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Wayang Image Classification using MLP Method and GLCM Feature Extraction

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ABSTRACT

Wayang is a form of shadow art that has been known to the Javanese people more than 1500 years ago. For Javanese people, the function of wayang is not only as a spectacle but also as a request, because in the wayang story there are values that are important to Javanese society. Wayang has developed from time to time, there are many types of wayang in Indonesia, with many types of wayang in Indonesia, of course preserving the art of wayang kulit is not an easy thing, especially because this traditional art is not yet very popular among young people, especially in the regionsburban. Today's young people use technology more in finding information, such as using laptops or smartphones. Because to make it easier for people who want to know about puppets and their types, a technology is created that can distinguish the types of puppets based on wayang images. So this research was made using the MLP (The Multi Layer Perceptron) method and its extraction feature GLCM (Gray-Level Co-Occurrence Matrix) with a total system accuracy of recognizing wayang image objects up to 73.4%.

Keyword : Puppet; MLP (The Multi Layer Perceptron); GLCM (Gray-Level Co-Occurrence Matrix); Classification; Image Processing.

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1. INTRODUCTION

Wayang is a form of shadow performance (Sulaksono & Saddhono, 2018). Wayang has been known by the Javanese people since approximately 1500 years ago (Sandy, B., Siahaan, J.K., Permana, P., & Muhathir, 2019). Wayang is made of leather which is the main material used for the puppets and is usually made from buffalo skin. Wayang art is very well known among Javanese people as a local art inherited from their ancestors. Therefore, in 2003, UNESCO made wayang a masterpiece of the oral and intangible cultural heritage of humanity (Sulaksono & Saddhono, 2018), various elements of art, namely art, sound art, movement, drama and literary arts (Ardiyasa, I.,P., & Sari, W.P., 1998). Wayang for Javanese people functions not only as a spectacle, but also as a guide because it contains several teachings of values derived from Javanese cultural teachings specifically for the community. (Setyawan, 2020).

According to the article (Ardiyasa, I.,P., & Sari, W.P., 1998) when seeing a puppet, it is not enough just to know it, but also to appreciate, understand, interpret, and evaluate, so that critical sensitivity and sensitivity to problem puppets emerge. (Ardiyasa, I.,P., & Sari, W.P., 1998). One of the famous stories that are told in the puppet show is rahvayana. Today, the transformation of Rahvayana's story is found in several modern Indonesian literary works from Rahvayana: Aku Lala Anda, a novel by Sujiwo Tejo. As a result, puppet shows and various innovations have changed considerably, which are adapted to the conditions of the time or situation in each region. Thus, contemporary wayang emerged in Indonesia today. Contemporary puppets are a kind of wayang that is the result of classic wayang innovations, for example the Obor puppet, the Pancasila puppet, the Hip-hop puppet, and the Motekar puppet. (Hikmatyar & Prawira, 2020).

Change and development of an art form in a society is something that is normal. One of human nature, that in addition to needing security from things that are constant, that is fixed, that is certain, and

thus gives a sense of peace, humans also have the urge to explore, looking for possibilities other than those that are daily in front of them. (Gunarto, 2020). In line with the wayang story, the types of wayang also develop from time to time (Hikmatyar & Prawira, 2020). There are many types of wayang in Indonesia, with various forms, each of which has its own story, history, form, and uniqueness.

With so many types of wayang in Indonesia, of course preserving the art of wayang kulit is not easy, especially since this traditional art is not very popular among young people living in urban areas. (Parikesit, 2016). Preservation of wayang needs to be done in the era of disruption (Astriyanto, F., K., Purwati., & Istingsih, G., 2020). Today's young people use technology more to find information, such as using a laptop or smartphone, as well as in finding information about wayang, most teenagers today no longer go to the library to find information. With technology such as smartphone or laptop, it makes it easy for many people in various ways.

Therefore, to make it easier for people who want to know about wayang and its types, a technology is made that can classify the types of wayang based on the image of the puppet, this technology is made using the MLP and GLCM methods, while the MLP method is used as a classifier of the wayang image. The multilayer perceptron (MLP) is an artificial neural network renowned for its ability to represent seamless, measurable functional relationships between inputs (predictors) and output (predictands). This is the most commonly used type of feed-forward neural network in atmospheric science (Agirre-Basurko et al., 2006).

