Classification of traditional ulos of Batak Toba ssing probabilistic neural network

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Abstract. Ulos are commonly used in traditional Batak events. Ulos has many variations of pattern and the pattern almost similar to one another. Ulos also have different functions in its use. So, people are often wrong to call the name of Ulos because the similarity of its pattern. Therefore, the research is doing Ulos classification to increase the introduction of Batak Toba’s Ulos. In this research, the method used in classification is Probabilistic Neural Network method. The stages before classification are pre-processing, extraction feature using Gray Level Co-Occurrence Matrix, and then classified using Probabilistic Neural Network. The research uses 650 data to be used as training data and test data. After testing in this research, it was concluded that the Probabilistic Neural Network method had the ability to classify Ulos into five patterns namely Bintang Maratur, Ragi Hidup, Ragi Hotang, Mangiring and Sibolang. The result showed that the accuracy level is 80%.

1. Introduction
Ulos is a typical Batak woven cloth in the form of a shawl. This sacred object is a symbol of blessing, affection and unity, according to the Batak adage which reads Ijuk pangihot ni hodong, Ulos pangihot ni holong, which means that if palm fiber is the binding of the fronds on the stem, Ulos is the binder of affection between people. Ulos literally means a blanket that warms the body and protects it from exposure to cold air. According to the beliefs of the Batak tribe, there are three sources that give heat to humans, namely the sun, fire and Ulos. Of the three sources of warmth, Ulos is considered the most comfortable and familiar with everyday life. In the past, the ancestors of the Batak tribe were mountain humans, that's how history has pinned them on them. This is due to their habit of living and farming in mountainous areas. By inhabiting the highlands means they must be prepared to fight against the chilly weather. Ulos cloth did not immediately become sacred at the beginning of its appearance. In accordance with the natural law, Ulos has also gone through a fairly long process that takes a long time, before finally becoming one of the traditional symbols of the Batak tribe as it is today. Unlike the sacred Ulos that we know, in the past, Ulos were even used as blankets or sleeping mats by the ancestors of the Batak tribe. Ulos cloth currently has a very important role for the Batak community. Ulos cloth is not only used for clothing, but is also used in several rituals and ceremonies such as birth, death and marriage.
Ulos Ragi Hotang including Ulos with high status and rank. Ragi Hotang comes from two words, namely *ragi* and *hotang*, *Ragi* means pattern and *hotang* means rattan. The Batak people from ancient times were mountainous communities, where the forest was one of their sources of livelihood. Rattan is abundant and easy to find in the Batak land area and is the most frequently used tool for grader because of the strength and durability of the rattan itself. So that rattan is used as a pattern on the Ulos cloth as a symbol of a strong bond in marriage. Ulos Mangiring has a mutually exclusive pattern that symbolizes fertility and agreement. The depiction of the Ulos cloth is depicted abstractly by looking at the shapes found around it (geometric). These shapes are drawn together to symbolize mutual agreement. Especially in forming a family. Usually given to women who are 7 months pregnant with the hope of smoothing the process of child birth. Ulos Sibolang has an abstract motif that has sharp edges. The pointed pattern facing upwards on the Ulos symbolizes that the Batak person always bears all his burdens patiently and so many sharp journeys or struggles, he is always strong in facing all his problems and continues to look forward to the top. This Ulos is given at a funeral ceremony. The pattern on Ulos Bintang Maratur depicts a regular row of stars. The regular rows of stars in this Ulos show people who are obedient, harmonious and in harmony in family ties. Also, in the case of *sinadongan* (wealth) or *hasangapon* (glory) there is nothing lame, all are in the same average level. Ulos Ragi Hidup, from its name, means a style of life. It is so named because its colors, paintings and patterns give the impression as if these Ulos are really alive. This type of Ulos consists of three parts, two sides that are woven at once and one middle part which is woven individually very intricately. This Ulos is commonly used in traditional wedding ceremonies, and is usually given by the parents of the bride to the mother of the man. The examples of the patterns of each of these Ulos can be seen in Figure 1.

