LEVENBERG MARQUARDT BACKPROPAGATION ALGORITHM ANALYSIS FOR RECOGNITION BATIK PATTERN

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ABSTRACT

Batik is a culture that has long developed and known by the people of Indonesia. The pattern in each region has a unique and distinctive characteristics of each, both in decoration and color with batik itself. One way to identify batik pattern is through pattern recognition.

Marquadt Levenberg algorithm is an enhancement of the back propagation algorithm. These algorithms are built to address some of the weaknesses in the backpropagation algorithm by using standard numerical optimization techniques is to use Jacobian matrix approach. The purpose of Levenberg Marquadt is to minimize the total error.

Testing of Levenberg Marquardt algorithm performed by the method of cross validation. Data used in the training process amounted to 50 pieces with a basic pattern of each 10 pieces and 45 pieces mix pattern with each 5 pieces. While the number of pattern that will be tested at 42 pieces, with each 3 pieces. Of the four test scenarios that use 1 to 4 hidden layer, the test results showed the highest accuracy with an accuracy of 62.5% on the basic pattern of 80% and accuracy in mix pattern of 15.79%. This accuracy is obtained from the composition variables with the number of neurons in the hidden layer neurons as many as 3 and 4 of neurons, learning rate that is worth 0:01, epoch boundaries of 7000, and the target error of 0.035.

Keywords : *backpropagation*, levenberg marquardt, batik, *pattern recognition*

1. INTRODUCTION

Batik is a culture that has long developed and known by the people of Indonesia. Etymologically the word comes from Javanese batik, which is "tik" meaning point / matic (verb, make a point), which later evolved into the term "batik" [1]. The pattern in each region has a unique and distinctive characteristics of each, both in decoration and color with batik itself. One way to identify batik patterns is through pattern recognition. Marquadt Levenberg algorithm is an enhancement of the back propagation algorithm. These algorithms are built to address some of the weaknesses in the backpropagation algorithm by using standard numerical optimization techniques is to use Jacobian matrix approach. The purpose of Levenberg Marquadt is to minimize the total error [8]. Levenberg Marquardt algorithm has been applied to the facial pattern recognition conducted by Mohammed Alwakeel [7] by comparing the algorithm Levenberg Marquardt algorithm Haar Wavelet Transform and Principal Component Analysis algorithm. These studies proved Levenberg Marquardt algorithm is more accurate, fast, and stable in comparison facial pattern recognition algorithms and algorithms Haar Wavelet Transform Principal Component Analysis. In another study conducted by Tulus Rise Primary regarding color image pattern recognition using google maps Levenberg Marquardt algorithm [17] with the results of this algorithm has managed to create a new image pattern is identified as an area of land and not land. With the background of this issue, it will do research on Levenberg Marquardt algorithm to be implemented to identify the pattern is not only a basic pattern, the pattern can also identify special or mixed. In this study will also determine the level of accuracy Levenberg Marquardt algorithm implementation to pattern recognition of batik.

1.1 Artificial Intelligence

Artificial Intelligence, or AI (Artificial Intelligence) is a study of how to make computers do things at an event or events in which people do well. AI is a process in which mechanical equipment can carry out the events by means of reason or intelligence of a human being [11].

1.2 Artificial Neural Network

Artificial neural network (ANN) is an information processing system that is based fisolofi structure of the nervous behavior of living things [13]. By doing so, the neural network is not programmed properly mechanism on conventional digital computers. So also in terms of its architecture. In architecture, neural networks learn how to produce the desired output when given a set of inputs. This process is done internally, by ordering the system to identify the relationship between the input and then studying the response.

Pensintesisan relationship with the method, the neural network can recognize situations that are and have been seen before. In contrast to internal processes, external processes more depending on the application. The system can use external feedback or signals the desired response, to form a network behavior. This is called supervised learning. In another way, the network can generate the desired response signal itself in the scenario of unsupervised learning.

1.3 *Levenberg Marquardt Algorithm*

Levenberg Marquardt algorithm developed by Kenneth and Donald Levenberg Marquardt, gives a numerical solution to the problem of minimizing nonlinear functions [16]. In the field of artificial neural networks, this algorithm is suitable for small and medium-sized training.

