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Implementation of Deep Learning Using Convolutional Neural Network for Wood Image Classification

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Abstract: - The use of wood cannot be separated from human life. The benefits of wood that are often used are as material for household appliances, furniture, and buildings. Wood consists of a cell wall of chemical compounds so that it has fibers. There are various types of wood so that they can be classified based on the group. There are 8550 wood images that will be classified using the VGG16 and VGG19 architectures. VGG network is a Convolutional Neural Network architecture using input in the form of an RGB image measuring 224x224 pixels. We use both architectures because by using them we get the highest results with an accuracy value of 0.79% and 0.78%.

***Keywords**:- Convolutional Neural Network, Deep Learning, VGG16, VGG19.*

I. INTRODUCTION

Wood is the product of natural wealth from trees which is used as raw material because it is easily processed to produce goods as desired. In this modern era, there is an assumption that using wood for household needs is an ancient thing, but in fact, more and more people are using wood because of the different properties of wood and cannot be imitated by other materials.

In recognizing the many types of wood from the images that have been collected, the use of automation theory that can be applied to wood image classification is deep learning.

The classification process is divided into two stages, namely the learning stage and the test stage.

Some data with known data classes are fed to form an approximate model, after that at the testing stage the model that has been formed is tested with some other data to determine the accuracy of the model, if the accuracy is sufficient then this model can be made. used to predict unknown data classes.

Image classification can be done using one of the new techniques of machine learning, namely deep learning. Deep learning has several methods, one of which is Convolutional Neural Network (CNN), is a deep learning method that can be applied to classify images. This method has been used, among others, in image recognition, computer vision, etc.

This CNN method uses an architecture to measure its learning performance. In this case, the architecture used is the architecture provided by the hard library, namely VGG16 and VGG19. we use both architectures because they match the dataset used, resulting in a high enough percentage.

II. PREVIOUS RESEARCH

Researchers previously conducted by Liang Zhang [1], in classifying rocket images using Deep Learning with the CNN (Convolutional Neural Network) method to determine rocket types and sizes.

Also, Erlyna Nour Arrofiqoh [2], classifies plants at high resolution using the CNN (Convolutional Neural Network) method. By using 5 classes of plant species, namely the class of rice, shallot, coconut, banana, and chili.

Le Cun in 1998 [3], introduced an algorithm that is useful for classifying images and objects with high accuracy results, the algorithm is the Convolutional Neural Network (CNN) algorithm.

Qing Li and Hung Nguyen et al [4] [5]. Classifying medical images and animal recognition using the Convolutional Neural Network in the application there.

According to Kaoutar et al, the introduction of traffic signs [6] [7]. Networked Convolutional Neural or abbreviated as D-CNN is a Convolutional Neural Network (CNN) Network Model which was developed using several deep layers trained in large data sets such as collections. imageNet data and produces high accuracy.

K. Simonyan and A. Zisserman [8] Convolutional Neural Network (CNN) architecture in recent years has grown very rapidly. One well-known architecture is VGG16. Meanwhile, according to A. Krizhevsky, I. Sutskever, and G.E. Hinton [9]. VGG16 is a simple architecture that has layers but is capable of producing high accuracy on the Image dataset.

III. DEEP LEARNING

Deep learning is the latest technique of machine learning which is the development of a neural network that is useful for detecting an object. If a computer uses deep learning techniques, the computer can classify an object through images, sound, text, or video. The computers were trained using a very large number of datasets. The source of the dataset used comes from zenodo.

Deep learning has several methods, one of which is Convolutional Neural Network (CNN). Convolutional Neural Network (CNN) is a supervised learning method that is useful for classifying data.

Convolutional Neural Network (CNN) has input for a convolutional layer with an image of size mxmxr, m is the length and width of the image while r is the number of image channels.

IV. METHODOLOGY

In this case, using the VGG16 and VGG19 architectures with different accuracy results.

Both of these architectures have in common, namely using a carnel of size (3 * 3) and RGB images with a fixed size (244x244).

The steps of the two architectures are shown in the image below. The image below is a dataset measuring (244x244) divided into two parts, namely the train data and test data, then enter the data augmentation stage and then arrive at the architecture use stage and display the performance results that have been processed.

