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Research Report

DIGITAL DETECTION SYSTEM DESIGN OF MYCOBACTERIUM TUBERCULOSIS THROUGH EXTRACTION OF SPUTUM IMAGE USING NEURAL NETWORK METHOD

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ABSTRACT

Tuberculosis (TBC) is an dangerous disease and many people has been infected. One of many important steps to control TBC effectively and efficiently is by increasing case finding using right method and accurate diagnostic. One of them is to detect Mycobacterium Tuberculosis inside sputum. Conventional detection of Mycobacterium Tuberculosis inside sputum can need a lot of time, so digitally detection method of Mycobacterium Tuberculosis was designed as an effort to get better result of detection. This method was designed by using combination between digital image processing method and Neural Network method. From testing report that was done, Mycobacterium can be detected with successful value reach 77.5% and training error less than 5%.

Key words: *mycobacterium tuberculosis, digital image processing, neural network*

INTRODUCTION

Tuberculosis (TBC) is an dangerous disease and many people has been infected. Accurate and fast detection of *Mycobacterium Tuberculosis* is needed and very important to prevent TB before getting worse.

One of detection method that has been developed to detect *Mycobacterium Tuberculosis* is by sputum examination. Conventional detection method of *Mycobacterium Tuberculosis* through sputum examination using microscope can need a lot of time, so digitally detection method of *Mycobacterium Tuberculosis* was designed as an effort to get better result of detection.

The advantage of computation technology is in digital imaging and image detection. Computation technologies that can be used in medical research are Digital Image Processing and Neural Network (NN).

THEORY

Tuberculosis

Tuberculosis (TBC) is an dangerous disease, most of *Mycobacterium* infect lungs but it can infect another part of body. *Tuberculosis* can infect by cough, patient bring *Mycobacterium* to the air in sputum drop (droplet nuclei). Once cough can result about 3000 sputum drops. Usually, *Tuberculosis* can infect in a long time. Ventilation can reduce number of drop. Quantity of *Mycobacterium* in lungs can increase infection quality of *Tuberculosis*.

Digital Image Processing

Digital image processing is used in many kind of aim. One of them is to convert 24 bit true color image to binary format through some steps character extraction, noise filtering, grayscale, and threshold.

Grayscale

By using representation of RGB (Red, Green, Blue) value, a true color image is converted to white color and gradation of black color that is usually called by grayscale image.

Threshold

Threshold is data conversion of image in refer to the image just has two value 0 and 1. This step is done to get an information of pixel "High" or "Low".

Neural Network

Neural Network (NN) is a method than can useful in many goals, for detection, identification, and control. NN was designed to solve some problem through learning technique. NN algorithm is easy to learned and can be used in medical research is to identify medical image. Basic configuration of Multilayer Neural Network is like Figure 1.

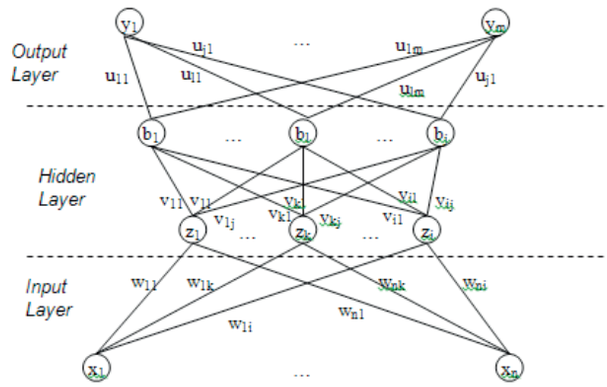


Figure 1. Basic Configuration of Multilayer Neural Network

Back propagation is one of some architectures of Neural Network. This architecture consist input layer, hidden layer and output layer, and every layer consists one or more artificial neuron. The name of this architecture is Multilayer Neural Network.

METHODOLOGY

This research was done by preparing digital image of sputum. Analog image of sputum was converted to digital using computer. 24 bit digital image of sputum was extracted to binary through digital image processing method. Pixel value at digital image was used as input of detection program. Program to detect digital image of *Mycobacterium Tuberculosis* was designed using Neural Network method. Neural Network method was tested by using sputum image and was compared to database that was recognized. Digital image of *Mycobacterium Tuberculosis* or not was used as input data of NN learning. If results of error compared to database, the value less than 5 percent and the conclucion should be done, but if error more than 5 percent then the design of program need to be repaired. Designed of research that was done was like at Figure 2.

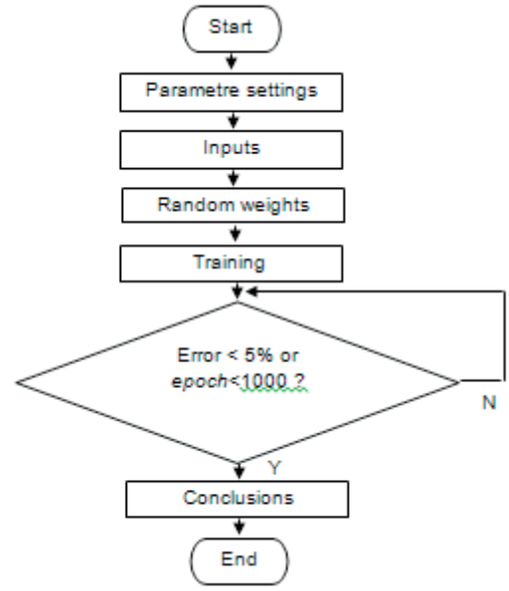
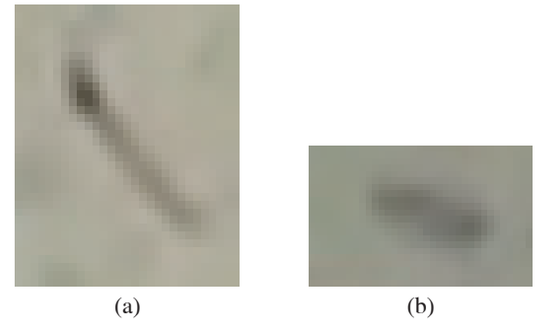


