The Implementation of Backpropagation Artificial Neural Network for Recognition of Batik Lampung Motive

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The Implementation of Backpropagation Artificial Neural Network for Recognition of Batik Lampung Motive

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Abstract. United Nations Educational, Scientific, and Culture Organization (UNESCO) has recognized batik cloth is one of the world cultural heritage that originated from Indonesia, exactly on October 2, 2009. Batik in Indonesia has a motive that many, varied and almost every motive of batik various regions have similar motives, but if viewed in more detail batik cloth from different regions are not the same. Certain people who have expertise and knowledge in the field of batik that can distinguish batik motive from various regions. Lampung is one area in Indonesia that has a cloth motive that characterizes the Lampung area used as batik cloth. This study discusses the backpropagation artificial neural network that will be used for the classification of pattern batik motive Lampung. Batik motive lampung used is sembagi, siger ratu agung, jung agung and siger clove cengkih, while for batik is not a motive Lampung used parang kusumo and broken parang. Stages to be done are scaling, grayscale, tresholding and classification. Comparison of training data and data testing used is 70:30 and 80:30 with the need of backpropagation neural network that is epoch = 2000, learning rate = 0.1 and target error = 0.001. The greatest accuracy value is found in the 70:30 data is 92%.

1. Introduction

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has recognized that batik cloth is one of the world cultural heritages originating from Indonesia, exactly on October 2nd, 2009 [2]. Batik cloth motives are so diverse, almost every region has a motive that is used as batik cloth. Batik has many motives, varies and almost every batik motive from different regions have similar motives, but if viewed in more detail batik cloth from different regions are not the same. Certain people who have expertise and knowledge in the field of batik that can distinguish batik motive from various regions [7]. Lampung is one of the area in Indonesia that has a cloth motive that used characterizes Lampung area as batik cloth. Lampung batik motive is what will be used as dataset in this research.

Pattern recognition has been used in various studies in different fields. Pattern recognition has been applied to face recognition, finger print, signature, vehicle number, retina and batik motive. Backpropagation algorithm is one of the supervised algorithms on artificial neural networks used for pattern recognition in many fields. Backpropagation can train the network to recognize the patterns used during the training and the network's ability to respond correctly to similar (but not identical) input patterns to the patterns used during the training [8]. Batik is very suitable as the object of pattern recognition research, because batik has a pattern of complex and varied motives. The researchers

raised the theme of artificial neural network backpropagation on pattern recognition of batik motive Lampung.

2. Data and Methods

2.1 History of Batik

Indonesia is a country that has diverse ethnic, linguistic, cultural and art dearah spread from sabang to merauke. United Nations Educational, Scientific, and Culture Organization (UNESCO) has recognized batik cloth is one of the world cultural heritage from Indonesia, exactly on October 2, 2009. The types and patterns of traditional batik is very much, batik patterns and variations in accordance with the philosophy and culture of each region [2].

Batik art is the art of drawing on the cloth for clothing that became one of the family culture of the kings of ancient Indonesia. Batik was originally create only limited in the palace alone and the result was for the king's clothes and his family and his followers. Kings followers who live outside the palace, therefore the art of batik is brought by them out of the palace and create in their place. Batik art is long imitated by the people closest and further extends into the work of women. Batik was only the clothes of the palace family, then became popular clothing, both women and men [9].

2.1.1 Batik Lampung

Lampung initially did not have a tradition of create a batik, but there is a relic called the first batik worn by the people of Lampung, Sebagi Cloth. Sebagi is a fabric that comes from China and has been worn by the people of Lampung since the time of the kingdom of Sriwijaya. Motives on cloth Most describe about nature, such as flowers and foliage [10].

The motive that is very typical for Lampung culture is the motive of the boat and the tree of life, these two motives are the most famous motives and become the seizure of foreign collectors. The motives are found in the handsome fabric, palepai and tatibin. Lampung motive relics sites that are legendary on the fabric filter, palepai handsome and tatibin is what will be poured into batik style. Batik and tapis are remnants of cultural heritage passed down from generation to generation for hundreds of years which should be preserved [1].

