Organ Disorder Identification Through Iris Using Multilayer Perceptron Algorithm

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Abstract

Human organ condition can be seen through the iris as learned in iridology. Iridology is the study of network structure contains in the iris pattern. By the sign of color, texture, and location of pigment in the iris, the state of someone health can be analyzed. Consider to person's health, identifying disease as well as potential development is very good topic to research. It also can be used as a highly effective complement to gain physical health and quality of life. It has become an important thing to do research in the identification of organs disorder through the iris pattern.

The method used in the identification process is a combination of Independent Component Analysis (ICA) with FastICA and MultiLayer Perceptron algorithm. By mixing three different images, it can be obtained three different outputs with different kurtosis value. From those three outputs, one image with has the highest kurtosis value is considered synonymous with the original image. There are seven statistical characteristic extraction results are used as input in the classification process by the method of MultiLayer Perceptron algorithm which are the average, standard deviation, skewness, kurtosis, energy, entropy, and smoothness. The results of the of classification by MultiLayer Perceptron algorithm produces an accuracy rate of 78.9%, a sensitivity of 86.67% and a specificity of 65.38% for organ disorder identification. As for the normal condition, identification produces 78.9% in accuracy rate, 65.38% in sensitivity and 86.67% in specificity.

Keyword: organ, iridology, iris, disorder, normal, FastICA, MultiLayer Perceptron

1. Background

Along with the development of technology, people can observe and learn more about the understanding of the eye. One important part of the eye that can detect the health of the body is the iris. Iris is an extension area of the brain. The organs send vibrations to the body cells and recorded in the brain. The recording can then be viewed through the iris that relates directly to the brain.

The condition of human organs can be seen through the iris of the eye and can be learned in iridology. Iridology is the study of signs in the network structure of the iris. By the color, texture and pigment location in the iris, the state of someone's health can be analyzed.

Within the last ten years, research on iris recognition for identification and detection of human organs disorders has been done. Iris can be utilized in the process of identifying disorders of the kidneys (Putra and Sutojo, 2014, Rahayu et al., Astuti et al., 2015). The next study is the identification process of the pancreas damage through the iris (Rochmad 2009, Lesmana et al., 2011) and cholesterol excess (Rani et al., 2014, Saefurrohman, 2013, Ramlee and Ranjit, 2009)

Based on these backgrounds, it can be concluded that iris recognition is very useful for the identification of organ disorders. The problem is, when a person impaired organ more than one condition, the system should also be able to identify it automatically. Therefore, to improve the understanding both doctors and medical staff on the identification process, it is necessary to develop an identification system that is easier to understand on some conditions that may be occurring.

2. Methods

In this paper, identifying organ disorders through iris passed through several stages which are (1) image acquisition, (2) pre-processing the image, (3) feature extraction, and (4) classification. Figure 1 shows the research phase.

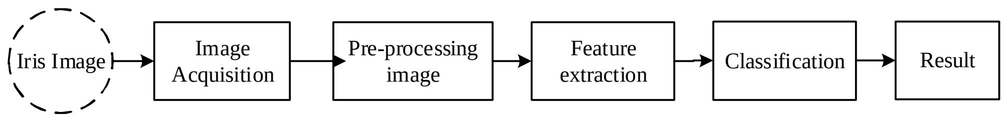

Figure 1. System Design Block Diagram

The first step are collect, aggregate, and prepare to process the data to produce the desired data and prepared for data input in the next process. In the acquisition process, the image to be processed is transformed into a numerical representation. In the next process, that representation will be processed digitally by computer.

In the beginning, the process is done by iris localization and normalization. Iris area in images needs to be localized before recognition process. Inner and outer boundaries of iris formed as a circle. To get its boundaries, edge detection process is needed. Iris normalization held by changing polar coordinate (r,θ) into Cartesian coordinate (x,y). After the normalization, the next step is image enhancement aimed to get a good quality image for the next process. Image enhancement can be done by changing its histogram value. Increasing histogram value is the first process, followed by using Contrast Limited Adaptive Histogram Equalization (CLAHE) method and using contrast stretching for the last step. Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR) is used to evaluate image quality after enhancement.

Feature extraction is an initial step in interpreting images. The method used in this research is Independent Component Analysis (ICA) with FastICA algorithm. The statistical characteristic of output from ICA will be found. Those data is used as input in the identification process.

Organ disorder identification is done by data mining with its disorder type classification technique. Data from feature extraction is used as input for training process and examination. The method used to classify organ disorders is Artificial Neural Network (ANN) with Multilayer Perceptron (MLP) algorithm. This is because ANN has good performance, less feature input, high accuracy, and good training ability, even though need more sample, long-time training and, and fair operating time.