For feature extraction we use GLCM (Gray-Level Co-Occurrence Matrix) where the gray level is a metric designed to measure the texture and shape of different images in the fields of pattern recognition and machine vision (Muhathir, Mawengkang, & Ramli, 2017). GLCM serves as an important feature in object-oriented image classification analysis (Obia), because it is able to recognize the texture of different objects, such as tree crowns (irregular, bumpy) versus grass (smooth) contributing to improved classification accuracy. (Park & Guldmann, 2020). Gray Level Co-Occurrence Matrix (GLCM) provides reliable information about the spatial relationship of an image pixel (Numbisi et al., 2019).

So this research uses The Multilayer Perceptron (MLP) method and feature extraction of the Gray-Level Co-Occurance Matrix (GLCM) is expected to help in preserving the culture of wayang, by introducing the types of wayang through simple and easy-to-use technology. The system is easy to use and can be used for all ages, both children as learning media, teenagers, parents and others. Hopefully this research can provide solutions and help wayang as a culture and heritage from Indonesia to become more famous in the world, not only for Indonesians, but also for foreign tourists and other countries around the world.

2. MATERIAL AND METHOD/LETERATURE REVIEW

A. Wayang

Indonesia has a culture of various forms and traditions contained in it, for example wayang. Wayang is one of the traditional arts whose existence is preserved (Kumara et al., 2020). The existence of wayang for Javanese people is something that has become a cultural tradition (Poniman, 2020). Wayang as a cultural product undergoes continuous changes in accordance with the nature of culture itself. These changes include both visible (form / function) and invisible (philosophy) aspects. This change is not without challenges because sometimes it collides with traditional aesthetics and criticisms from wayang art observers, such as denying the standard, unclear concept of innovation and so on. (Gunarto, 2020).

The world, through UNESCO, has been famous for shadow puppets as a world cultural heritage of Indonesia in 2003 (Astriyanto, F., K., Purwati., & Istingsih, G., 2020). International recognition is important evidence for maintaining and preserving the rich cultural heritage of Indonesia to prevent extinction. There are many forms of wayang performances in Indonesia such as: wayang beber, wayang purwa, wayang golek, wayang wong, wayang gedog, Balinese wayang, sasak puppet and so on. However, the existence of some types of wayang is in danger of becoming extinct because it is not enjoyed by many people, especially youth, who are interested in learning about them. Therefore this research is focused on classifying the types of puppets such as: Arjuna, Batara Wisnu, Gareng, Werkudara, and Yudishtira. (Lazuardi et al., 2020).

B. Gray Level Co-Ocurrence Matrix (GLCM)

GLCM (Gray Level Co-Occurrence Matrix) was originally developed by computer scientist Robert Haralick for quantification of heterogeneous surface patterns and roughness shown in digital images (Öztürk & Akdemir, 2018). The GLCM is used to calculate the spatial dependence on the level of ash in an image. In GLCM the number of rows and columns is exactly the same as the number of gray levels in

the image (P.S & V.S, 2016). GLCM is a popular texture-based feature extraction method. The GLCM determines the texture relationship between pixels by performing operations according to the second order statistics in the image. The GLCM property of an image is represented as a matrix with the same number of rows and columns as the gray values in the image (Öztürk & Akdemir, 2018).

The first step to calculate the GLCM feature is to convert a color or RGB image to a grayscale image because the GLCM method extracts the feature by calculating the neighbor gray level. The second step is to create a co-occurrence matrix, then proceed to determine the spatial relationship between reference pixels and neighboring pixels based on distance d and angle θ . The elements of this matrix depend on the frequency of the two pixels specified. The two pixel pairs can vary depending on their environment (Feri Agustina, 2020). The GLCM determines the combination frequency of the specified pixel brightness values. That is, it represents the frequency formation of the pixel pairs (Öztürk & Akdemir, 2018).