Marquadt Levenberg algorithm is an enhancement of the back propagation algorithm. These algorithms are built to address some of the weaknesses in the backpropagation algorithm by using standard numerical optimization techniques is to use Jacobian matrix approach. The purpose of Levenberg Marquadt is to minimize the total error.

2. RESEARCH

2.1 Analisis Masalah

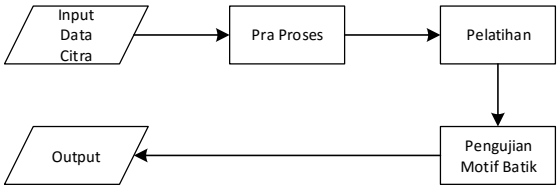
This research will be conducted using the batik fabric pattern recognition algorithm Levenberg Marquardt. Based on the results of a study of the literature on the use of the algorithm Levenberg Marquardt against facial pattern recognition in journals and Zyad Shaaban Mohammed Alwakeel [7]. In this paper discusses the use of facial pattern recognition algorithm Levenberg Marquardt and produce output that is more accurate than algorithm Haar Wavelet Transform and Principal Component Analysis. In addition, the algorithm Levenberg Marquardt has never done research for the introduction of the pattern. For this reason, the research on the Levenberg Marquardt algorithm will be implemented against the introduction of batik pattern.

2.2 System Analysis

Analysis is an activity that includes a number of activities such as outlining a discussion. In this case the discussion on the introduction of batik pattern using Levenberg Marquardt algorithm

2.3 Architecture System Analisys

Applied architecture consisting of a data input of image file extension * .jpg, pre-process, process training using Levenberg Marquardt algorithm, testing pattern using Levenberg Marquardt, and generate output accuracy. Architectural system used can be seen in Picture 2.1 below.



Picture 2.1 Architecture System

The steps are:

1. Input image data is a stage that the data entered is a file ending in * jpg.
2. In the pre-stage process, the system performs a stage consisting of a color change image to grayscale to facilitate the binary process. At this stage was done to clarify the image histogram equalization batik so that the process can be more visible binary of the batik image.
3. In the training phase, the system will conduct training for the formation of the neural network as a data source when identifying the pattern that will be tested.
4. Testing batik, batik fabric pattern testing to determine based on the types of batik motives. The output will be generated in the form of accuracy in testing the introduction of the pattern using Levenberg Marquardt algorithm.

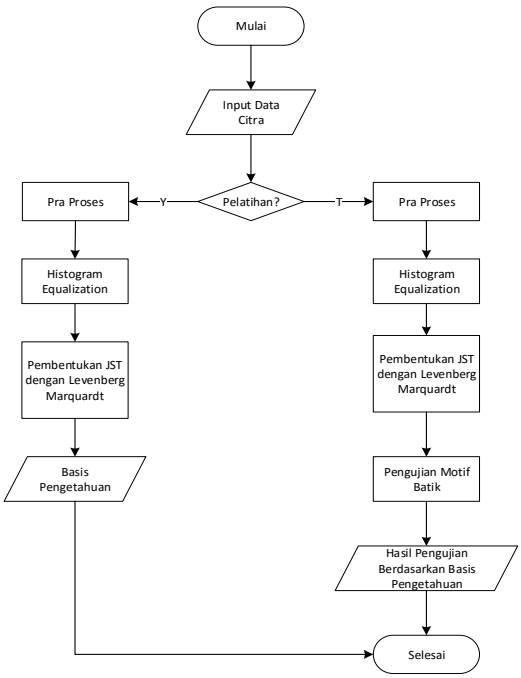
2.4 Processing Analysis

The initial process that describes the flow of the system to be built. The initial stages of the system is checking the input data. Data input is allowed an image data format * .jpg. The input data consist of image files in the form of the pattern that will be used for the formation of the artificial neural network (ANN) and testing to identify the pattern is inputted. The system would then provide a choice of menus, the Training and Testing.

