APPLICATION OF NEURAL NETWORKS ON BLOOD SERUM IMAGE FOR EARLY DETECTION OF TYPHUS

by Suryani Dyah Astuti

Submission date: 08-Nov-2018 03:29PM (UTC+0800)
Submission ID: 1035208303
File name: APPLICATION_OF_NEURAL_NETWORKS_ON_BLOOD_SERUM.pdf (947.96K)
Word count: 3068
Character count: 16140

Indonesian Journal of
Tropical and Infectious Disease
Vol. 4. No. 4 October–December 2013

Research Report

APPLICATION OF NEURAL NETWORKS ON BLOOD SERUM IMAGE FOR EARLY DETECTION OF TYPHUS

Betty Purnamasari[1], Franky Chandra S.A[2], Suryani Dyah A[3]
[1] Bachelor of Biomedical Engineering Study Program, Physics Department, Faculty of Science and Technology, Universitas Airlangga
[2] Bachelor of Biomedical Engineering Study Program, Physics Department, Faculty of Science and Technology, Universitas Airlangga
[3] Bachelor of Physics Study Program, Physics Department, Faculty of Science and Technology, Universitas Airlangga
Contact Person: bettysanchezh@yahoo.com

ABSTRACT

Background: Typhus is a disease caused by Salmonella typhi, Salmonella paratyphi A Salmonella parathypi B, dan Salmonella paratyphi C bacteria that attacks digestive tract and caused infection in small intestine. The common test that performed in the laboratory is widal test. The result reading of the widal test still processed manually with looking the turbidity caused by the agglutination. Aim: The research was made to decrease human error by creating a program based on artificial neural network (ANN) with learning vector quantization (LVQ) method. Method: Input of this program is image of blood serum that has reacted with widal reagen. Image procesing start with grayscaling, filtering, and thresholding. Result: Output of this program is divided into two classes, normal and typhus detected. Conclusion: From this experiment result that using 24 testing data, gives the accuracy of this program 95.833% with 1 error result from 24 testing data.

Key words: *Artificial Neural Network, Learning Vector Quantization, Salmonella, Typhus, Widal*

ABSTRAK

Latar belakang: Penyakit typhus adalah penyakit yang disebabkan oleh bakteri Salmonella typhi, Salmonella paratyphi A Salmonella parathypi B, dan Salmonella paratyphi C yang menyerang bagian saluran pencernaan, sehingga terjadi infeksi saluran pencernaan tepatnya usus halus dan masuk ke aliran darah. Pemeriksaan awal yang umum dilaksanakan di laboratorium adalah dengan melakukan pemeriksaan widal. Pembacaan hasil pemeriksaan widal masih dilakukan secara manual dengan mengandalkan kemampuan manusia memeriksa kekeruhan yang timbul akibat terjadinya aglutinasi. Tujuan: Penelitian ini dibuat untuk mengurangi adanya human error yang terjadi pada pembacaan hasil tes dengan menggunakan program berbasis jaringan saraf tiruan (JST) metode Learning Vector Quantization (LVQ). Metode: Citra yang digunakan adalah citra serum darah yang telah direaksikan dengan reagen widal. Proses pengolahan citra dilakukan dengan teknik grayscaling, filtering dan thresholding. Hasil: Keluaran dari program ini adalah deteksi citra serum darah typhus dan normal. Kesimpulan: Dari hasil penelitian ini dengan menggunakan 24 data uji, memberikan akurasi program sebesar 95,833% dengan 1 kesalahan uji dari 24 data uji.

Kata kunci: *Jaringan Saraf Tiruan, Learning Vector Quantization, Salmonella, Typhus, Widal*

INTRODUCTION

Typhoid fever or commonly referred to as typhus is a disease caused by the bacterium Salmonella typhi, Salmonella paratyphi A Salmonella parathypi B, and Salmonella paratyphi C, which attacks the digestive tract. Acute infectious disease is always there in society (endemic) in Indonesia, ranging in age from toddlers, children and adults. According to WHO (World health organization) in 2003, each year there are approximately 17 million cases with 600,000 cases leading to death in the world. Approximately 2% of patients with typhoid can be a carrier. In Indonesia, there were 900,000 cases with 20,000 deaths case.[1]

