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Study Comparison of Color Channel to Median Filter in Wayang Image Using Convolutional Neural Network Algorithm

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Abstract. Industry 4.0 has a tremendous impact and influence on the development of information technology. Various applications of information technology that were previously carried out conventionally are now undergoing drastic changes. One area currently being developed is the introduction of an object automatically by the system or often called computer vision. The rapid development of computer vision has resulted in many algorithms being developed and modified to find optimal performance. One of the widely used algorithms is CNN (Convolutional Neural Network). From several previous studies related to comparing several algorithms, CNN is dominant and superior to other algorithms. The accuracy of object recognition is influenced by the algorithm and many factors that influence it. One of them is the type of image used and the treatment of the image before analysis. In general, the widely used image in computer vision is an RGB image consisting of 3 color channels. Each channel has a characteristic pixel value and different degrees of gray. There are several types of data treatment before analysis. One of them is the filtering process which aims to improve the quality of an image using a median filter. Therefore, the authors are interested in comparing three color channels to the preprocessed treatment of wayang images using the CNN algorithm to obtain the best scenario combination in terms of the accuracy obtained. From several scenarios, the best scenario is the green channel without the use of filtering with an accuracy of 96.25%. Because based on previous research literature, the green channel contains the slightest noise, while the filtering method aims to reduce the noise in an image. Thus, median filtering is less effective for green channels. Increasing the value of the median filter parameter to reduce noise will have a side effect of blurring the image and also disrupting the object recognition process.

INTRODUCTION

Indonesia is known for its cultural diversity, one of which is wayang art. In the past, this art was played with shadows and used as a ritual of worshiping ancestral spirits by Hindus [1]. According to [2], there are 2 types of wayang, namely wayang kulit which is played with puppets as the puppet characters, made of wood, and wayang orang played by people directly. This art is intended for public entertainment. However, according to [3], wayang is useful for shaping one's character through wayang stories. There are many wayang figures, but the most well-known wayang characters are clowns consisting of Semar, Gareng, Petruk, and Bagong.

Currently, wayang art is less attractive to the public, especially millennials, this is due to several factors, such as the decreasing number of actors working due to funds, community groups who love wayang culture, and support from the government [5]. One alternative to maintaining this art is through digital image recognition. The recognition process is carried out through the image classification of wayang figures with certain algorithms that have been studied with puppet image data.

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Previous research [6] has classified wayang figures using the KNN (K-Nearest Neighbor) and GLCM (Gray Level Co-occurrence Matrix) algorithms using shape characteristics resulting in an accuracy of 77.5%. Another study [7] compared several classification algorithms, namely the SVM (Support Vector Machine), CNN (Convolutional Neural Network), and ANN (Artificial Neural Network) algorithms. The test results show that the deep learning algorithms, namely CNN and ANN, are superior to the SVM algorithm. The superiority of the deep learning algorithm makes other researchers [8] want to develop it by comparing the CNN algorithm with additional parameters of ERACNN with the RBF-SVM, Linear-SVM, and KNN algorithms. The results showed that the CNN algorithm is still superior. Accuracy results are not only influenced by the algorithm but several factors influence it, such as in pre-processing. One of them is using the CLAHE method (Contrast Limited Adaptive Histogram Equalization) which can increase the accuracy to 86.76% [9]. Another factor that can affect the accuracy of results is the use of filters. Research [10] compared filtering methods that can reduce noise from an image, and found the two best methods, namely Gaussian and Median filters.

The use of filters is expected to improve the quality of the resulting image because with reduced noise the detection and analysis of the image become easier and more precise. From some of the descriptions above, the authors are interested in conducting research using the CNN algorithm with VGG16 architecture and using the Median Filter method as a comparison parameter in determining the scenario whether the addition of this filter is effective on the accuracy value obtained or not.

METHOD

The algorithm used in this study is the CNN algorithm. This algorithm is the development of the Multilayer Perceptron (MLP) algorithm. The data propagated on the CNN network is in the form of two-dimensional data with linear operations and weight parameters on CNN. The method used in linear operations is the convolution method, while the weights have a four-dimensional form which is a collection of convolution kernels [11]. CNN has two main layers, namely the convolution layer which functions as a feature extractor from the image, and the fully connected layer which functions to group classes.