In the training menu, image data is inputted will be pre-stage process, which converts image data into grayscale form. Then to clarify the pattern or pattern of the image data that has been colored grayscale, then the image data is carried histogram equalization. Once the image data is converted back into binary form so that the image data will produce the matrix is 1 and 0. In the next stage, namely the formation of neural network using Levenberg Marquardt algorithm. Once the data is stored as a knowledge base.

Next on the menu testing process is almost the same as the training, which is to convert the image data into grayscale form, perform histogram equalization to clarify the pattern or pattern image, then the formation of neural network using Levenberg Marquardt algorithm. After JST formed, then the data for the test will be compared with existing data to the knowledge base so that it can generate output types of batik along with the level of accuracy.

Broadly speaking, flowchart batik fabric pattern recognition applications are as follows.



Picture 2.2 Flowchart System

2.5 Input Analysis

This stage describes the input data and the manner of writing data that allowed the system. Data input is allowed an image data format * .jpg. The input data consist of image files in the form of the pattern that will be used for the formation of ANN and testing to identify the patterns of batik inputted.

2.6 Pre-processing Analysis

2.6.1. Resizing

To change the image size of batik, can use resize() function in matlab. In this example, the batik image data converted into a size 7 x 5 pixels. When seen in the form of a matrix will produce a 3-dimensional, ie 7 x 5 x 3 because the image data is still shaped RGB (Red Green Blue).

2.6.2. Grayscale

In this process the matrix RGB images are converted to grayscale form. To convert the RGB image to grayscale matrix can be done by the following equation.

Grayscale = (R+G+B)/3 (2.1)

2.6.3. Histogram Equalization

The basic concept of the histogram equalization is by downloading the histogram stretch, so that the difference becomes larger pixels or in other words become more powerful information that the eye can capture the information submitted. The equation used for HE that equation (2.2).

$$S_k = \frac{(L-1)}{n}\sum_{j=0}^{k} n_j \quad (2.2)$$

Sk = output
Hk = values that appear in the image
L = degrees of gray
n = the total number of pixels in the image
nj = number that appears on each value of k

2.7 Training Analysis

2.7.1. Initialization Weight Using Nguyen Widrow

Nguyen Widrow is a simple modification of weights and biases into the hidden unit that can improve network speed in the process of network training. This method can be simply implemented with the following procedure.

1. Set :

$\beta = 0.7(p)^{1/n}$ (2.3)

where
n = the number of neurons in the input layer
p = the number of neurons in the hidden layer
β = scaling factor

2. Make for each unit in the hidden layer (j = 1, 2 ...., P).

a. Initialize the weights from the input layer to the hidden layer:
b. Calculate: | | Vj | |
c. Set bias:
b1j = random number between -β to β.

2.7.2. Formation of Neural Network

ANN developmental stages can be done in the following way [14].

1. Initialize weights.
2. Initialize maximum epoh, target error, and learning rate
3. Initialize Epoh, MSE.
4. Do the following steps for (Epoch <maximum epoch) and (MSE> a target error):
   a. Epoh = Epoh + 1
   b. For each pair of elements that will be done learning :
      - Each unit of input (xi, i = 1,2,3 ..., n) receives signals xi and forwards the signal to all the units in a layer that is on it (hidden layer)
      - Each unit in a hidden layer (jj, j = 1,2,3 ..., p) summing the weighted input signals:

$$z_in_j = b1_j + \sum_{i=1}^{n} x_i\, v_{ij} \quad (2.4)$$

Use the activation function to calculate the output signal:

$z_j = f(z_in_j)$ (2.5)

and send the signal to all units in the upper layer (units of output)

- Each unit of output (y_k, k= 1,2,3, ..., m) summing the weighted input signals.

$$y_in_k = b2_k + \sum_{i=1}^{p} z_i \, w_{jk} \qquad (2.6)$$

Use the activation function to calculate the output signal:

$y_k = f(y_in_k)$ (2.7)

and send the signal to all units in the upper layer (units of output)

- Each unit of output (y_k, k = 1,2,3, ..., m) received a target pattern associated with learning input patterns, calculate the error information:

$\delta 2_k = (t_k - y_k)\, f'(y_in_k)$ (2.8)

$\varphi 2_{jk = k} z_j$ (2.9)

$\beta 2_k = \delta_k$ (2.10)

then calculate the correction weights (which will be used to improve value of w_{jk}):

$\Delta w_k = \alpha \, \varphi 2 j_k$ (2.11)

also count the bias correction (which will be used to improve the value of $b2_k$):

$\Delta b2_k = \alpha \beta 2_k$ (2.12)

The above step is also done as much as the number of hidden layers, which calculates the error information and a hidden laposan to previously hidden layer.

