the reference pixel and the neighbor pixel, determine the angle value θ and distance d.
   Example table matrix given initialization θ = 0, d = 1. Then we get the spatial relationship between pixels as follows:

	0	1	2	3
0	2	2	1	0
1	0	2	0	0
2	0	0	3	1
3	0	0	0	1

3. Calculates the amount of concurrency with its transposes so it becomes symmetrical

2	2	1	0		2	0	0	0		4	2	1	0
0	2	0	0	+	2	2	0	0	=	2	4	0	0
0	0	3	1		1	0	3	0		1	0	6	1
0	0	0	1		0	0	1	1		0	0	1	2

4. Normalized matrix to convert it into probability form (P_d)

4/24	2/24	1/24	0/24		0.167	0.083	0.041	0
2/24	4/24	0/24	0/24	=	0.083	0.167	0	0
1/24	0/24	6/24	1/24		0.083	0	0.25	0.041
0/24	0/24	1/24	2/24		0	0	0.041	0.083

The characteristics of GLCM statistics are as follows:

1) Angular Second Moment

$$ASM = \sum_i \sum_j p_d^2(i,j) \quad (2)$$

$$Energy = \sqrt{ASM} \quad (3)$$

2) Contrast

The average contrast matrix will be 0 when it has the same value with the surrounding location and will have a high value when it has a big difference.

$$Con = \sum_i \sum_j (i-j)^2 p_d(i,j) \quad (4)$$

3) Inferse Different Moment (Homogeneity)

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$$Hom = \sum_i \sum_j \frac{1}{1+(i+j)^2} P_d(i,j) \quad (5)$$

4) Entropy

$$\mu_i = \sum_{i,j=0}^{N-1} i(P_{i,j}) \quad (6)$$

$$\mu_j = \sum_{i,j=0}^{N-1} j(P_{i,j}) \quad (7)$$

F. Classification

Classification is used to provide a decision between the normal and abnormal circumstances of a data input. The classification used in the system using the neural network.

1) Artificial Neural Network Backpropagation

The equation of backpropagation are:

1. Calculate the input value of each input pair on the hidden layer

$$z\_in_j = bl_j + \sum_{i=1}^{n} x_i v_{ij} \quad (8)$$

Calculate the output using the sigmoid activation function

$$z_j = f\left(z_{in_j}\right) = \frac{1}{1+e^{(z\_in_j)}} \quad (9)$$

2. Calculate the output signal from the hidden layer to get the output layer output

$$y\_in_k = b2_k + \sum_{i=1}^{m} x_i v_{jk} \quad (10)$$

Calculate the output with sigmoid activation

$$y_k = f(y_{in_k}) = \frac{1}{1+e^{(y\_in_k)}} \quad (11)$$

3. Compare the network output to the target, and calculate the error value

$$E = t - y_k \quad (12)$$

4. Count MSE (Mean Square Error)

$$MSE = \frac{\sum E^2}{n} \quad (12)$$

With ***n*** is the number of inputs.

5. On each unit of output use the formulation below to improve the weight and bias values

$$\delta 2_k = Ef'(y\_in_k) \quad (13)$$

6. Correct the weight and bias values using the formula below

$$\Delta w_{jk} = \nexists \propto (\delta_k z_j) \quad (14)$$

$$\Delta b2_k = \propto \delta_k \quad (15)$$

7. Count the return signal from the output layer of each hidden layer unit

$$\delta\_in_j = \sum_{k=1}^{p} \delta_k w_{jk} \quad (16)$$

8. In each hidden layer unit, calculate $\delta 1$ to improve the weight and bias values

$$\delta 1_j = \delta\_in_j f'(z\_in_j) \tag{17}$$

9. Improve the value of weight and bias

$$\Delta v_{ij} = \propto (\delta_j x_j) \tag{18}$$

$$\Delta bl_j = \propto \delta_j \tag{19}$$

10. For all layers, fix the weights and bias
    For output layer

$$w_{jk} = w_{jk} + \Delta w_{jk} \tag{20}$$

$$b2_k = b2_k + \Delta b2_k \tag{21}$$

For hidden layer

$$v_{ij} = v_{ij} + \Delta v_{ij} \tag{22}$$

$$bl_k = bl_k + \Delta bl_k \tag{23}$$

11. Count MSE (Mean Square Error)

$$MSE = \frac{\sum E^2}{n} \tag{24}$$

12. If Epoch < max_Epoch or MSE < target_error, repeat the training steps.

IV. EXPERIMENT RESULT

The eye area which is the main input of the system is obtained by using Hough Circle Transform. Hough Circle transform can detect circles that are in the image assumed as the iris. The input of the Hough Circle Transform method is an image that has been done in the first filter to reduce noise in the image. In this research the filter that we used is median filtering. To do the median filtering the image is converted into grayscale image first.