This matrix element contains a second order statistical probability value depending on the gray value. rows and columns. If the intensity value is wide, the transient matrix is large enough. This creates a time consuming process load (Öztürk & Akdemir, 2018). In GLCM, there are several texture characteristics that can be obtained from images that are used as differences between images with a certain class, characteristics such as contrast, correlation, homogeneity, and energy which will then be analyzed (Indriani et al., 2018). The following are texture parameters that are often used in the GLCM method (Feri Agustina, 2020):

Table 1 GLCM Texture Parameters

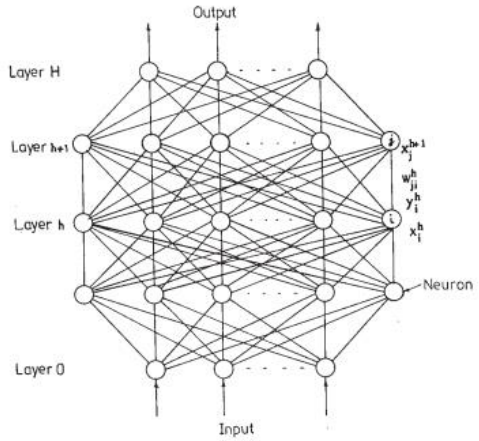
No	GLCM Features	Explanation	Formula
1.	***Contrast***	Is a calculation that relates to the amount of Grayscale intensity diversity	$\sum_{x,y}(x-y)^2 p(x,y)$
2.	***Correlation***	Provides clues to the presence of a linear structure in the image by showing the measure of the linear dependence of the degree of gray	$\sum_{x,y} \frac{(x-\mu x)(y-\mu y)(x,y)}{\sigma x \sigma y}$
3.	***Homogeneous***	Homogeneous number of similar gray levels in the image by showing a measure of the linear dependence of the degree of gray	$\sum_{x,y} \frac{p(x,y)}{1+\lvert x-y\rvert}$
4.	***Energy***	The textural feature of the Energy is represented against the size of the intensity pairs in the matrix. The higher the energy, the higher the similarity value	$\sum_{x,y} p(x,y)^2$

C. Multilayer Perceptron (MLP)

The concept of neural networks was founded in 1943. Then, in 1958, the first practical artificial neural network was presented the perceptron. Since 1986, Neural Networks have become more widely recognized (Agirre-Basurko et al., 2006). MLP (Multilayer Perceptron) is a method of the Neural Network which is very suitable for solving non-linear and non-deterministic problems. MLP has been implemented successfully to solve difficult and varied problems by training it using error back propagation (EBP) algorithms (Hidayatulloh, 2014). The Multilayer Perceptron (MLP) is one of the most popular neural network models due to its clear architecture and simple comparable algorithm (Yan et al., 2006)(Arif Ridho Lubis et al., 2019)(A.R. Lubis et al., 2019).

In MLP, each neuron is connected to its nearest multiple, with various weights representing the relative influence of different neuron input for other neurons. The weighted sum of the inputs is transmitted to the hidden neuron, where it is converted using the activation function. In turn, the output

of the hidden neurons serves as the input for the output of which neurons are undergoing another transformation (Heidari et al., 2016). Multilayer Perceptron (MLP) is an artificial neural network known for its ability to smoothly represent any measurable functional relationship between input (predictor) and output (prediction). It is also the most commonly used type of feed-forward neural network in atmospheric science (Agirre-Basurko et al., 2006)(A.R. Lubis et al., 2018).



(Sumber : (Pal & Mitra, 1992))

Figure 6 Artificial neural network with three hidden layers. Neurons are connected to each other via variables connected to weights.

From the weights and repeatedly update each weight by a sum $\Delta w_{ji}^{h}(t) = -\in \frac{\partial E}{\partial w_{ji}} + \alpha \Delta w_{ji}^{h}(t-1) - hdec.w_{ji}^{h}(t-1)$ (1)

Where the positive constant e controls decline, $0 \leq \alpha \leq 1$ is the damping coefficient or momentum, *hdec* is the % decay coefficient, and t denotes the number of iterations currently in progress. Using a decay factor 0,01> hdec> 0 allows only those weights to do a useful job of reducing errors to persistence and thereby increasing the generalizability of the network (Pal & Mitra, 1992).

MLP (Multilayer Perceptron) with input, one hidden layer with h units (neurons), and one output layer (Agirre-Basurko et al., 2006) containing one unit. Network output due to the vector presentation of the input x = {x1, x2 ,. . . , xn}, the following below (Castro & Braga, 2013):

$$\hat{f} = \phi(v) = \phi\left(\sum_{s=0}^{h} w_s \, \phi\left(\sum_{r=0}^{n} w_{sr} \, x_r\right)\right)$$

Where w_{sr} and w_s are the invariable weights of hidden and output layers respectively, and φ (·) is an activation function. With the dataset T = {(x (i), y (i)) | i = 1 ,. . ., N}, with y (i) ∈ {+1, −1} which shows the label (target output) for each input x (i) ∈ Rn, general expression of the error signal for training examples i adalah e (i) = y (i) - f^ (i) (Castro & Braga, 2013)(Prayudani et al., 2019).