- Each hidden layer (z_j, j=1,2,3,…,p) summing delta inputs (from the units that are in the upper layer):

$$z_in_j = \sum_{k=1}^{m} \delta 2_k \; w_{jk} \qquad (2.13)$$

Multiply this value with a derivative of the activation function to calculate the error information:

$\delta 1_j = \delta_in_j \, f'(z_in_j)$ (2.14)

$\varphi 1_{ij} = \varphi 1_j \, x_j$ (2.15)

$\beta 1_j = \delta 1_j$ (2.16)

Then calculate the correction weights (which will be used to improve the value of v_{ij}):

$\Delta v_{ij} = \alpha \, \varphi 1_{ij}$ (2.17)

Calculate also the bias correction (which will be used to improve the value of $b1_j$):

$\Delta b1_j = \alpha \beta 1_j$ (2.18)

- Each of output layer (Y_k, k = 1,2,3,…,m) fixing bias and weight (j=0,1,2,…,p):

$w_{jk}(baru) = w_{jk}(lama) + \Delta w_{jk}$ (2.19)

$b2_k(baru) = b2_k(lama) + \Delta b2_k$ (2.20)

each of hidden layer (z_j, j=1,2,3,…,p) fixing bias and weight (i=0,1,2,…,n):

$v_{ij}(baru) = v_{ij}(lama) + \Delta \, v_{ij}$ (2.21)

$b1_j(baru) = b1_j\,(lama) + \Delta \, b1_j$ (2.22)

Calculate MSE

2.7.3. Levenberg Marquardt Algorithm

In the process backpropagation algorithm updates the weights and biases use negative gradient descent directly, while Levenberg Marquardt algorithm using the matrix approach Hessian (H) which can be calculated by:

$H = J^T J$ (2.23)

While the gradient can be calculated by:

$g = J^T e$ (2.24)

In this case is a Jacobian matrix that contains the first derivative of a network error to the weights and biases of the network. Changes the weight can be calculated by:

$\Delta W = [J^T J + \mu I] - J^T e$ (2.25)

So that repairs the weight can be determined by:

$W = W + \Delta W$ (2.26)

$W = W + [J^T J + \mu I] - J^T e$ (2.27)

W = function weights and biases network

e = vector declare all error at the output of the network

μ = constant learning

I = identity matrix

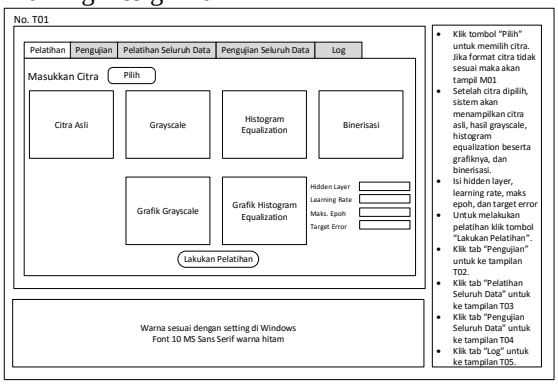
2.8 Testing Analysis

At this stage is done only until the advanced stages only, no step backwards and weight modification phase. Weights used the final weight of the results of previous training.