A common initial examination was carried out in the laboratory by examining widal. Widal tes is included in the class of serological test, which is done by reacting the blood serum of patients with widal reagents. Widal test is the

examination steps are easy to do and the results are quickly obtained. Widal test involving agglutination reaction that helps detect antibodies in the diagnosis of typhoid fever.[2] Positive Widal test characterized by the appearance of turbidity caused by agglutination arising from the reaction of antibodies in the blood serum of patients with bacterial antigens present in widal reagents. Widal test results can be used as a follow-up diagnosis of typhoid fever. Diagnosis of typhoid disease from widal test must be supported by other examinations, such as checking the physical condition of the patient's own or other laboratory tests such as examination of peripheral blood and blood cultures.[3]

The results of turbidity caused by agglutination widal examination read by relying on human capabilities so that errors can occur due to human error, because each medical staff have different possibility of reading the results of turbidity arising from the blood serum agglutination reagents.[4] Based on the above presentation, to reduce human error and to develop research using soft computing technologies it needs to make a program to solve it is by using a program based on artificial neural networks.

Artificial neural network is an information processing system that has characteristics similar to biological neural networks, which can be applied to one of them in pattern recognition or pattern recognition.[5] Typhus diagnostic research with widal test using artificial neural networks has been studied before with bacpropagation method.[4] The procentage of the result is success detection for 93.75% positive typhoid and negative 90% for typhoid. The study was conducted by using the features in the form of a binary matrix pattern of image processing as input feature propagation. Artificial neural networks have many methods that can be used. Comparative research results using an artificial neural network classification methods bacpropagation and LVQ (Learning Vector Quantization) to obtain the result that the LVQ training process faster and more accurate than backpropagation.[6]

Due to the background, the author will make an application methode of artificial neural network in blood serum image for early detection of disease typhoid. The present study microscopic images of blood serum which has given widal reagents are used as inputs of the software, but the image is processed first using image processing methods. The output of image processing features value then processed using LVQ neural network method and going through the learning phase.

MATERIALS AND METHODS

Sample data collection of blood serum samples is done by taking a blood serum sample data that has been diagnosed from clinical laboratory that consist normal blood serum sample and typhus blood serum samples. Blood serum is then reacted with a reagent widal then conducted observations and image capture using a digital microscope. The whole image is obtained jpeg format, and done cropping on an object the size of 100 x 100 pixels.

Image of the blood serum was observed if there is agglutination in it, if it is exposed to typhus blood serum then there will be agglutination otherwise if there is no agglutination in the serum it is normal serum. Agglutination occurs due to the reaction between serum by cellular antigen or cell body surface. The reaction between the reagent and serum observed under a microscope with magnification 4x10, the results of these observations in the form of images to be processed into the image processing and artificial neural networks.

Broadly speaking, software design schemes undertaken in this study is depicted in Figure 1.

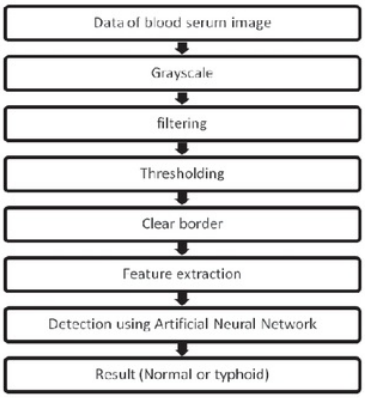


Figure 1. Flow procedure typhus detection program

Blood serum samples processed image using a digital image processing techniques such as grayscale, namely, filtering, thresholding and clear border. First Data of blood serum image was color image that consists of three layer matrix, namely R - layer, G - layer and B - layer converted to grayscale images or images that represent the level of gray. Grayscale process aims to alleviate the computational load while performing data processing. Then the filtering process done to the image that has grayscale form. Filtering is used to improve the quality of the processed image by smoothing noise contained in images of blood serum samples. The research will use median filter as the filter technique. Median filter method serves as a nonlinear filter for the workings of this filter is not included into the category convolution operation. The next process is thresholding, thresholding is a simple and effective techniques for image segmentation of blood serum. This method can be used to extract objects from the background by selecting the threshold value T that separates the background and object and the result of thresholding process will produce a binery image or image with black and white colour. In this case the object needed is agglutination that caused by the reaction of serum with reagents. Agglutination will be represented by the white pixels that result from thresholding

process, so the feature image obtained in the form of the number of pixels that are white. Clear borbeder process after thresholding process is used to eliminate unwanted image on the wall background.

