Main Menu

- Home
- Accepted Papers
- Best Papers
- Call for Papers
- Important Dates
- Paper Submission
- Publication
- Registration
- Conference Program
- Technical Session Schedule
- Conference Venue
- Accomodation And Tour
- Past Conferences
- Keynotes
- Workshop
- Organizers
- Preparing Final Manuscripts

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Tropical Diseases Identification Using Neural Network Adaptive Resonance Theory 2

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***Abstract*-The diagnosis of tropical diseases carried out by a doctor to determine medical treatment for patients must be done carefully and accurately. Errors in diagnosis can be fatal and dangerous for patients. Tropical diseases are discussed in this study are malaria, dengue fever and typhoid. These three diseases have some similar symptoms, so doctors often make mistakes in conducting the initial diagnosis for the patients. To solve this problem, the authors conducted a study by implementing Artificial Neural Networks Adaptive Resonance Theory 2 which can be done simply by entering the data of the same symptoms of the three tropical diseases. This data is then trained by using the model and compared with the data of symptoms experienced by the patients to determine the tropical diseases suffered. The advantage of this method is the use of the new data does not defect the old data[6]. The application of the method has been tested by using several real cases with a success rate of 91,67 %.**

Keywords—component; formatting; style; styling; insert (key words)

I. INTRODUCTION

In a study Anggraini (2011) World Health Organization (2009) wrote malaria is an infectious disease that has been reported to be a serious global health problem, causing between 1.5 and 2.7 million of deaths every year in more than 90 countries [2][9]. In a study Anggraini (2011) Murray wrote it is caused by intracellular single-celled parasite that belongs to genus Plasmodium [2][7]. The diagnosis of tropical disease carried out by a physician to determine medical treatment for patients must be done carefully and accurately. Wrong diagnosis to determine the medical treatment can cause fatal effect and endanger patients. And for some particular disease, the diagnosis cannot be performed by general medical personnel but can only be done by a specialist who has special expertise in the field. A common problem we faced nowadays is the minimal medical specialists in remote areas. Where in this area, the medical personnel available are common medical personnel such as paramedics, midwives or general practitioners who have limited knowledge and experience to deal with specific diseases. This condition can lead to less optimal medical treatment for patients.

II. RELATED WORK

In a previous study [1] using ANFIS diagnostics for patient illness based on medical record information system according to symptoms experienced by patient. This can help to provide accurate results of the diagnosis. Research [3] uses Backpropagation to predict dengue fever and typhoid-based symptoms. By using a single input layer with 18 neurons, one layer with 125 neurons and one layer of the results with one neuron and a constant momentum value of 0.95. This system has a good performance. Research [5] uses a perceptron method for intelligent diagnostic system of internal medicine. This study uses data input based on information obtained from doctors, nurses and patients information. The training process contained 48 data, resulting in 78.9% that can be delivered correctly. Research [8] using a hybrid smart system in diagnosing typhoid. This study mentioned a hybrid intelligent system, known as Adaptive Neuro Fuzzy Inference System (ANFIS) that provides an efficient way of handling to diagnose typhoid. Test results got 97.5% can be imported well.

The differences of this research compared with related research such as the above are that the writer implemented Adaptive Resonance Theory 2 method to identify type of tropical disease patient suffered. The tropical diseases discussed in this study are malaria, dengue fever and typhoid. These three diseases have some similar symptoms, so doctors may make mistakes in conducting the initial diagnosis for the patients. To solve this problem, the authors conducted a study by implementing Artificial Neural Networks Adaptive Resonance Theory 2 which can be done simply by entering the data of the same symptoms of the three tropical diseases. This data is then trained by using the method and compared with the data of symptoms experienced by the patients to determine the tropical diseases suffered. The advantage of this method is the use of the new data does not defect the old data [6]. The application of the method has been tested by using several real cases.

III. RESEARCH METHOD

The method used in this research is a quantitative research method. It is the method which is used to solve a problem by using scientific methods to measure the research variables and the relationships between variables. The purpose of quantitative research is to develop and use mathematical models, theories and / or hypotheses pertaining to natural phenomena by presenting significant statistical data.

The procedures performed in this study are:

1. Formulate a research problem.

2. Conduct a literature review related to the issues discussed in the form of research papers , journals and other references
3. Collect data research by giving questionnaires to some relevant experts to provide information on tropical diseases discussed in this study, namely malaria, dengue fever and typhoid.
4. Perform analysis of data by grouping similar symptoms from all three tropical diseases.
5. Build the application by applying the algorithm of Adaptive Resonance Theory 2
6. Execute the training data.
7. Run the test data to determine the type of tropical diseases suffered.
8. Measuring the percentage success rate of the test data.