![Pattern from ulos which is used as a dataset.](image)

Research conducted by Manalu in 2014 explained about the classification of ulos motifs based on digital image processing which can provide information in the form of ulos motif names using the Support Vector Machine and statistical feature extraction methods. The simulation results show the level of accuracy obtained is 70% [1]. Research conducted by Sibarani in 2015 was to classify images through Bengkulu's Besurek batik image. K-Nearest Neighbor (KNN) was used as a method in this study [2]. Aditya et al. in 2015 also conducted research to classify Batik motifs using the Neural Network with GLCM and Statistical Color Feature Extraction [3]. Aufar and Pramunendar in 2015 made modifications to the KNN algorithm using the Chebyshev distance based on GLCM for wood classification [4]. Siregar et al. in 2016, he has also conducted research to identify tropical tree cuttings using the Backpropagation Neural Network based on image sensing results using a microscope [5]. Research conducted by Idati in 2017 applied the Fuzzy C-Means algorithm to classify woven images based on texture features [6].
2. Method

The data used in this study are images obtained through direct observation. Observations were made at the Ulos Gallery in Medan City and the market in Tarutung City, North Sumatra Province. The image used is an image in the form of images in the JPEG format obtained by taking the image directly using a smartphone camera. Overall data obtained amounted to 650 images consisting of 5 categories, namely Bintang Maratur, Mangiring, Ragi Hidup, Ragi Hotang, and Sibolang, with details as many as 207 images of Bintang Maratur, 115 images of Mangiring, 113 images of Ragi Hidup, 97 images of Ragi Hotang and 118 images of Sibolang. A total of 550 images were used as training data and 100 images as test data.

2.1. Ulos image classification method

The method for classifying the Toba Batak Ulos in this study consists of several stages. The initial stage is the collection of data on the image of Bintang Maratur, Ragi Hotang, Ragi Hidup, Mangiring and Sibolang which are used as training and testing images. After that is the pre-processing stage which consists of the cropping stage which aims to cut the image to facilitate the computation process, then the Ulos image data in the form of an RGB image is converted into grayscale color mode and then the Contrast Limited Adaptive Histogram Equalization (CLAHE) process is carried out to improve image quality. CLAHE provides a limit value on the histogram so that the contrast increases in the image. After that, a feature extraction process is carried out using the Gray Level Co-Occurrence Matrix (GLCM) method which aims to extract the characteristics of the object in the image which will then be analysed. GLCM uses a gray degree distribution (histogram) by measuring the contrast, granularity, and roughness of an area from the adjacency relationship between pixels in the image. After that enter the classification stage using the Probabilistic Neural Network (PNN). After all stages are carried out, the application produces output in the form of information on the type of Ulos. The general architecture of the design used in this study can be seen in figure 2.

![Figure 2. General architecture.](image-url)
The pre-processing stage consists of a resizing process, grayscaling, and a thresholding process.

2.2. **Resizing**

The dimensions of the image resulting from direct shooting with a smartphone camera are not always the same. This stage is needed to adjust the pixel size of the image to be processed at the testing stage. The image input used in this study has different pixel sizes. Because it is necessary to resize so that each training data and testing data has the same dimension size and value range. The greater the number of pixels, the more time it takes in the image processing process. In this study, to meet the system's requirements, an image resizing from different sizes was made to 200 x 200 pixels.

2.3. **Grayscaling**

At this stage there is a process to convert images that have RGB mode into grayscale mode, because color characteristics are not the topic of this research.

2.4. **CLAHE**

At this stage, CLAHE aims to adjust the contrast of the image so that it can display dark or invisible parts.

2.5. **Thresholding**

Thresholding is needed to perform segmentation in order to produce binary images.

2.6. **Feature extraction**

This stage is in the form of texture feature extraction on the Ulos image. At this stage, Ulos texture will be recognized through four feature vectors, namely contrast, correlation, homogeneity, and energy. The steps for extracting texture features using GLCM are as follows:

- Calculate the co-occurrence matrix value obtained by counting the number of pixel pairs with the same intensity and entering the value into the work area of the GLCM matrix. In determining pixel pairs, all values in the grayscale matrix are placed on the co-occurrence matrix with reference to the gray level mode conditions;
- Calculate the symmetric matrix value. The co-occurrence matrix can be converted into a symmetrical matrix by adding the co-occurrence matrix to the transposition matrix;
- After obtaining the symmetric matrix value, normalization is carried out to obtain a value in the form of probability;
- Calculating the feature vector value is by calculating the second order statistical feature that represents the image into a feature vector value. The characteristics used are contrast, correlation, homogeneity, and energy.