3. METHOD

A. Datasheet

The data used in this study were the image of wayang (Arjuna, Batara Wisnu, Gareng, Werkudara, Yudishtira) with a size of 480x640 which was taken using the camera itself (Sandi, Siahaan, Permana, & Muhathir, 2019).

B. General Research

The general research steps built in this study are illustrated in Figure 7.

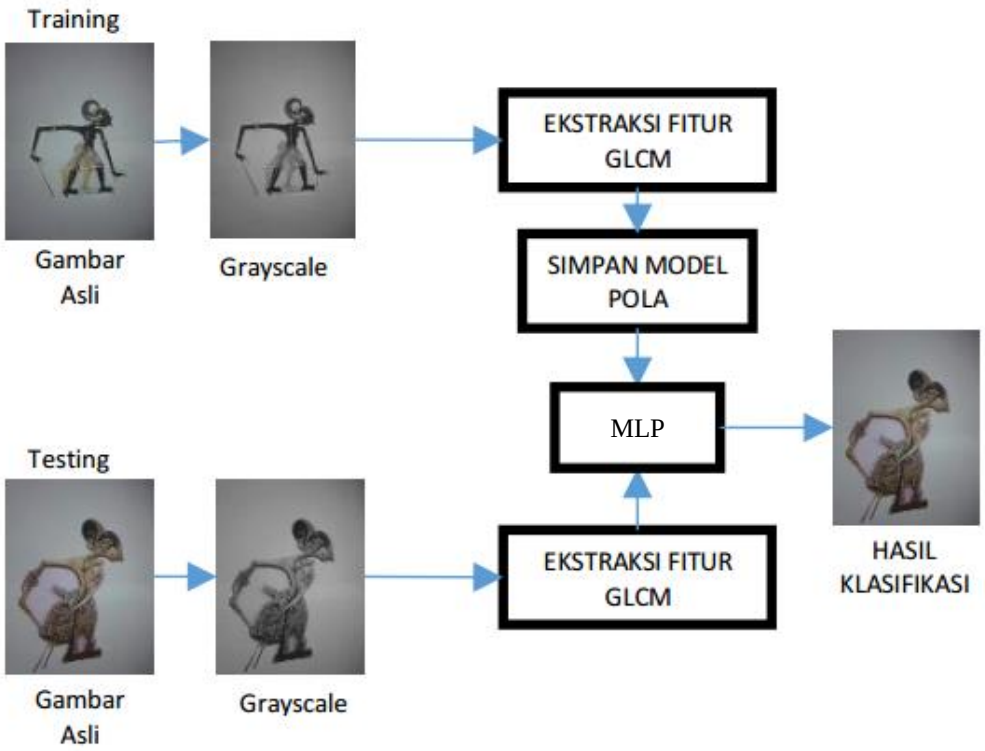


Figure 7 General Research Steps (Muhathir, 2018) (Muhathir & Santoso, 2020)

In Figure 7 there are several processes, the first is the training process. In the training process, the images are inputted through the preprocessing stage with grayscale to make calculations easier. All images including puppets have three channels, namely channels R, G and B. After the grasyscale process works, the image will become only one channel, namely the grayscale channel, then it will be continued with the extraction of the GLCM feature which is useful for getting the weight of the value or pattern of the puppet object, then after the weight of the value or pattern is known, the weighted value is stored in the database to be classified using the SVM method. Then in the testing stage, the image is inputted through the preprocessing stage using grayscale to make it easier for GLCM feature extraction to be carried out, then proceed to the stage of classifying the pattern model using MLP, if the pattern is similar or approaches the pattern that has been trained then the output of the classification will result in the name of the puppet already classified (Muhathir, Rizal, Sihotang, & Gultom, 2019).

4. RESULTS AND DISCUSSION

The puppet pattern training sample used in this study amounted to 100 images, namely Wayang Arjuna, Batara Wisnu, Gareng, Werkudara and Yudishtira. Where the trained pattern is 60% and the classified pattern is 40%. Figure 3.1 attaches a sample of the wayang pattern used for training.