A. Neural Network Model of Adaptive Resonance Theory 2

Neural network models of Adaptive Resonance Theory (ART) are designed to facilitate the control of the degree of similarity of patterns placed in the same cluster. This model can also address the stability-plasticity problem, which is the ability to store information that has been learned when there is new information that is faced by other artificial neural networks.

This model was developed by Carpenter and Grossberg in 1988. It has several advantages over other neural network models. ART is one of the networks with unsupervised learning. Based on how it works, this model can be grouped into two categories: ART 1 or Binary ART and ART 2 or Analogue ART. ART 1 can only process binary input data or data with only two circumstances such as 0 and 1 while ART 2 can process continuous data [4].

B. ART2 Architecture

The architectural model of the development of the ART 2 in this study can be seen in Figure 1. [4].

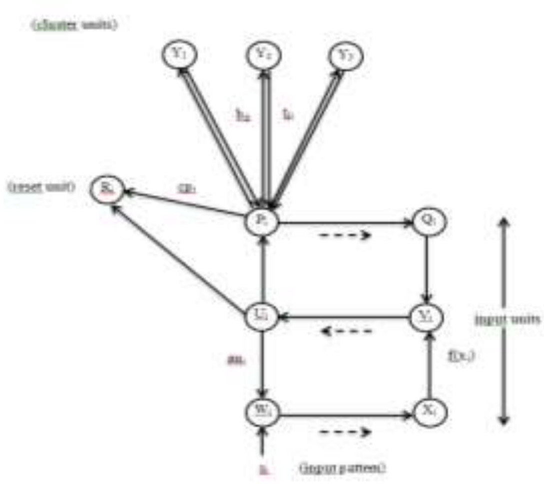

Fig. 1. ART2 Architecture

In ART2, F_1 layer architecture consists of six types of units, namely: W, X, U, V, P, Q and there are units for each type of unit. The additional unit "N" between W and X unit receives signals from all the units of "W", calculate the norm of vector W and sends this signal to each unit of X. Similarly, the additional output units between U and V, and P and Q, perform the same operation as that between W and X. The relationships between Pi F_1 layer and Y_1 until Y_3 F_2 layer indicate weights interconnection which multiplies the signal transmitted and is a unit of cluster [3]. The number of clusters in this study consisted of three classes, namely malaria, dengue fever and typhoid.

C. ART2 Algorithm

The algorithm Adaptive Resonance Theory 2 is [4]:

Step 0 Initialize parameters:
a,b, θ, c, d, e, α, ρ

Step 1 Do step 2-12 N epoch times.
(Perform the specified number of epochs of training)

Step 2 For each input vector s, do step 3-11.

Step 3 Update F_1 unit activations :

$u_i = 0$

$w_i = s_i$

$p_i = 0$

$$x_i = \frac{s_i}{e + \|s\|}$$

$q_i = 0$

$v_i = f(x_i)$

Update F_1 unit activations again :

$$u_i = \frac{v_i}{e + \|v\|}$$

$wi = si + aui$

$p_i = u_i$

$$x_i = \frac{w_i}{e + \|w\|}$$

$$q_i = \frac{p}{e + \|p\|}$$

$v_i = f(x_i) + bf(q_i)$

Step 4 Compute signals to F_2 units :

$$y_j = \sum_i b_{ij} p_i$$

Step 5 While reset is true, do steps 6-7

Step 6 Find F_2 unit y_J with largest signal. (Define J such that $y_J \geq y_j$ for j = 1,2,...,m)

Step 7 Check for reset :

$$u_i = \frac{v_i}{e + \|v\|}$$

$p_i = u_i + dt_{Ji}$

$$r_i = \frac{u_i + cp_i}{e + \|u\| + c\|p\|}$$

Jika $\|r\| < \rho - e, then$

$y_J = -1$ (inhibit J)

(reset is true ; repeat step 5)

Jika $|r| \geq \rho - e, then$

$w_i = s_i + au_i$

$$x_i = \frac{w_i}{e + \|w\|}$$

$$q_i = \frac{p}{e + \|p\|}$$

$$v_i = f(x_i) + bf(q_i)$$

Reset is false; proceed to step 8

Step 8 Do step 9-11 N iteration times

Step 9 Update weights for winning unit J.