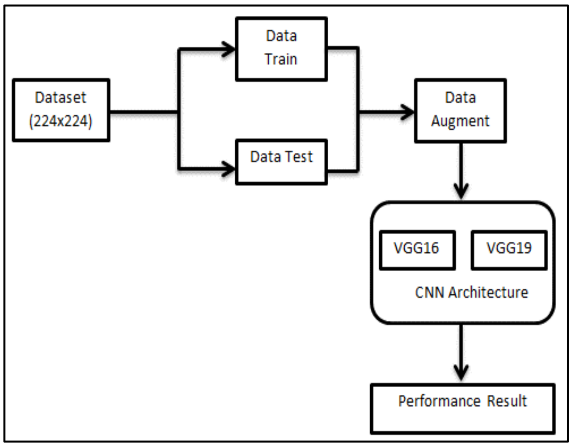

Figure 1.1 Process Arsitecture VGG16 dan VGG19

A. Dataset

The dataset in this study was obtained from [10]. In this study, samples were used as many as 8550 images divided into 12 classes of a dataset. The tested dataset has a size of 224x224 pixels to meet the requirements of the VGG16 and VGG19 network input data. The image format in the dataset is file.jpg. The following is a sample image in the dataset used. The dataset we use is called wood dataset.

Wood Fibers Classification

B. Preprocessing

Preprocessing is done to prepare the image and then it will be further processed, both for feature extraction needs and classification needs. The wood dataset that is used consists of two folders, namely the train folder, and the test folder and is divided into several classes to classify wood images based on their fibers. The dataset is divided into 12 classes, namely class 1, class 2, class 3, class 4, class 5, class 6, class 7, class 8, class 9, class 10, class 11, and class 12. By using the VGG16 architecture and VGG19, the image size will be changed to 224x224 pixels with a 1./255 rescale.

Figure 1.3 The results of image basing in multi-label classification

The percentage used will be divided into the percentage and the percentage is evenly applied to the binary and multilabel classification. The comparison of these percentages using the VGG16 and VGG19 architectures is 70%: 30%, 80%: 20%, 90%: 10%.

C. Feature Extraction

This research uses VGG16 and VGG19 architectures with hard libraries. Based on the use of both architectures, the image is processed by a convolutional layer and a max-pooling layer with a 3x3 kernel size. These two architectures have 19 layers consisting of 16 convolutional layers and 3 fully-connected layers.

V. EXPERIMENTAL RESULT

This test uses two architectures, namely VGG16 and VGG19. The two architectures will be tested using the same set of image data and each prediction accuracy will be calculated with a percentage of 70%: 30%, 80%: 20%, and 90%: 10%

To be clearer, here is a graph of the final results from testing the two architectures with different percentages.

1. VGG16 architecture with a percentage of 70%: 30%.

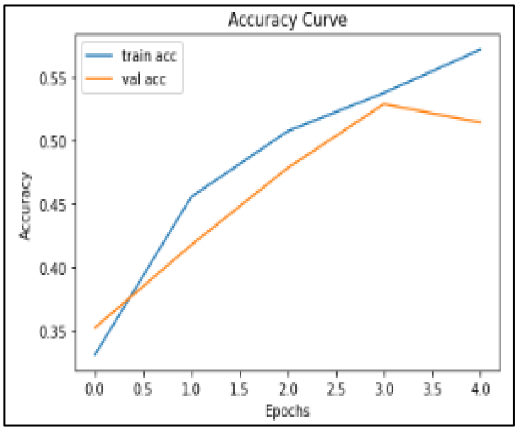

Figure 1.4 Graph of Accuracy in Binary Classification

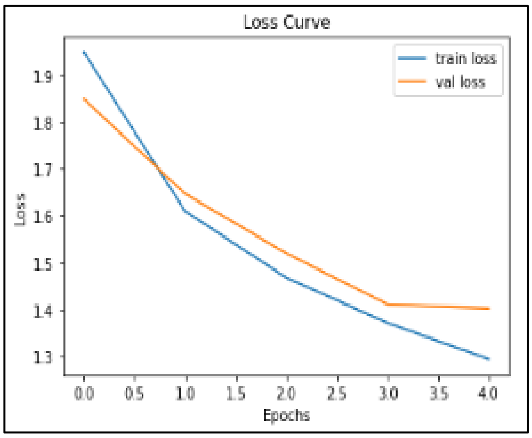

Figure 1.5 Graph of Losses in Binary Classification

In testing using the VGG16 architecture with a percentage of 70%: 30% resulting in an accuracy of 0.5718% and a loss of 1.2946%.