2.2 Pattern Recognition

Pattern recognition is a science to classify or describe the quantitative measurement of features (characteristics) or the main nature of an object. The purpose of pattern recognition is to define a group or category of patterns based on characteristics possessed by the pattern or, in other words, the recognition of the pattern of distinguishing an object from another object. Classification of an object can be done by going through the stages that can be seen in figure 1.

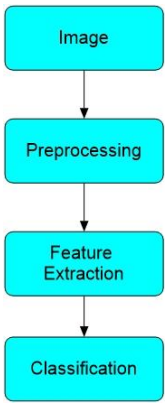

Figure 1. The process of the pattern recognition [3]

Information from the image is then extracted feature that aims to measure certain features and traits. These features (or more precisely, the feature values) are then passed to the classifier that evaluates the features obtained and makes the final decision of the image into which class [3].

2.3 Artificial Neural Networks

Artificial neural network is one of the information processing system designed by mimicking the workings of the human brain in solving a problem by doing the learning process through the synapse of weight changes. Artificial neural networks are capable of introducing past data-based activities. Past data will be studied by artificial neural networks so as to have the ability to make decisions on data that have not been studied [4]. The neural network consists of several neurons and there is a connection between the neurons. A neuron is an information processing unit that becomes the basis for the operation of artificial neural networks. Neural networks mostly make adjustments to their weights during training [5]. The layers of the artificial neural networks can be divided into 3, namely the input layer, hidden layer and output layer [7]. Artificial neural networks are characterized by their specific architecture, this architecture is represented by the number of neurons from the input layer, the number of hidden layers, the number of neurons in each hidden layer and the number of neurons in the output layer [11].

2.4 Backpropagation

Artificial neural network architecture is very popular one of them is multilayer feedforward networks. Such networks, in general, consist of a number of neuron units as the input layer, one or more neurons as a hidden layer, and a number of neuron units as the output layer. The input signal is propagated forward (direction of the output layer), layer by layer. This type of network is the result of generalization of one layer perceptron architecture, so commonly referred to as multilayer perceptron (MLP). Backpropagation is a systematic method for multilayer training of artificial neural networks. This method has a strong, objective mathematical base and this algorithm derives the form of equations and coefficient values in the formula by minimizing the sum of the squares of error through the developed mode l [8].

2.5 Recall, Precision, Accuracy and Error Rate

True Class (TC) is the number of the image of batik will classification with backpropagation artificial neural network exact targets in its class. False Class (FC) is the number of the image of batik will classification with backpropagation not exact targets or classified by on other batik class.

Table 1. Multiclass Confusion Matrices [6]

TC = True Class FC = False Class		The Output Class				
		C1	C2	C3	C4	C5
Target Class	C1	TC1	FC1	FC1	FC1	FC1
	C2	FC2	TC2	FC2	FC2	FC2
	C3	FC3	FC3	TC3	FC3	FC3
	C4	FC4	FC4	FC4	TC4	FC4
	C5	FC5	FC5	FC5	FC5	TC5

The value of recall, precision, accuracy and error rate will be calculated when all testing is complete classified data. The value of Recall, precision, accuracy and error rate is calculated using this formula [6]:

$$Recall = TC/Outputclass\_true \quad (1)$$

$$Precision = TC/Targetclass\_true \quad (2)$$

$$Accuracy = \frac{TC1+TC2+TC3+TC4+TC5}{C1+C2+C3+C4+C5} \quad (3)$$

$$Error\ rate = 100 - Accuracy \quad (4)$$

Recall is the value of accuracy based on output class, while precision is the value of accuracy based on the target class. Accuracy value is the value of the overall accuracy testing data, while the value of the error rate is the value of the error in the whole of the testing data.