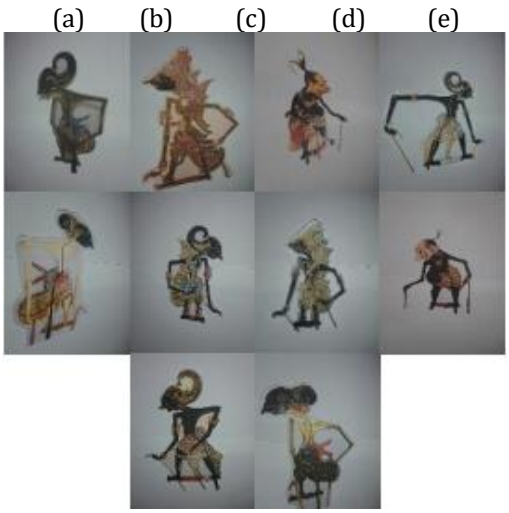


Figure 8 Sample of wayang (a) Wayang Arjuna (b) Wayang Batara Wisnu (c) Wayang Gareng (d) Wayang Werkudara (e) Wayang Yudishtira

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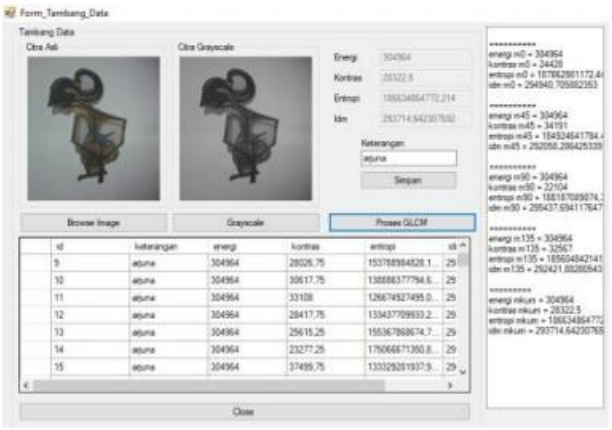

Figure 8 Puppet Pattern Training Process

A. Puppet Pattern Classification Process

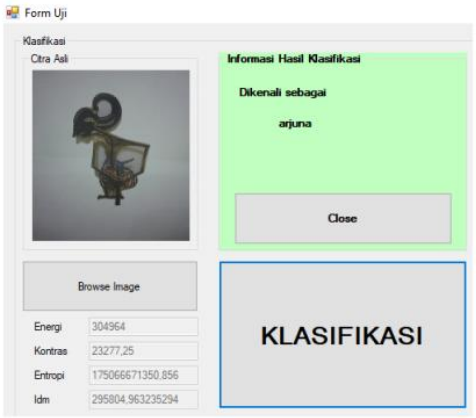

Figure 9 Wayang Pattern Classification Process

Table 2 Pattern Classification Test Results

	Arjuna	**Batara Wisnu**	**Gareng**	**Werkudara**	**Yudishtira**
Arjuna	53	14	13	20	0
Batara Wisnu	2	88	1	9	0
Gareng	0	9	91	0	0
Werkudara	0	7	18	75	0
Yudishtira	7	18	15	0	60

Table 3 Accuracy Results of Pattern Classification Tests

	TRUE	**FALSE**
Arjuna	53	47
Batara Wisnu	88	12
Gareng	91	9
Werkudara	75	25
Yudishtira	60	40
Accuracy	73.4	