2. VGG16 architecture with a percentage of 80%: 20%.

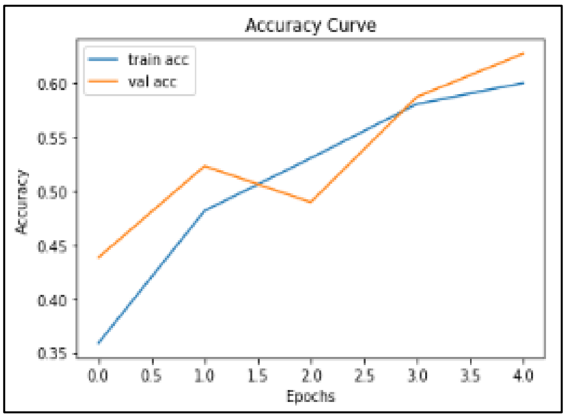

Figure 1.6 Graph of Accuracy in Binary Classification

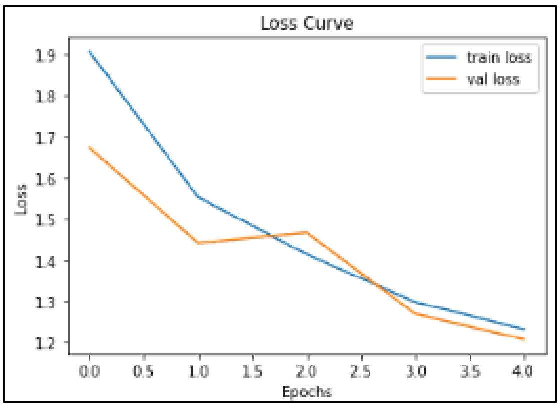

Figure 1.7 Graph of Losses in Binary Classification

While the test using the VGG16 architecture with a percentage of 80%: 20% resulted in an accuracy of 0.6729% and a loss of 1.0183%.

3. VGG16 architecture with a percentage of 90%: 10%.

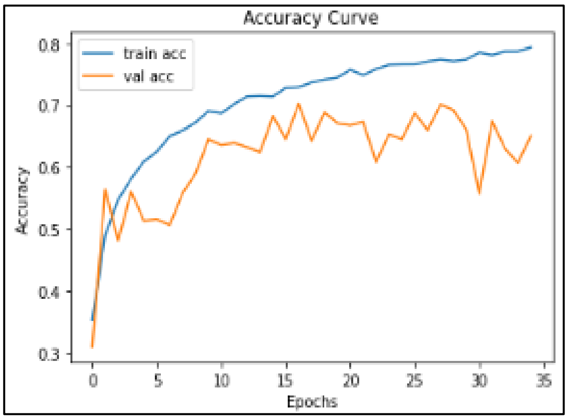

Figure 1.8 Graph of Accuracy in Binary Classification

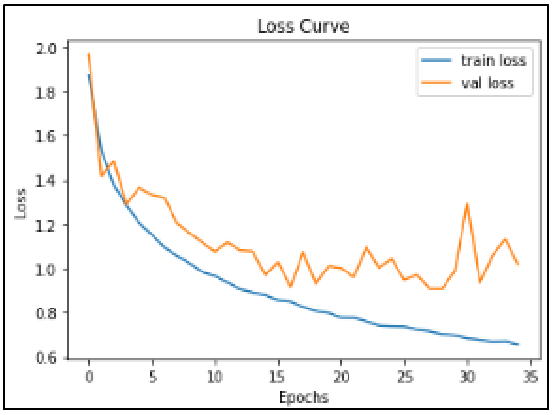

Figure 1.9 Graph of Losses in Binary Classification

And the last test using the VGG16 architecture with a percentage of 90%: 10% produces an accuracy of 0.7933% and a loss of 0.6567%.