2.6 Methodology

Stages of research conducted in the implementation of artificial neural network backpropagation on pattern recognition Lampung motives are:

a. Batik image collection
   Citra Batik Motive Lampung obtained from the sale of batik cloth motive Lampung named Siger Roemah Batik. The location where the data is taken is addressed on Jalan Bayam, No. 38 Beringin Raya, Kemiling, Bandar Lampung. Data was taken using Canon EOS 1200D SLR Camera with Lampung batik motive taken the Sembagi motive, siger queen agung, jung agung and siger clove cengkih. The image taken for each motive is 50 images with JPEG (Joint Photographic Experts Group) format.
b. Scaling
   Scaling is the process of resizing the image so that all images used have the same size. This scaling process will resize the image in the train data and test data into images of 50 x 50 pixels in order that the image does not have much value to be processed in the classification process [7].
c. Grayscale
   The image will go through the grayscale stage or change the image to gray after a scaling process. The grayscale value obtained will replace the RGB value of each image pixel [7].
d. Thresholding
   Tresholding is the process of converting images into binary images or black and white images. The tresholding process is carried out with the following steps:
   1. The threshold value (T) is determined by the range 0-255, in this study the value T = 118.
   2. The pixel value if obtained more than or equal to 118 then change the pixel value in the image to 1, if the pixel value is less than 118 then change the pixel value to 0.

   This output will be used as an input in backpropagation learning [7].
e. Data Training and Data Testing
   Training data or training data is a data that is used to train a system in order to recognize the pattern of the data and used as material or reference data in the recognition of a pattern. Data testing or test data is a data used on the system to test whether the data has a match or in accordance with the pattern that has been obtained from the data already in training (training). The amount of training data and data testing used is 70:30 and 80:20 which is useful to find the optimal level of accuracy.
f. Classification Using Backpropagation Neural Networks
   The process of artificial neural network backpropagation begins with reading input data, initial weight, training parameters (learning rate, epoch maximum, target error), and output target. The parameters used in this study were the maximum epoch = 2000, learning rate = 0.1 and target error = 0.001. The feedforward process starts from the initial weight reading, the initial bias and the reading of the input value forwarded to the hidden layer until it reaches the output layer. The error value is still greater than terget error, then the feedforward process continues to backpropagation process. This process aims to minimize the error value by improving the weight and bias values of each layer. Feedforward and backpropagation processes are repeated over and over until the training objectives are achieved, ie the number of epochs (the number of feedforward and backpropagation loops) is greater than or equal to the epoch maximum, or the target error value is less than or equal to output [7].

3. Results and Discussion

3.1 Batik motive Data

The Image of the Lampung motive used in this research is the Sembagi motive jung agung, siger queen agung and siger kembang cloves. The Image of the photo results with using the camera with jpeg formats (.jpg) 250 data that consists of 175 data trained namely 35 data sembagi motive, 35 motive data jung agung, 35 data siger motive queen agung, 35 data siger motive kembang cloves, 17 data parang kusumo motive and 18 parang motive data is damaged and 75 test data.