3. Results

Image acquisition is premier step to get a digital image. The purpose of image acquisition is determining data and choosing digital image recording method. Tools used for a capturing image are Nikon Coolpix digital camera and Iris Camera. The image produced by the camera is digital, so digitalization is not necessary. Data used in this research both as a reference and test are downloaded from several databases. Retrieval of those data has been given license by data providers which are CASIA Iris Image Database, IIT Delhi Iris Database (Version 1.0), UBIRIS database and UPOL database.

The following steps are consist of segmentation process and normalization. First segmentation is filtering by the median filter. In this filtering, image gray level in each pixel replaced by the median value of the gray level in window filter. The last step in segmentation process is edge detection. Canny algorithm approach is performed by image convolution function with Gaussian operator and its derivatives. This edge detector representing ideal edge with considered thickness designed for iris localization. The localization is aimed to detect pupil, a black circle region surrounded by iris fibers. The pupil center can be used to detect the outer radius of the iris. The main steps of the iris localization involve the detection of the pupil and iris outer localization. If the outer circle of the iris and pupil superbly identified, the next step is to reconstruct into a unity circle in a circle in the form of a ring. The results are shown in Figure 2.

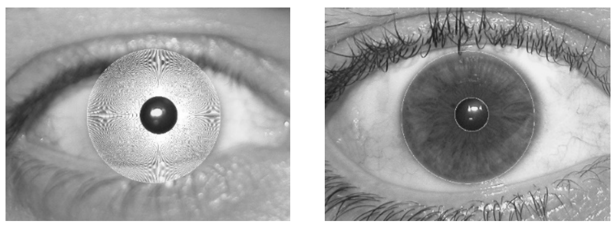

Figure 2. The final result of the segmentation process

After successfully localized iris area, next is the normalization of the iris. Ring-shaped normalized iris image into the rectangular image after being converted from polar coordinates to Cartesian coordinates. Cartesian coordinate conversion to non-coaxial center and the iris image I (x, y) is defined. The main process of identification systems that will be combined depend on Daugman's rubber models (Daugman, 2009). Normalization results of two different samples shown in Figure 3.

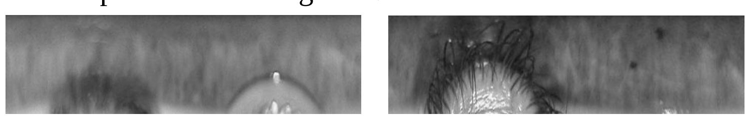

Figure 3. Normalized results of iris image

Image enhancement process is very important to obtain good quality image before being used for the next process. Enhancement image quality is done by improving histogram equalization and contrast stretching. The results show the value of MSE is decreasing when using contrast stretching. This indicates that the value of the error of the method indicates that the good image quality obtained after the pre-processing stage. On the other hand, the increase in PSNR is shown when using contrast stretching. Hence the image quality enhancement used is the result of contrast stretching method.

The method used to perform the extraction process is an Independent Component Analysis (ICA) with FastICA algorithms. FastICA algorithms such as neural which are parallel. distributed. computing simple and requires little memory. To use the ICA method of separating the signal takes several conditions that must be fulfilled that is independent and non-Gaussianity. Independent means that if there are two signals that different, the signal does not give any information about other signals, and has a value of zero covariance. Non-Gaussianity kurtosis means that the signal may be positive or negative and will not be zero. The process is carried out at this stage is to mix three iris image pre-processing results as input. Then it will generate three outputs images that have been mixed. The third output image sought statistical value then do a ranking based on the value of kurtosis. Components that have the highest kurtosis value will be chosen because it is considered the most dominant with the signal source. Table 1 shows a sample calculation of statistics for the ICA output and election to the highest kurtosis value to be used for the next process.