Feature extraction is used to determine the characteristics of the image or pattern of positive and negative blood serum typhus before being put to be processed into the neural network. Results of feature extraction is a number of white pixels, which is where white pixels represent the image in the image agglutination.

Results of feature extraction processing will be used as input to an ANN using LVQ models. The next stage is the determination of the network design. This stage will be determined the definition of the problem, namely the determination of input and output patterns for training and testing the ANN. The next step taken is to initialize the network to be trained or tested. This research was conducted using 64 training sample data consist of 32 normal samples and 32 samples of typhus. The data used for testing amounted to 24 data consists of data from 12 normal and 12 Data typhus. The flow chart of LVQ itself can be shown in Figure 2.

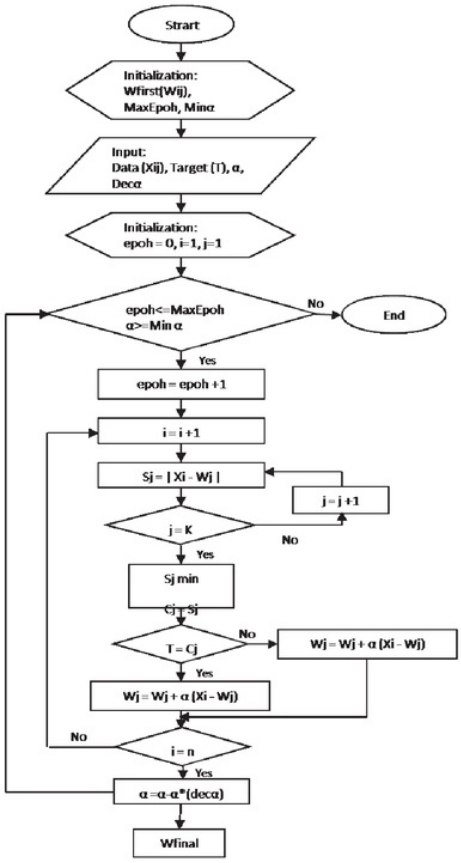


Figure 2. Flowchart LVQ

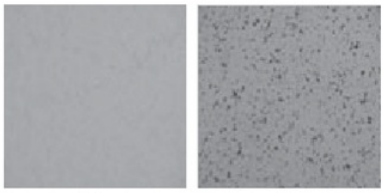
RESULT AND DISCUSSION

This research was conducted using 64 training sample data, where each consisting of 32 normal samples and 32 samples of typhus. The data used for testing amounted to 24 data consists of data from 12 normal and 12 Data typhus. All training sample data processed with image processing and ANN using LVQ methode.

For the first image processing is grayscale, grayscaling process is done for change the image color on the blood serum into gray image to reduce the computational burden. After grayscalling process, image has filtered with median filtering methode to reduce the noise. Grayscalling image processing result is shown in Figure 3.

The next processed is thresholding. Thresholding process in this study is done by taking 115 as the threshold value that obtained by observation the histogram blood serum images were used as training samples. Objects needed in this case is the agglutination that caused by reaction with the reagent serum. Agglutination will be represented by the white pixels caused by the thresholding process. Image processing results for thresholding disaikan in Figure 4.

The last step of image processing that used in this study is clear border. Clearborder process needed for eliminate unneeded image attached or contact with blood serum image to be processed. Image processing results of the process is a clear border binary image like the result of the previous image processing wihich is thresholding. This binary image is used to deteminate the value of feature extraction. At this clearborder process used toolbox matlab syntax "cb = imclearborder (cb)". Results of image processing for clear border is shown in Figure 5.

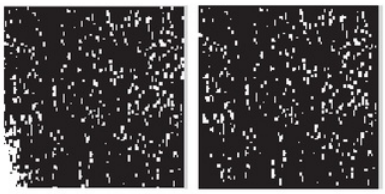


(a) (b)

Figure 3. (a) Grayscale normal serum image (b) Grayscale typhus serum image

(a) (b)

Figure 4. (a) Threshold normal serum image (b) Threshold typhus serum image



(a) (b)

Figure 5. (a) Threshold image typhus serum (b) clearborder image typhus serum

For feature extraction, object that needed in this case is the agglutination that caused by the reaction with the reagent serum. Agglutination will be represented by a white pixel in the resulting binary image. Binary image of blood serum results will be processed for image feature extraction process to count the number of white pixels as features that are used as input for training and testing process in ANN.