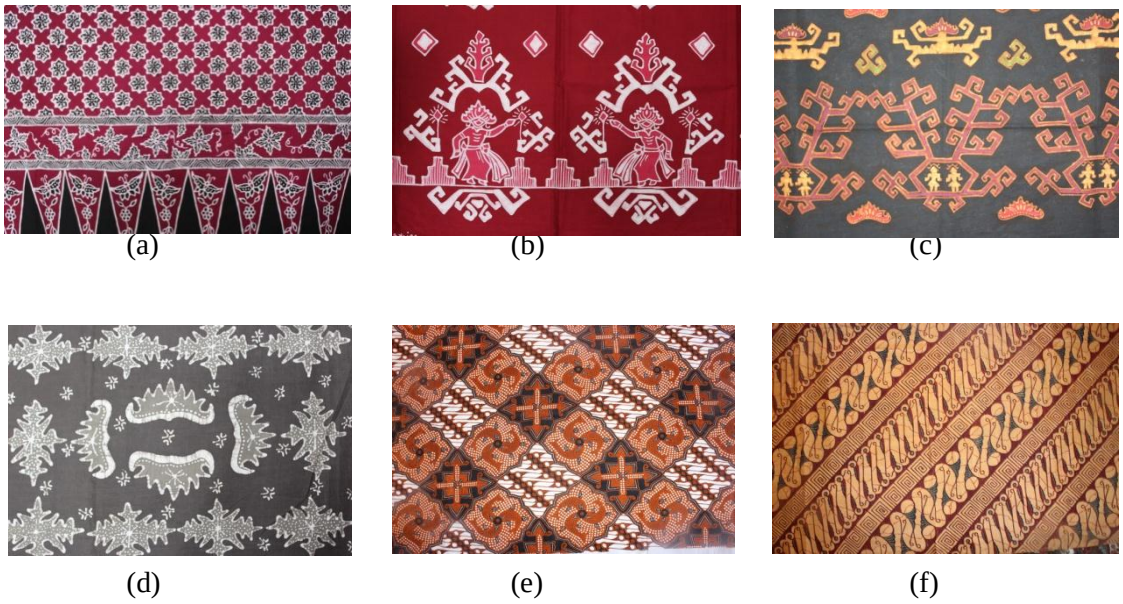

Figure 2. The Image of Batik motif (a) Sembagi; (b) Siger Queen Agung; (c) Jung Agung; (d) Siger Kembang Cloves; (e) Parang Kusumo; (f) Parang Damaged

3.2 Scaling

This phase of the original image size of 5184 × 3456 pixels will be scaled in size to 50 × 50 pixels. The initial image still has the value of Red Green Blue (RGB) on every pikselnya. The value of the RGB each pixels will be sought after the change the size. Batik Sembagi motive RGB value will be displayed on the table 2 stretches only the size of 5 × 5 pixels only.

Table 2. The value of the RGB Image Sembagi Motive

Pixels	1	2	3	4	5
1	73,34,150	76,55,118	158,152,169	132,122,152	118,94,164
2	138,132,151	131,115,162	96,72,144	89,65,135	133,117,164
3	124,132,109	145,131,173	82,49,146	76,47,132	146,135,168
4	150,131,186	119,100,157	122,103,158	133,117,165	125,109,157
5	100,56,186	87,65,130	154,150,161	117,111,130	127,104,172

3.3 Grayscale

The value of grayscale from each pixels will search using the RGB values that are on the image of the Sembagi motive. The value of grayscale batik Sembagi motive will be displayed in the table 3 below only stretches the size of 5 × 5 pixels only.

Table 3. The value of Grayscale Batik Sembagi motive

Pixels	1	2	3	4	5
1	73	76	158	132	118
2	138	131	96	89	133
3	124	145	82	76	146
4	150	119	122	133	125
5	100	87	154	117	127

The Image of grayscale has a minimum value and the maximum value is worth 0 - 255, where 0 shows the level of intensity darkness and 255 shows the level of intensity most light.

3.4 Threshold

Binary image is the image that has 2 possible colors black and white. The formation of binary image requires keabuan timeout value or threshold that is used as the value of the guidelines.

Table 4. Batik Sembagi motive Binary Value

Pixels	1	2	3	4	5
1	0	0	1	1	1
2	1	1	0	0	1
3	1	1	0	0	1
4	1	1	1	1	1
5	0	0	1	0	1

The value of the threshold has a range of values between 0-255, the value of the threshold that will be used in this research namely 118. The value of pixels more or equal to the value of the threshold 118 will be changed to 1, while the value of pixels less than the value of the threshold 118 will be changed to 0. Binary value on every image pixel Sembagi motives in table 4 obtained from comparing the value of grayscale image Sembagi motive of each pixels are shown in Table 3 with the value of the threshold is 188.

3.5 Backpropagation Artificial Neural Network

Backpropagation artificial neural network will be used for the process of classification data that has been through the process of thresholding. Feedback on the process of classification is the matrix of the results of the threshold, the matrix was changed to become a one-dimensional array. This data will be used as the backpropagation input value. The results of the values that have been changed from the array values that are shown in table 4 become a one-dimensional array for input backpropagation can be seen in table 5.