2.7. **Classification**

The next step after getting the value from feature extraction is to enter the value from the extraction of feature features, texture, and color as input values in the PNN process. Furthermore, the classification results are obtained by comparing the output value in the training process with the output value in the testing process. The classification steps are as follows:

- Receiving input in the form of feature extraction. The results of the feature extraction, texture, and color become input values for the input layer;
• Calculating the similarity value with a probability density function. After that, the calculation of the similarity value (distance of the input data weight vector to the training data weight vector);
• Adding up the similarity value in each class. The similarity value in each class is determined. To simplify the calculation, the number of similarity values is normalized by dividing each value with the smallest number of values;
• Specifies the maximum value to be output or result. After calculating the number of similarity values for each class, these values are compared to obtain the maximum value. The maximum value of the output vector becomes the decision class.

2.8. Output
At this stage, the classification result data will appear in the form of the name of one of the five types of Ulos tested.

3. Result and Discussion
The data used were obtained by taking pictures of Ulos directly using a smartphone camera, which was then assessed manually by an expert, Mr. Manjunjung Hutabarat, who is a weaver and owner of the Batak Toba Ulos gallery. The data taken were grouped into five types, namely Bintang Maratur, Mangiring, Ragi Hotang, Ragi Hidup, and Sibolang. The summary of the data used in this study can be seen in Table 1.

Table 1. Example of image as dataset.

| No. | Ulos Type      | Image                  |
|-----|----------------|------------------------|
| 1   | Bintang Maratur| ![Image](image1.jpg)   |
| 2   | Mangiring      | ![Image](image2.jpg)   |
3.1. Training stage

In this study, the system training used the PNN method with training data of 153 Bintang Maratur images, 91 Mangiring images, 89 Ragi Hidup images, 73 Ragi Hotang images and 94 Sibolang images. The parameters used at this stage are Standard Deviation of 1 and the number of Batches of 128. Batch size is the size of many batches of images that will be trained at one time unit (one training). The value 128 is chosen based on the default value in the library used and is the value that provides optimal performance during the training process. The standard deviation becomes the smoothing value or Gaussian smoothing parameter. The value 1 is chosen based on the most accurate value based on the training results. In Table 2, we can see the results of the model training in the built system.

|       | Bintang Maratur | Mangiring | Ragi Hidup | Ragi Hotang | Sibolang |
|-------|-----------------|-----------|------------|-------------|----------|
| Bintang Maratur | 123            | 0         | 22         | 0           | 8        |
| Mangiring    | 14             | 72        | 5          | 0           | 0        |
| Ragi Hidup   | 12             | 7         | 70         | 0           | 0        |
| Ragi Hotang  | 0              | 5         | 8          | 60          | 0        |
| Sibolang     | 0              | 0         | 0          | 2           | 92       |
Furthermore, the values for True Positive (TP), False Positive (FP), and False Negative (FN) are obtained as shown in Table 3.

### Table 3. TP, FP, FN, recall, and precision values.

|                | TP  | FP  | FN  | Recall | Precision |
|----------------|-----|-----|-----|--------|-----------|
| Bintang Maratur| 123 | 26  | 30  | 80%    | 82.5%     |
| Mangiring      | 72  | 12  | 19  | 79.1%  | 85.7%     |
| Ragi Hidup     | 70  | 35  | 19  | 78.7%  | 67%       |
| Ragi Hotang    | 60  | 2   | 13  | 82%    | 96.7%     |
| Sibolang       | 92  | 8   | 2   | 97%    | 92%       |

3.2. Testing Stage

Testing is done by using 100 random images with different image formats, sizes and modes. The results of the tests that have been carried out can be seen in Table 4.

### Table 4. Testing results.

| No. | Real Image  | Thresholding Result | Prediction | Result |
|-----|-------------|---------------------|------------|--------|
| 1   |             |                     | Ragi Hotang| True   |
| 2   | Bintang Maratur |                  | True      |        |
| 3   | Sibolang    |                     | False     |        |
| 4   |             | Mangiring           | True      |        |
| 5   | Ragi Hidup  |                     | True      |        |
| 6   |             | Bintang Maratur     | True      |        |
| 7   |             | Mangiring           | True      |        |
The test results of the total test data of 100 images produce an accuracy value of 80%, which means there were 20 misidentifications.
4. Conclusion

The conclusions that can be drawn from the results of this research are as follows: The Probabilistic Neural Network method can introduce the Ulos with an accuracy rate of 80%; In the data training process using the Probabilistic Neural Network method the number of Ulos images affects the accuracy of the system. More and more the data used increases the resulting accuracy.

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