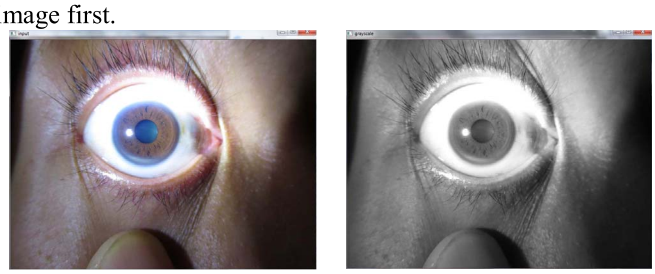


Fig 4. Convert the original image into gray scale image

After getting grayscale image the next process is median filtering. This median filtering image is used as a Hough Circle Transform input. When the input image exposed to light that is too much or too little will affect the result of Hough Circle Transform circle detection so it is not detected. Median filtering result shown in fig 5.

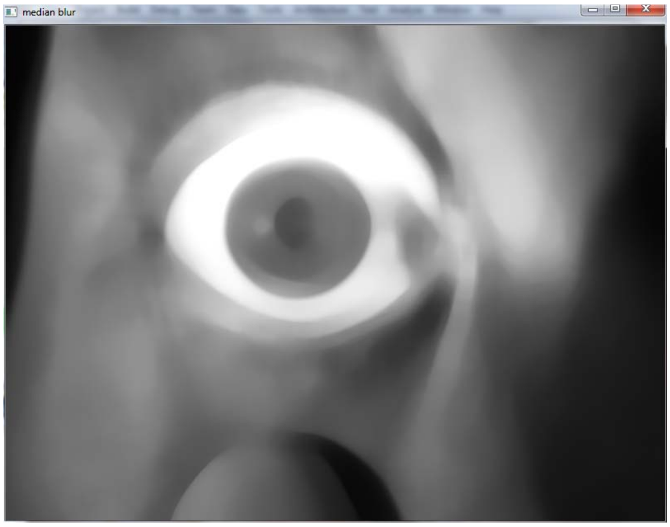


Fig 5. Median Filtering Result

After obtaining the image that has been filtered the next process is the detection of the shape of a circle on the image by using Hough Circle Transform. The red line represent the circle from the image.

Fig 6. Hough Circle Transform Result

The next process is to crop the iris area that has been detected. Iris is where the research area of the pancreas organ is located. The result of the cropping iris shown on fig 7.

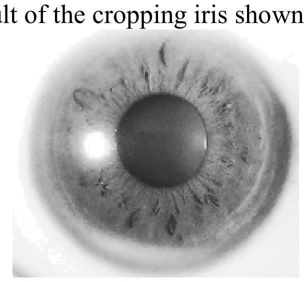


Fig 7. Cropping the iris area

The next step is the normalization process. Normalization process serves to change the shape of polar iris into a square shape. After we get the square shape of the iris the area of the pancreas organ is in between (393,56) left corner to (421,68) right corner.

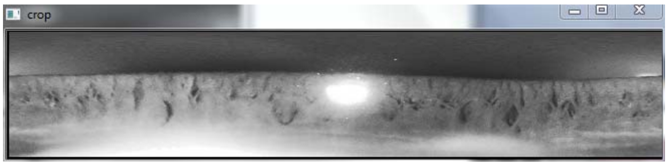


Fig 8. Normalization Process

TABLE I. ROI IMAGE RESULT

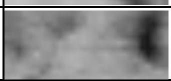
Nama file	ROI	Nama File	ROI
Ab2.jpg		N5.jpg	
Ab3.jpg		N6.jpg	
Ab4.jpg		N8.jpg	
Ab5.jpg		N9.jpg	
Ab 6.jpg		N3.jpg	