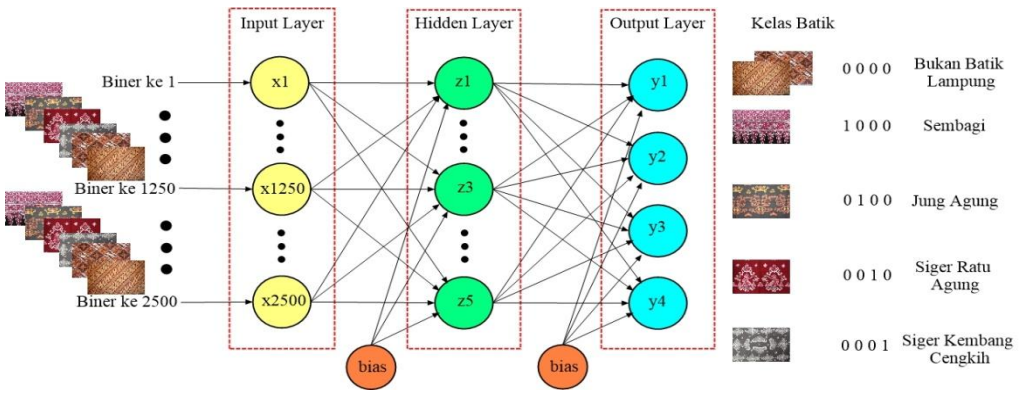

Figure 3. The Backpropagation Artificial Neural Network Architecture to Batik motive

Table 5. One-dimensional array Sambagi Motive Image

Pixels	Binary Value
1	0
2	0
3	1
4	1
5	1
6	1
7	1
8	0
9	0
10	1
11	1
12	1
13	0
14	0
15	1
16	1
17	1
18	1
19	1
20	1
21	0
22	0
23	1
24	0
25	1

Built-in network layer input have 2500 node and 1 node bias, hidden layer has 5 node and 1 node bias, while in the output layer has 4 nodes.

3.6 Testing and Analysis

Training Data and testing data that will be used is 70:30 and 80:20. Testing data for each of the image of batik numbered 15 citra to 70:30 and each batik image ten image to 80:20. Batik will classified by image one by one the image of the batik into which class. The value of recall, precision, accuracy and error rate will be calculated when all testing is complete classified data. Results of the confusion matrices obtained for training data and testing data 70:30 with maximum determinists epoch = 2000 learning rate = 0.1 and target error = 0.001 can be seen in table 6.

Table 6. Confusion Matrices Classification Results Batik motive 70:30

Batik Class		The Output				
		S	JA	Era	SKC	BBL
Target	Sembagi	13	1	0	0	1
	Jung Agung	0	14	1	0	0
	Siger Queen Agung	0	0	14	1	0
	Siger Kembang Cloves	0	0	0	14	1
	Not Batik Lampung	1	0	0	0	14
	The Total	14	15	15	15	16

Testing data to the Sembagi motive there are 13 testing that classified by data as the image of batik Sembagi motive while 2 data testing classified by as the image of batik motive jung agung and not batik Lampung. The motive jung agung there are 14 testing that classified by data as the image of batik motive jung agung while 1 data testing classified by as the image of batik motive siger queen agung. The motive siger queen agung there are 14 testing that classified by data as the image of batik motive siger queen agung while 1 data testing classified by as the image of batik motive siger kembang cloves. Siger Motive kembang cloves there are 14 testing that classified by data as the image of batik motive siger kembang cloves while 1 data testing classified by as the image of the motive not batik Lampung. Not Motive batik Lampung there are 14 testing that classified by data as the image of batik motive not batik Lampung while 1 data testing classified by as batik Sembagi motive image.

Results of the confusion matrices obtained for training data and testing data 80:20 with maximum epoch = 2000 learning rate = 0.1 and target error = 0.001 can show in table 7 below.