Table 1. Statistical Feature of ICA output

No	Nama Data	Output ICA	Statistic Feature							Kondisi
			Rerata C1	Standar deviasi C2	Skewness C3	Kurtosis C4	Energy C5	Entropy C6	Smoothness C7	
		Img_1_1_1_output_image_1.tif	103.2368	70.9754	-16.4339	1.68E+03	0.0047	5.4491	0.0719	
1	Img_1_1_1.tif	Img_1_1_1_output_image_2.tif	129.4927	38.9465	-32.6254	4.19E+03	0.0087	4.9780	0.0228	tidak normal
		Img_1_1_1_output_image_3.tif	123.5978	36.5639	-28.3379	3.47E+03	0.0076	5.0063	0.0201	
		Img_3_1_2_output_image_1.tif	129.4412	45.4062	-32.5861	4.19E+03	0.0062	5.1669	0.0307	
2	Img_3_1_2.tif	Img_3_1_2_output_image_2.tif	145.0998	44.9773	-46.0161	6.63E+03	0.0079	5.0679	0.0302	tidak normal
		Img_3_1_2_output_image_3.tif	124.5706	34.4326	-29.0178	3.59E+03	0.0087	4.9399	0.0179	
		Img_5_1_4_output_image_1.tif	128.4647	46.8671	-31.8485	4.06E+03	0.0060	5.2037	0.0327	
3	Img_5_1_4.tif	Img_5_1_4_output_image_2.tif	125.3183	7.3270	-29.5478	3.67E+03	0.0083	4.9978	0.0210	tidak normal
		Img_5_1_4_output_image_3.tif	134.0088	31.1504	-36.1877	4.81E+03	0.0111	4.7543	0.0147	

Statistical data from the feature extraction used as input data for the process of training and testing. The method used to classify organ disorders using Artificial Neural Network (ANN) algorithmically Multilayer Perceptron (MLP) with a data testing system 10-fold cross validation. As a comparison, the Rough set algorithm is also used to perform classification. From both algorithms will be selected that have the best performance index. The result of classification using multilayer Perceptron (MLP) is described in Table 2.

Table 2. Values of TP, FP, TN, and FN on MLP method

Condition	TP	FP	FN	TN
Abnormal	39	9	6	17
Normal	17	6	9	39

From Table 2, Multilayer Perceptron (MLP) method only produces an accuracy of 78.9%, a sensitivity of 86.67% and specificity of 65.38% for identification organ disorder. As for the normal condition, identification produces 78.9% in accuracy rate, 65.38% in sensitivity and 86.67% in specificity.

4. ACKNOWLEDGE AND LEGAL RESPONSIBILITY

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5. REFERENCES

Astuti, E, D., Mahmudi & Afifah, Q, 2015. Rancang Bangun *Software* Pendiagnosis Gangguan Ginjal Melalui Citra Iris Mata Menggunakan Algoritma *Backpropagation*. *Jurnal Ppkm I***,** pp.26-33.

Daugman, J. (2009). How Iris Recognition Works. *The Essential Guide to Image Processing*, *14*(1), 715–739. https://doi.org/10.1016/B978-0-12-374457-9.00025-1

Lesmana, I.P.D., Purnama, I.K.E. & Purnomo, M.H., 2011. Abnormal condition detection of pancreatic beta-cells as the cause of diabetes mellitus based on iris image. *Proceedings - International Conference on Instrumentation, Communication,* *Information Technology and Biomedical Engineering 2011, ICICI-BME 2011,* (November), pp.150–155.

Putra, A, P, & Sutojo, T, 2014. Identifikasi Penurunan Kondisi Fungsi Organ Ginjal Melalui Iris Mata Menggunakan Metode Jaringan Syaraf Tiruan *Learning Vector Quantization*. *Techno.Com,* 13(1)**,** pp.45-52.

Rahayu, D. N. P., Isnanto, R. R. & Hidayatno, A., Aplikasi Pendiagnosis Gangguan Ginjal Melalui Citra Iris Mata Menggunakan Metode Segmentasi Berdasar Deteksi Tepi. ,pp. 62-69.

Ramlee, R.A. & Ranjit, S., 2009. Using iris recognition algorithm, detecting cholesterol presence. *Proceedings - 2009 International Conference on Information Management and Engineering, ICIME 2009*, pp.714–717.

Rani, H. A. D., Supriyati, E. & Khotimah, T., 2014. Deteksi Iris Mata Untuk Menentukan Kelebihan Kolesterol Menggunakan Ekstraksi Ciri *Moment Variant* Dengan *K-Means Clustering. Prosiding Snatif Ke-1***,** pp.287-292.

Rochmad, M., 2009. Identifikasi Kerusakan Pankreas Melalui Iridology Menggunakan Metode Bayes Untuk Pengenalan Diabetes Millitus. *Seminar Nasional Informatika 2009 (SEMNASIF 2009), Upn Veteran Yogyakarta***,** A33-A42.

Saefurrohman, 2013. Sistem Penentu Kolesterol Pada Manusia Dengan Iridology Menggunakan Deteksi Tepi. *Jurnal Teknologi Informasi Dinamik,* 18**,** 30-40.