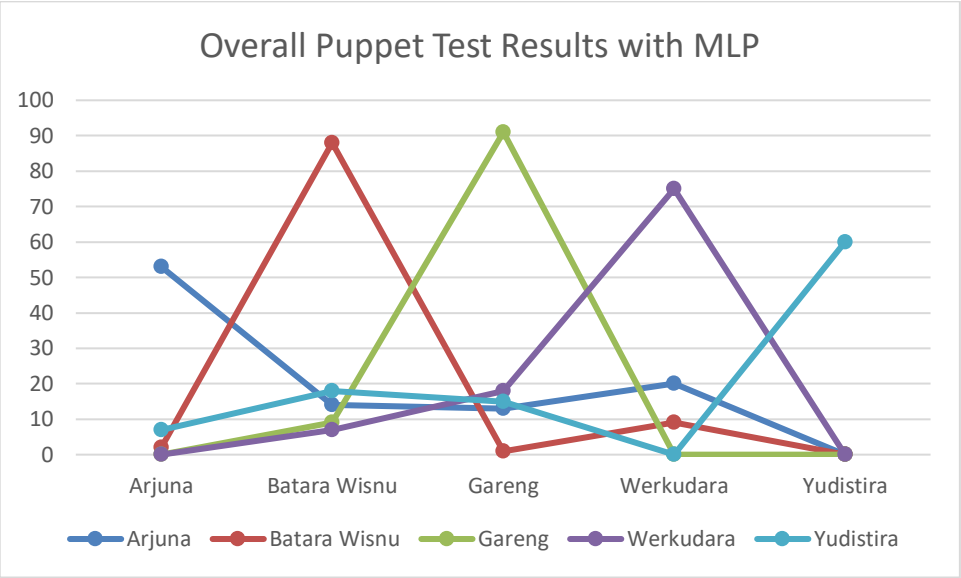

Figure 10 Classification Test Results Using the MLP Method

In the picture above, shows the results of the wayang classification test using the MLP method and the GLCM feature extraction with a percentage, in the Arjuna puppet the percentage is 53%, in the Batara Wisnu wayang the percentage is 88%, in the Gareng wayang the percentage is 91%, in wayang Werkudara the recognizable percentage was 75% and in the wayang Yudishtira the recognizable percentage was 60%. With a total average accuracy of 73.4%.

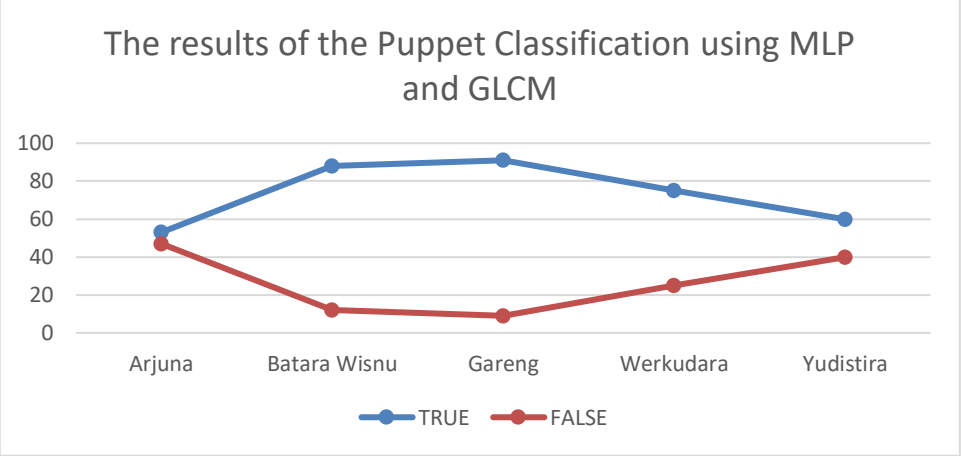

Figure 11 Puppet Test Results Using the MLP Method and GLCM Feature Extraction

Figure 11 illustrates the level of accuracy of the puppet samples that have been classified where the lowest puppet sample is the Arjuna puppet, from 100% of the classified samples, the system can only recognize 53% of samples and Yudishtira puppets, from 100% of the classified samples, the system can only recognize 60%. The high level of accuracy is the Gareng puppet where from 100% of the classified samples, the system can recognize 91% of the sample and the remaining 9% of the sample cannot be recognized.

Based on the results of the research that has been done, the level of accuracy is not maximal, especially in the recognition of the Arjuna puppet pattern with an accuracy rate of 53%, the Yudishtira puppet with an accuracy rate of 60%, the Werkudara puppet with an accuracy rate of 75%. In the process of recognizing the Gareng wayang pattern, it is quite high, namely 91% and the last wayang is Batara Wisnu with an accuracy rate of 88%. This may be due to the good and perfect sampling process in the Gareng and Batara Wisnu puppets. That way it will be applied and improved on the types of puppets whose accuracy level results are not optimal in subsequent studies.

5. CONCLUSION

The results showed that the classification of wayang using the MLP (Multi Layer Perceptron) method and the GLCM (Gray Level Co-Occurrence Matrix) feature extraction can recognize wayang objects based on the puppet image and classify them is not accurate enough and the maximum total accuracy is 73.4%..

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