Table 7. Confusion Matrices Classification Results Batik motive 80:20

Batik Class		The Output				
		S	JA	Era	SKC	BBL
Target	Sembagi	9	0	0	0	1
	Jung Agung	0	9	1	0	0
	Siger Queen Agung	0	0	9	1	0
	Siger Kembang Cloves	0	0	0	9	1
	Not Batik Lampung	1	0	0	0	9
	The Total	10	9	10	10	11

Testing data to the Sembagi motive there are 9 data testing that is classified as the image of batik Sembagi motive while 1 data testing is classified as the image of batik Jung Agung motive and not batik Lampung. The Jung Agung motive there are 9 data testing that is classified as the image of batik Jung Agung motive, while 1 data testing is classified as the image of batik Siger Queen Agung motive. The Siger Queen Agung motive there are 9 data testing that is classfied batik siger motive image as queen of songs while 1 data testing classified by as the image of batik motive siger kembang cloves. Siger Motive kembang cloves there are 9 data testing that is classifed as the image of batik motive siger kembang cloves while 1 data testing is classified as the image of the motive not batik Lampung. Not Motive batik Lampung there are 9 data testing that is classified as the image of batik motive not batik Lampung while 1 data testing classified as batik Sembagi motive image.

Confusion matrices data from the table 6 and table 7 will be used to seek recall, precision, accuracy and error rate from each class batik. Training Data and testing data on the data 70:30 and data 80:20, result calculation recall, precision, accuracy and error rate using the formula (1), (2), (3) and (4) can be seen in table 8.

Table 8. Recall, Precision, Accuracy and Error Rate Results of the batik motive Classification

Batik Class	The results of the Data 70:30		The results of the Data 80:20	
	Recall (%)	*Precision* (%)	*Recall* (%)	*Precision* (%)
Sembagi	86,67	92,86	90	90
Jung Agung	93,33	93,33	90	100
Siger Queen Agung	93,33	93,33	90	90
Siger Kembang Cloves	93,33	93,33	90	90
Not Batik Lampung	93,33	87.5	90	81,81
Accuracy (%)	92		90	
Error Rate (%)	8		10	

Recall value obtained from TC divided by the output class while the value of precision obtained from TC divided by target class. The value of the largest recall data on 70:30 namely 93,33% there on

the batik class jung agung, siger queen agung, siger kembang cloves and not batik Lampung, while the value of the largest recall data on 80:20 namely 90% found in all classes of batik. The largest precision values at the data 70:30 namely 93,33% there on the batik class jung agung, siger queen agung and siger kembang cloves, while the largest precision values at the data 80:20 namely 100 percent there on the class jung agung. Nila accuracy obtained from the TC from the whole class will require further divided by the number of testing data on the data, 70:30 - 69 divided 75 acquired 92 percent while the value of the error rate from 100% reduced accuracy value is 92% acquired 8%. The value of the accuracy of the data 80:20 namely 45 divided 50 acquired 90 percent while the value of the error rate from 100% reduced accuracy value is 90% acquired 10%.