2.9 Design

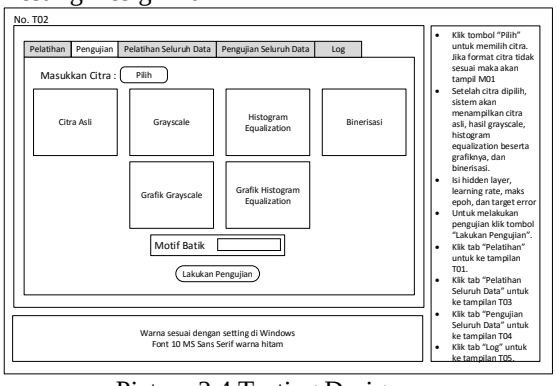
2.11.1. Interface Design

a. Training Design T01



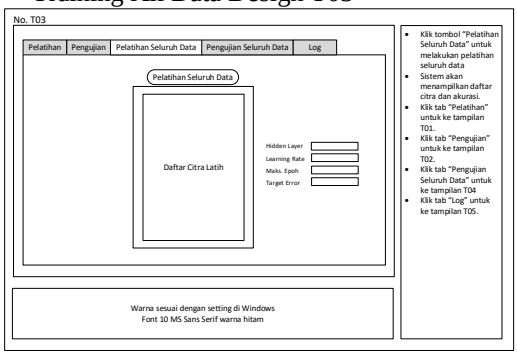
Picture 2.3 Training Design

b. Testing Design T02



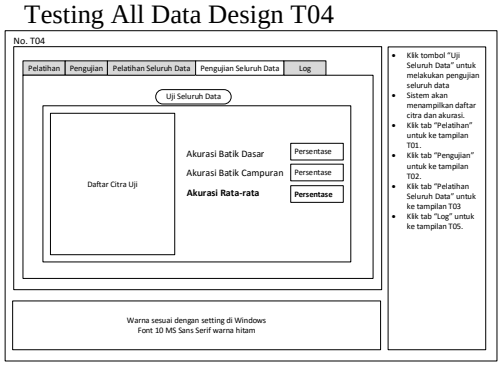
Picture 2.4 Testing Design

c. Training All Data Design T03



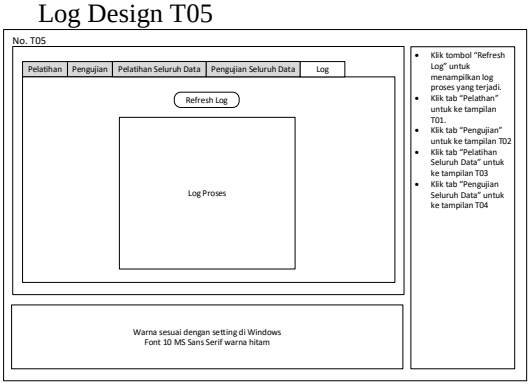
Picture 2.5 Training All Data Design

d. Testing All Data Design T04



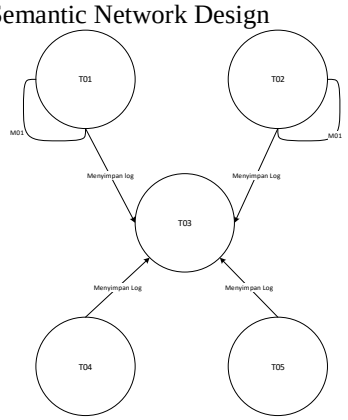
Picture 2.6 Testing All Data Design

e. Log Design T05



Picture 2.7 Log Design

2.11.2. Semantic Network Design



2.11.3. Picture 2.8 Semantic Network Design

3. CONCLUSION

From the research that has been done can be concluded as follows.

1. Levenberg Marquardt algorithm can be applied for the introduction of basic batik pattern and patterns mix.
2. Introduction to the basic pattern batik cloth and mixed-use Levenberg Marquardt algorithm has the highest accuracy of 62.5% with accuracy on the basic pattern of 80% and accuracy in pattern mixture of 15.79%. This accuracy is obtained from the composition variables with the number of neurons in the hidden layer neurons as much as 3 or 4 neurons, learning rate that is worth 0:01, epoch boundaries of 7000, and the target error of 0.035. While the data samples tested in this study amounted to 137 units. Sample data used in the training process amounted to 50 pieces with a basic pattern of each 10 pieces and 45 pieces pattern mix with each 5 pieces. Total motives testing is 42 pieces, with each pattern 3 pieces.

From the results of this study can be given suggestions is to identify the basic pattern or mixture may use other algorithms that can get the algorithm suitable for the introduction of a basic pattern or mix.

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