Training process of neural network LVQ method for detection of typhus used 64 data of blood serum image, which consists of 32 images of normal blood serum and 32 images of typhoid blood serum. Training process is performed using some variations of Learning Vector Quantization input parameters, as shown in Table 1.

The results of the training process is obtainment of final weight values that saved and used for the testing process. After the data passing through the training process will be performed test matches to the target data which is the result of a doctor's diagnosis. The number of matches data with the target compared to the entire amount of data to get the accuracy rate of the training process. The accuracy obtained from each parameter changes is shown in Table 2.

Table 2 shows the percentage level of accuracy of the results of the training process to some variations of the learning rate (α) and a reduction in the rate of learning (dec α), these variations affect the number of epoch that and the level of accuracy for the training. Parameter

Table 1. Variation parameter of LVQ

Amount of *training data*	64
Amount of target classification	2
Learning rate (α)	0.1 ; 0.01 ; 0.001
Decrease of learning rate (dec α)	1.01 ; 0.1 ; 0.5 ; 0.25
Minimum learning rate (min α)	0.0000001
Maximum epoch	10000

Table 2. Result accuracy testing value on training data

α	Dec α	Epoch	Akurasi (%)
0.1	0.001	1146	93,75
	0.1	110	93,75
	0.25	41	93,75
	0.5	17	93,75
0.01	0.001	917	93,75
	0.1	88	93,75
	0.25	33	95,3125
	0.5	14	96,875
0.001	0.001	688	93,75
	0.1	66	96.875
	0.25	25	96.875
	0.5	10	96.875

variation indicates a accuray changes that does not necessarily(volatile). The most optimal level of accuracy in this study was the learning rate 0.01 with a reduction in the learning rate 0.5 and learning rate 0.001 with the reduction of learning rate 0.1, 0.25, 0.5 by 96.875% accuracy. Display ANN training program is shown in Figure 6.

The testing process used 24 data outside of the data that used for training process. 24 data consists of 12 images of normal blood serum, 12 images typhus blood serum. Classification of testing data process performed by finding the minimum distance between features of testing data with the final weight values that obtained from the results of ANN training process. The testing process is done by

Figure 6. Display of training program

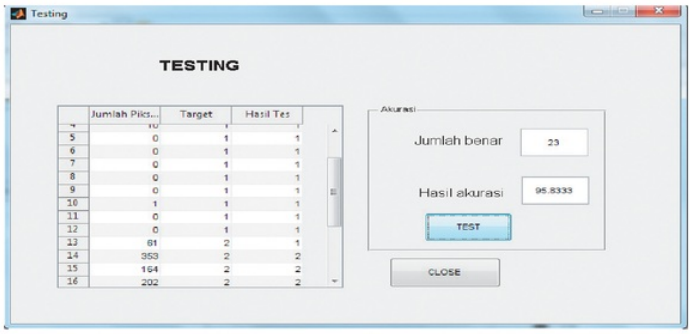


Figure 7. Testing program display

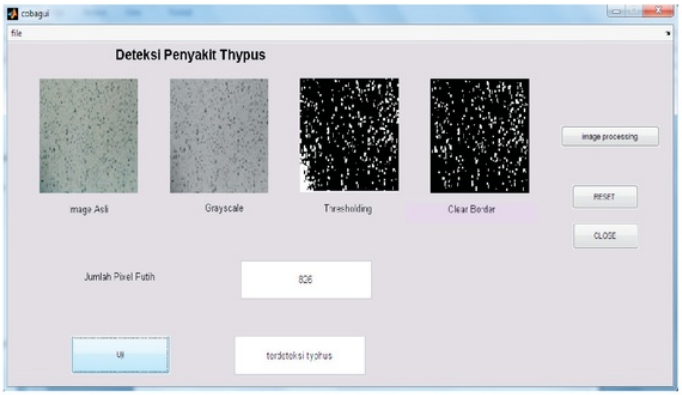


Figure 8. Display of early detection of typhus program

using a variation of the dec alpha and alpha which has the highest value accuracy of training data which is used alpha 0.01 and dec alpha 0.5. Testing process results for testing data using the alpha value of 0.01 and the dec alpha value of 0.5 is obtained the accuracy of 95.833%. From 24 testing data are, there's 1 testing data that does not match the target. Display ANN testing program is shown in Figure 7.

Display program of early detection of typhus which thre are image processing, feature values and the image test results is presented in Figure 8.