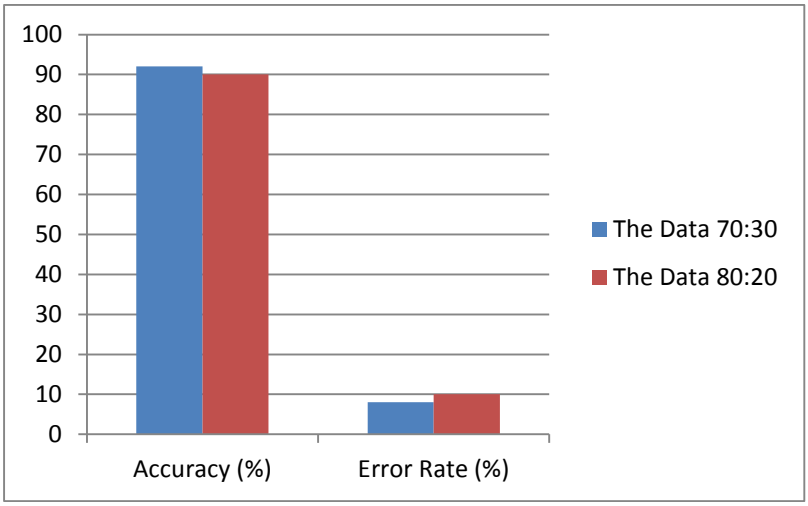

Figure 4. Graph Comparison of accuracy and Error Rate Data 70:30 With Data 80:20

Comparison of training data and testing data 70:30 and 80:20 can be seen in the figure 4 where data 70:30 have greater accuracy value from data 80:20 namely 92% and error rate that produced the data 70:30 smaller than the data 80:20 is 8%. Factors that affect the accuracy produced namely because the amount of data testing on data 80:20 less data from 70:30. Testing data on the data 80:20 of 50 data and data testing on data 70:30 namely 75 data, when 1 the image of the one classified by on data 80:20 the influence of greater accuracy value is 2 percent while on the data 70:30 when 1 the image of the one classified by, the influence on the value of the accuracy that is 1.33%.

4. Conclusion

The results obtained in the study using the maximum requirement epoch = 2000 learning rate = 0.1 and target error = 0.001 is the value of recall, precision, accuracy and error rate. The most accurate recall, precision, accuracy and error rate are found in the training data and 70:30, and the recall and precision values of each class are 86,67% and 92,86% for batik motive, batik motive jung agung 93, 33% and 93,33%, batik motive siger ratu agung 93,33% dan 93,33%, batik motive siger cengkih flower 93,33% and 93,33% for not batik Lampung 93,33% and 87,5%. Artificial neural network backpropagation as a whole can distinguish Lampung motive batik with Lampung motives not batik well with 92% accuracy rate and 8% error rate.

References

[1] Artistiana N R 2010 *Kreasi Batik Nusantara* (Bogor: Horizon) pp. 60-62.
[2] Brasilka Y Ernawati and Andreswari D 2015 Klasifikasi Citra Batik Besurek Berdasarkan Ekstraksi Fitur Tekstur Menggunakan Jaringan Syaraf Tiruan Self Organizing MAP (SOM) *Jurnal Rekursif* **3** 2 pp 132-145

[3] Duda R O Hart P E and Stork D G 2001 *Pattern Classification, Second Edition* (United States of America: John Wiley and Sons) pp 3-19
[4] Fitryadi K and Sutikno 2016 Pengenalan Jenis Golongan Darah Menggunakan Jaringan Syaraf Tiruan Perceptron *Jurnal Masyarakat Informatika* **7** 1 pp 1-10
[5] Kasim A A and Harjoko A 2014 Klasifikasi Citra Batik Menggunakan Jaringan Syaraf Tiruan Berdasarkan Gray Level Co-Occurrence Matrices (GLCM) *Seminar Nasional Aplikasi Teknologi Informasi* (SNATI) pp C-7 - C-13
[6] Kasim A A Wardoyo R. and Harjoko A 2017 Batik Classification with Artificial Neural Network Based on Texture-Shape Feature of Main Ornament *I.J. Intelligent Systems and Applications* **6** pp 55-65
[7] Pebrianasari V Mulyanto E and Dolphina E 2015 Analisis Pengenalan Motive Batik Pekalongan Menggunakan Algoritma Backpropagation *Techno.COM* **4** pp 281-190
[8] Redjeki S 2013 Perbandingan Algoritma Backpropagation dan K-Nearest Neighbor (K-NN) untuk Identifikasi Penyakit *Seminar Nasional Aplikasi Teknologi Informasi (SNATI)* pp. I-1 - I-5.
[9] Restianti H 2010 *Mengenal Batik.* (Bogor: Tim Quadra) pp 2-5
[10] Rudiansyah 2016 *Sebagi, Riwayat Batik Lampung (*Bandar Lampung: Lampung Post 18 September 2016)
[11] Tarik H Kodad M and Miloud J E 2014 Digital Movements Images Restoring by Artificial Neural Netwoks *Computer Science and Engineering* **4** 2 pp 36-42