This research was compiled by conducting several experimental scenarios on the classification of wayang images with the CNN algorithm. There are two main scenarios in this study, namely the scenario of treatment with the filtering method and without the use of filters on several color channels that exist in the RGB color type. The purpose of this study was to determine the effect of each color channel on the accuracy of RGB color and also the effect of increasing the median filter on the pre-processing process. The dataset used in this study is in the form of shadow puppet image data consisting of 4 classes, namely Semar, Gareng, Petruk, and Bagong. Data collection was done manually by taking from internet sources, namely, google image with the scrapping method. In this study, several experimental scenarios will be carried out which will produce several classification models as shown in Figure 1.

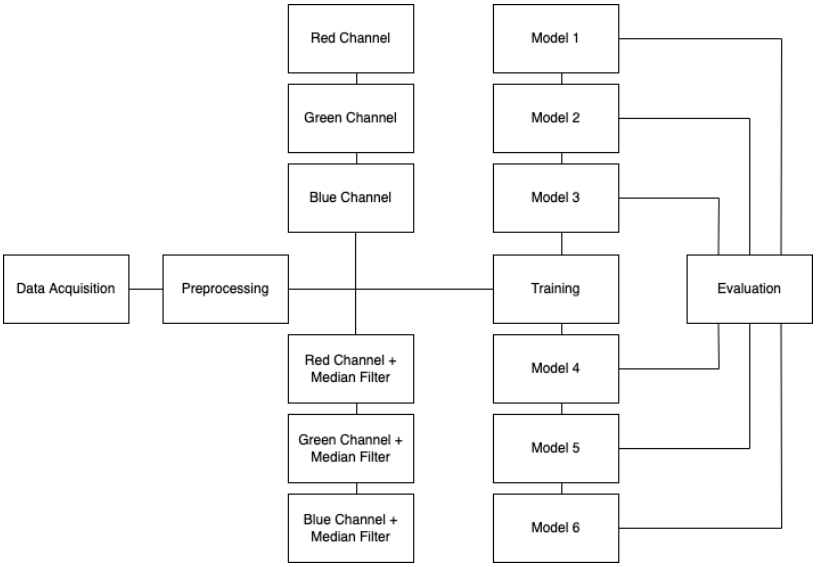

FIGURE 1. Process flow

To prove the hypothesis that has been proposed, the author uses several experimental scenarios that will be compared with several test parameters. Several experimental scenarios can be seen in Table 1.

TABLE 1. Scenario lists

No.	Alias	Scenario
1.	S1	Red channel + Clahe + Thresholding
2.	S2	Green channel + Clahe + Thresholding
3.	S3	Blue channel + Clahe + Thresholding
4.	S4	Red channel + Clahe + Thresholding + Median Filter
5.	S5	Green channel + Clahe + Thresholding + Median Filter
6.	S6	Blue channel + Clahe + Thresholding + Median Filter

The six scenarios are shown in Table 1. will carry out the learning process using the CNN algorithm with the VGG-16 architecture. After obtaining the model for each scenario, the next step is to evaluate each model obtained and then compare the accuracy values of each model to determine the effect of color channels and filtering on model accuracy.

RESULT AND DISCUSSION

The data used in this study amounted to 400 data which was divided evenly into 4 classes of wayang clowns consisting of Gareng, Bagong, Petruk, and Semar. To get better results, the wayang image dataset is resized to 220 x 220 pixels according to the input standard on the VGG-16 architecture on the CNN algorithm. To enrich the dataset, the researcher carried out an image augmentation process with several parameters such as horizontal flip, rotation, and mirroring. The results of the augmentation process produce an additional dataset of 1200 images so that the total images used are 1600 data. This study uses a dataset ratio of 80:20, which means that 80% of the total data will be used as training data and the remaining 20% of the total dataset will be used as test data.