In this page display there is a menu bar file, which is used to retrieve data from the directory. Also in this page there are some buttons that have the functions of each. Image processing button, a button that contains the command for perform the process image processing on the data tested. Image processing process shown on this page are the original image, grayscale, binary image from thresholding process and clear border. This button also count the feature extraction value. Test button, a button that contains the commands for perform testing process on the data tested. In this case the results of the test is information whether the data classified in "normal" or classified in "typhosa detected". Reset button, serves to reset or delete the previous data so that the page can be used for perform other testing data. Close button, serves to close the page process the data and return to the home page.

CONCLUSION

Based on the results of the discussion, it concluded that early detection system design on blood serum image based on neural network methode, done by looking for the value of the number of features in the form of white pixels in the images of blood serum which has been processed using image processing. The most optimal parameter values for the typhus early detection design programs is using the value of the learning rate (α) of 0.01 and a reduction of learning rate (dec α) of 0.5 with the accuracy of the program 95.83%.

REFERENCES

1. Crump, Jhon A. 2004. Stephen P, Luby. Eric D, Mintz. 2004. *The Global Burden of Thypoid Fever*. Buletin of World Health Organization
2. Nigam, Arty. Ayyagary Archana. 2007. *Lab Manual in Biochemistry: Immunology and Biotechnology*. Tata McGraw-Hill Publishing Company Limited. New Delhi.

3. Djojodibroto, Darmanto. 2001. Seluk-Beluk Pemeriksaan Kesehatan (general Medical Check Up). Pustaka Populer Obor. Jakarta.
4. Mak`ruf, Muhammad Ridha. 2006. Identifikasi Penyakit Thypus dengan Widal Test Menggunakan jaringan Syaraf Tiruan. Teknik Fisika, Institut Teknologi Sepuluh Nopember. Surabaya.
5. Siang, Jong Jek. 2009. Jaringan Saraf Tiruan & Pemrogramannya Menggunakan MATLAB. Penerbit Andi. Yogyakarta.
6. Nurkhozin, Agus, Irawan, Mohammad Isa. Mukhlas, Imam. 2011. Komparasi Hasil Klasifikasi Penyakit Diabetes Mellitus Menggunakan Jaringan Syaraf Tiruan *Backpropagation* Dan *Learning Vector Quantization*, Fakultas MIPA, Universitas Negeri Yogyakarta.
7. Sudibyo, Akhmad. 2012. *Widal Test* (Uji Widal). Fakultas Kedokteran, Universitas Wijaya Kusuma. Surabaya.
8. Putra, Dharma, 2010, Pengolahan Citra Digital, CV Andi Offset, Yogyakarta
9. Prasetyo, Eko, 2011, Pengolahan Citra Digital dan Aplikasinya Menggunakan Matlab, Yogyakarta: ANDI. ISBN : 978-979-29-2703-0
10. Kusumadewi, Sri. 2004. Membangun Jaringan Syaraf Tiruan Menggunakan Matlab dan Excellin., Graha Ilmu. Edisi 1. Jogjakarta
11. Munir, Rinaldi. 2004. Pengolahan Citra Digital dengan Pendekatan Algoritmik. Informatika Bandung.
12. Sumathi, S. Paneerselvam, Surekha, 2010. *Computational Intelligence Paradigms: Theory & Applications Using MATLAB.* Taylor and Francis Group. LLC.
13. Sherwood, L. Gorbach. Dr John G Bartlett, M.D., Neil R. Blacklow, M.D. 2004. *Infectious diseases*, third edition.

APPLICATION OF NEURAL NETWORKS ON BLOOD SERUM IMAGE FOR EARLY DETECTION OF TYPHUS

ORIGINALITY REPORT

6%	5%	2%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	uad.portalgaruda.org Internet Source	1%
2	portalgaruda.ilkom.unsri.ac.id Internet Source	1%
3	obatstrokeherbal.web.id Internet Source	1%
4	www.aicit.org Internet Source	1%
5	vdocuments.site Internet Source	1%
6	docplayer.info Internet Source	<1%
7	Handbook of Genetic Programming Applications, 2015. Publication	<1%
8	issuu.com Internet Source	<1%

9	"International Conference on Applications and Techniques in Cyber Security and Intelligence ATCI 2018", Springer Nature America, Inc, 2019 Publication	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		

APPLICATION OF NEURAL NETWORKS ON BLOOD SERUM IMAGE FOR EARLY DETECTION OF TYPHUS

GRADEMARK REPORT

FINAL GRADE

/0

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6