TABLE II. GLCM RESULT FROM ABNORMAL IMAGE

Image	Contrast	Energy	Homogen	Entropy
ab1	0.3206	0.565	0.86	1.6277
ab2	0.3709	0.4509	0.8374	2.02
ab3	0.8678	0.3814	0.7301	2.4573
ab4	0.4498	0.3859	0.8162	2.2514
ab5	0.4751	0.4761	0.8107	2.0959
ab6	1.0619	0.2957	0.6966	2.8038
ab7	0.8546	0.4125	0.7213	2.2267
ab8	0.9344	0.2817	0.7052	2.8563
ab9	0.5341	0.4708	0.7862	1.9116
ab10	1.1359	0.3117	0.717	2.761

TABLE III. GLCM RESULT FROM NORMAL IMAGE

Image	Contrast	Energy	Homogen	Entropy
n1	0.006173	0.981569	0.996914	0.108282
n2	0.080247	0.882111	0.959877	0.521665
n3	0.018519	0.960209	0.990741	0.208865
n4	0.256173	0.622229	0.871914	1.17892
n5	0.135802	0.821939	0.932099	0.680688
n6	0.327161	0.537675	0.83642	1.3115
n7	0.182099	0.654128	0.908951	1.06981
n8	0.040124	0.954146	0.979938	0.233453
n9	0.037037	0.950878	0.981481	0.275808
n10	0.138889	0.77233	0.930556	0.812211

The file name "n" is the normal image and "ab" is the abnormal image.

TABLE IV. TESTING OF TRAINING DATA RECOGNITION

Image	Target X	Target Y	Output X	Output Y	Result
ab12	0	1	0	1	V
ab13	1	0	1	0	X
ab14	1	0	1	0	X
ab15	0	1	0	1	V
ab16	0	1	0	1	V
ab17	1	0	1	0	X
ab19	0	1	0	1	V
ab20	0	1	0	1	V
ab21	0	1	0	1	V
ab22	0	1	0	1	V
ab23	0	1	0	1	V
n11	1	0	1	0	v
n12	1	0	1	0	v
n13	1	0	1	0	v
n14	1	0	1	0	v
n15	1	0	1	0	v
ab12	0	1	0	1	V

Note: [highlighted box] the wrong output

Based on output of the training data recognition we can count the percentage of the successful system is

$$\frac{14}{17} \times 100\% = 82{,}35\%$$

V. CONCLUSION

Based on testing that has been done, we can know if the eyes of someone who has a condition of the pancreas is not good to have broken tissue while a person who has a healthy pancreas condition does not have broken tissue. From the experiments that we have done, we know, if using GLCM method and neural network backpropagation for classification, we can know the condition of pancreas organ based on iris have 81,35% success rate.

VI. Future Work

For subsequent work we can perform more accurate eye segmentation, this allows the detection of pancreatic organs more precisely and the resulting results are more appropriate.

VII. Acknowledgement

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References

[1] Eskaprianda A, Istanto R. R, Santoso I. Deteksi Kondisi Pankreas Melalui Iris Mata menggunakan Jaringan Syaraf Tiruan Metode Perambatan Balik dengan Pencarian Matriks Ko-Okurasi Aras Keabuan, TRANSMISI, 13 (1), 33-38. 2011.

[2] Rochmad M, Basuki A. Identifikasi Kerusakan Pankreas Melalui Iridology Menggunakan Metode Bayes untuk Pengenalan Diabetes Mellitus, PENS- ITS, Surabaya,2009.

[3] A. D. Wibawa, M. H. Purnomo. Early Detection on the Condition of Pancreas Organ ad the cause of Diabetes Mellitus by Real Time Iris Image Procesing, IEEE, 2006.

[4] Jensen B, "The Science and Practice of Iridology," Volume 1. California Bernard Jensen Co. 1985.

[5] Saik F, Prasad G, Rao J, Rahim A. Medical Image Analysis of Electron Micrographs in Diabetic Patients Using Contrast Enchancement, ICMET, 2010.

[6] S. K. Bhatia, A. Priyanka. Methodology for Detecting Presence from Iris Image Analysis, International Journal of Advanced Research in Computer Engineering & Technology, Vol. 4, Issue 3, Maret 2015.

[7] Christopher E. Hann, J. Geofferey Chase, James A. Revie. Diabetic Retinopathy Screening Using Computer Vision, Proceedings of the 7th IFAC Symposium on Modellinh and Control in Biomedic Systems, Aalborg, Denmark, Agustus 2009.

[8] http://informatika.web.id/transformasi-hough.htm