$$t_{Ji} = \alpha du_i + \{1 + \alpha d(d-1)\}t_{Ji}$$

$$b_{iJ} = \alpha du_i + \{1 + \alpha d(d-1)\}b_{iJ}$$

Step 10 Update F_1 activations:

$$u_i = \frac{v_i}{e + \|v\|}$$

$w_i = s_i + au_i$

$p_i = u_i + dt_{Ji}$

$$x_i = \frac{w_i}{e + \|w\|}$$

$$q_i = \frac{p}{e + \|p\|}$$

$$v_i = f(x_i) + bf(q_i)$$

Step 11 Test stopping condition for weight updates

Step 12 Test stopping condition for number of epoch

Where:

a, b = fixed weights in the F1 layer

c = fixed weights used in testing for reset ; a sample value is c=.1, a small c gives a larger effective range of the vigilance parameter

d = activation of winning F2 unit

e = small parameter introduced to prevent division by zero if norm vector = 0. This value prevents the normalization to unity from being exact. A value of zero is typically used in the hand computations and derivations that follow and maybe used in the algorithm if the the normalization step is skipped when the vector is zero

θ = noise suppression parameter, a sample value is 1√n.

n = number of disease symptoms (F1 layer)

m = number of diseases (F2 layer)

α = parameter to determine the speed learning (small value is safer) for weight convergence

ρ = vigilance parameter weights *bj* and *tj* to determine the number of clusters

D. *Tropical Diseases*

Tropical diseases discussed in this study are malaria, dengue fever and typhoid. These three diseases have some similar symptoms, so doctors often make mistakes in conducting the initial diagnosis for patients. The symptoms are splenomegaly, hepatomegaly, fever, nausea and vomiting. These symptoms are then used as the input data for the next procedures.

IV. Result And Discussion

For this study, there were 30 training data that come from the doctor. The training data as follows:

0,9	0,6	0,5	0,5
0,6	0,7	0,5	0,6
0,7	0,7	0,7	0,9
0,8	0,6	0,6	0,6
0,5	0,4	1	0,8
0,5	0,5	0	0,9
0,75	0,65	0,6	0,75
0,6	0,7	0,5	0,6
0,7	0,7	0,7	0,9
0,5	0,5	1	0,3
1	1	0	0,8
0,5	0,5	0	0,7
1	0,8	1	0,8
0,5	0,3	0,4	0,9
0,6	0,6	0,5	0,75
0,5	0,3	0,5	0,45
0,75	0,3	0,7	0,5
0,4	0,3	0,3	0,3
0,5	0,3	0,5	0,8
0,5	0,5	0,3	0,7
0,5	0,3	0,6	0,8
0,75	0,3	0,7	0,9
0,5	0,3	0,3	0,75
0,75	0,3	0,75	0,45
0,5	0,3	0,5	0,75
0,5	0,3	0,3	0,5
0,25	0,3	0,5	0,3
0,9	0,6	0,5	0,5
0,6	0,7	0,5	0,6
0,7	0,7	0,7	0,9

Fig. 2. Training Data

There are 12 test data derived from patients' symptoms. The data is derived from doctors. The test data as follows:

	HEPATOMEGALY	NAUSEA AND VOMITING	SPLENOMEGALY	FEVER
Malaria Fever	0,9	0,6	0,5	0,5
Dengue Fever	0,6	0,7	0,5	0,6
Typhoid Fever	0,7	0,7	0,7	0,9
Malaria Fever	0,7	0,57	0,6	0,6
Dengue Fever	0,5	0,7	0,4	0,5
Typhoid Fever	0,7	0,7	0,6	0,8
Malaria Fever	0,74	0,66	0,57	0,76
Dengue Fever	0,65	6	0,5	0,7
Typhoid Fever	0,6	0,3	0,5	0,6
Malaria Fever	0,8	1	0	0,5
Dengue Fever	0,5	0,5	0,9	0,3
Typhoid Fever	0.5	0.4	0.1	0.7

Fig. 3. Test Data

From the test data contained shown above, It can be seen that 1 of the test data that is inconsistent with the diagnosis. For the success rate of the data can be seen for the cases tested at the value of rho = 0.9, alpha = 0.6 resulted with the success rate of 91.67%.

. V. CONCLUSION

Based on the data analysis tested above, it can be concluded that the implementation of artificial neural network algorithm model adaptive resonance theory 2 provides significant results to determine the type of tropical disease patient suffered with a success rate of 91, 67%.

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