Figure 2. Algorithm of Detection using Neural Network

Detection method of *Mycobacterium Tuberculosis* through image extraction using Neural Network method was designed by using Back propagation type. Neural Network was build using 3 layer objects (one input layer, one hidden layer and one output layer).

RESULT

Input data of Neural Network in Bitmap format with dimension is 70 pixels x 70 pixels. Training data of Neural Network is digital image of sputum which consist *Mycobacterium* and not that was already detected. 20 images data was used as inputs in Neural Network training process with specifications 10 images consists *Mycobacterium* and 10 images are not. Example of Neural Network image data inputs is like in Figure 3.



(a) (b)

Figure 3. Input Image of Neural Network (a)*Mycobacterium* (b) Not *Mycobacterium*

40 images data was used as inputs in testing of Neural Network with specifications 10 images consists *Mycobacterium* and 20 images are not. Input image that was used in Neural Network testing process was not input image that was used in Neural Network training process.

Neural Network training was used to classify sputum image according to type of object that had been researched, sputum images which consists *Mycobacterium* and sputum images which not consists *Mycobacterium*.

Training of Neural Network was done by using Delphi 6.0 software. Program that was designed is shown in Figure 4.

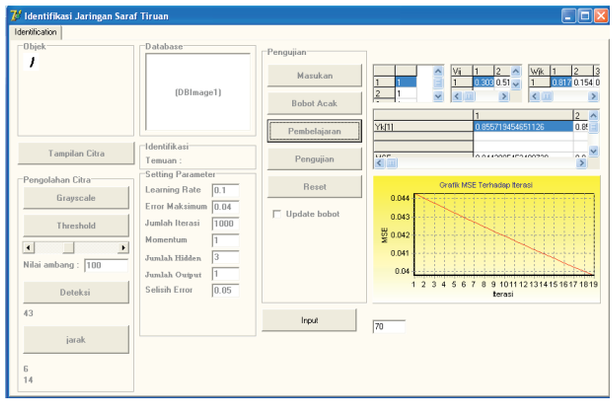


Figure 4. Training Process of Neural Network

In training process of Neural Network, some parameters value was set according to the aim. Parameters value that was set are dimension of input image, Hidden number, Output number, learning rate value, momentum value, limit of epoch, and limit of maximum error. Parameters value of Neural Network was shown in Table 1.

Table 1. Parameters Value Specification of Neural Network

Parameters	Value
Number of Input (pixel)	4900
Number of Hidden	3
Number of Output	1
Learning Rate	0,1
Momentum	1
Number of Epoch	269
Output value	0,1399
Target:	
– *Mycobacterium*	0,1
– Not *Mycobacterium*	0,9
Error	0,0399

Parameters value in Table 1 was used in Neural Network testing process. From the result of Neural Network testing that had been done using training parameter from Table 1, Neural Network training can be done well and error value of training reach criteria less than 5 percent.

Table 2. Successful Level of Neural Network Testing

No.	Image Type	Number of Input	Successful Detection	Successful Level
1.	*Mycobacterium*	20	16	80%
2.	*Not Mycobacterium*	20	15	75%

According to data in Table 2, mean of successful to detect *Mycobacterium* and not *Mycobacterium* image is about 77.5 percent. Result of Neural Network testing by using 20 input images of *Mycobacterium* and 20 input images of not *Mycobacterium*, 16 input images of *Mycobacterium* and 15 input images of not *Mycobacterium* was successfully detected according to the target. Some results does not match because the dimension of *Mycobacterium* is not suitable with the dimension of *Mycobacterium* in program setting. That is caused by *Mycobacterium* which were grow up a become longer than limit of dimension. This condition as difficulty in identification. There were noise of image so it can be affected performance of *Mycobacterium*. The resolution of camera was low so the contrast of *Mycobacterium* image was low too. It can caused by position of *Mycobacterium* and another image and it can influenced value, and result of detection. Coloring at sputum image can affected different illumination so comparison of image value can be different. Cropping position was not suitable, it can affected pixel value because maybe some part of image was out of cropping area. Threshold value was not suitable and it can be affected input of Neural Network. Successful level of *Mycobacterium* detection is like Table 2 that is 80 percent of *Mycobacterium* images and 75 percent of not *Mycobacterium* images or mean of successful level was reach 77,5 percent by using 40 inputs of data. This result is still need to be repaired by choosing better method so detection result will be more accurate, some efforts to get better result are by adding inputs of training data with many variations, repairing characteristic detection or characteristic extraction of *Mycobacterium tuberculosis* and not *Mycobacterium tuberculosis* images, modification value of Neural Network parameters so success level of Mycobacterium will higher than before, repairing digital image processing method, then performance of *Mycobacterium* image could be contrast, or need modification of detection method by adding good method.

CONCLUSIONS

The result of digital detection system of *Mycobacterium Tuberculosis* has been reached 80 percents succesful level of identification and less than 5 percents error value of Neural Network training.

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