The distribution of the dataset ratio is equalized to the 6 scenarios to get a valid comparison. After the training process, 6 models will be generated from the total scenario, each of which will be tested with 20% test data. The test results for each model, the results are shown in Table 2. below.

TABLE 2. Experimental results

No.	Scenario	Accuracy	Precision	Recall	F1-Score
1.	S1	0.9334	0.9300	0.9300	0.9300
2.	S2	0.9625	0.9600	0.9600	0.9600
3.	S3	0.9500	0.9500	0.9500	0.9500
4.	S4	0.8875	0.8900	0.8800	0.8800
5.	S5	0.9000	0.9000	0.9100	0.9000
6.	S6	0.8000	0.8000	0.8000	0.8000

Table 2 shows the experimental results for the six scenarios using several assessment parameters such as accuracy, precision, recall, and F1-score. To find out the comparison of the six scenarios, it will be written in more detail on the comparison of the accuracy variable to the scenario data.

The graph is shown in Feature 2. is a comparison of the accuracy of the three RGB channels without using a median filter. From the results above, it can be seen that the green color channel has the highest accuracy value compared to the other 2 color channels.

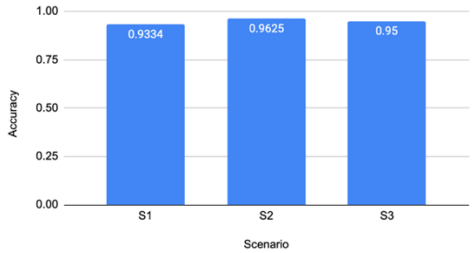

FIGURE 2. Accuracy without median filter.

The graph is shown in Figure 3. is a comparison of the accuracy of the three RGB channels using the median filter. From the results above, it can be seen that the green channel still gets the highest accuracy value. The difference between the results using a filter and without a filter is in the blue channel, where the blue channel decreases drastically.

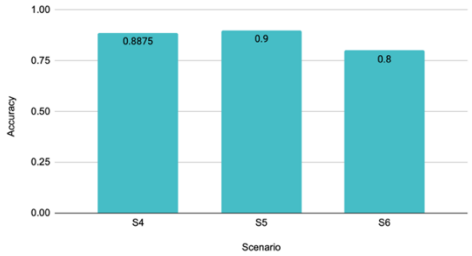

FIGURE 3. Accuracy with median filter.

The graph is shown in Feature 4. shows the comparison of all experimental scenarios in terms of the model accuracy measurement variables. From the graph, it can be seen that both those who use a filter and those who do not use the green channel filter get the highest accuracy value.

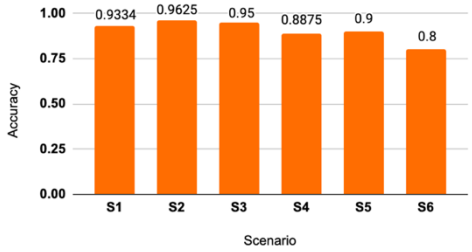

FIGURE 4. Scenario with filter vs without filter.

On the other hand, the blue channel which was originally studied without using a filter got a higher accuracy value than the red channel. After applying the filter, the blue channel decreased drastically and got a smaller accuracy value or below the red channel. All color channels decreased when the median filter was applied.

CONCLUSION

Based on the experimental results of the 6 scenarios above, it is found that the best scenario is S2, which consists of Green channel + Clahe + Thresholding. The highest accuracy value obtained is 0.9625. The green color channel is proven to be very influential on the accuracy value generated from the RGB color channel because this color channel tends to have the least amount of noise. So with the minimal amount of noise from an image, it can facilitate the feature extraction process. The median filter is not suitable to be applied to the image in each channel. The accuracy of each channel that uses the median filter has decreased in accuracy. Moreover, in the blue channel, the accuracy value has decreased drastically. This is because the amount of noise from the blue channel has a very large amount of noise compared to other color channels. The application of excessive filtering methods on images that contain a lot of noise can cause side effects, namely, the image becomes blurry. This can make it difficult to recognize the characteristics of an image in the learning process.

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