4. VGG19 architecture with a percentage of 70%: 30%.

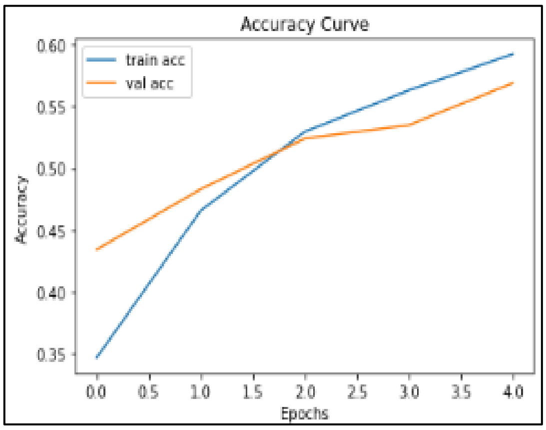

Figure 1.10 Graph of Accuracy in Binary Classification

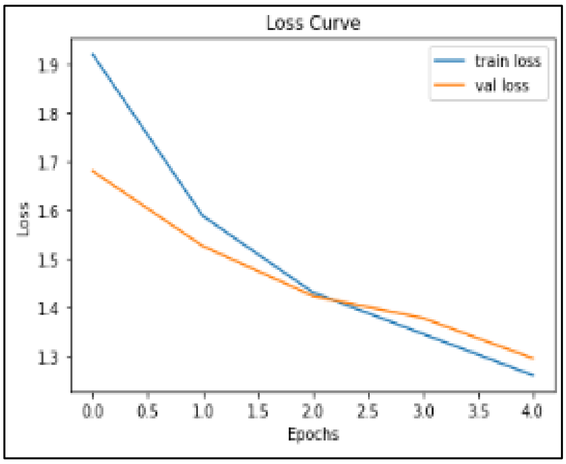

Figure 1.11 Graph of Losses in Binary Classification

In testing using the VGG16 architecture with a percentage of 70%: 30%, it produces an accuracy of 0.5695% and a loss of 1.2925%.

5. VGG19 architecture with a percentage of 80%: 20%.

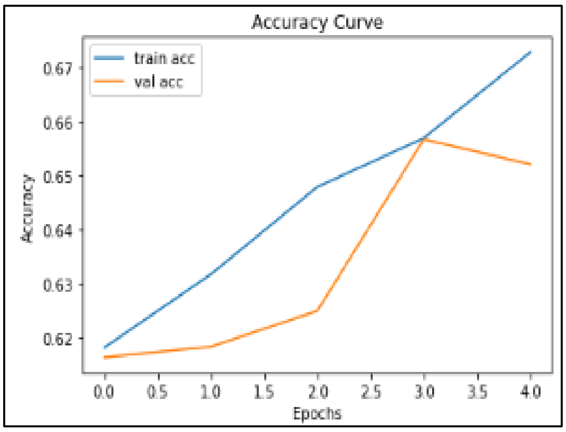

Figure 1.13 Graph of Accuracy in Binary Classification

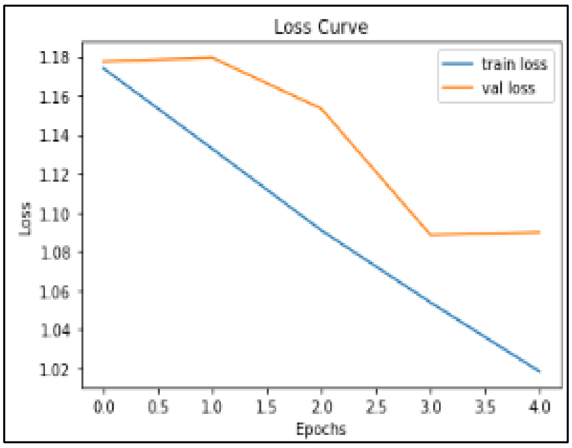

Figure 1.12 Graph of Losses in Binary Classification

While the test using the VGG16 architecture with a percentage of 80%: 20% resulted in an accuracy of 0.5998% and a loss of 1.2336%.

6. VGG19 architecture with a percentage of 90%: 10%.

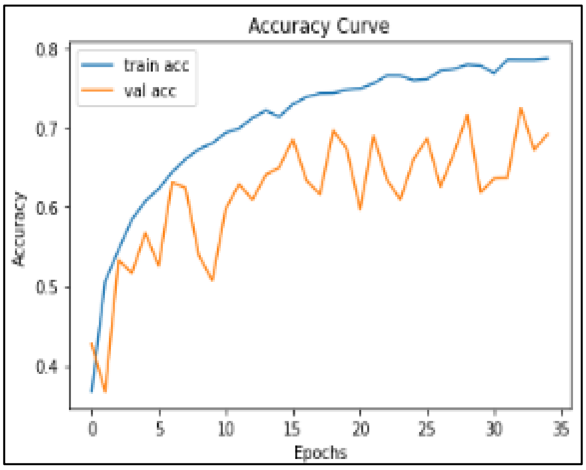

Figure 1.14 Graph of Accuracy in Binary Classification

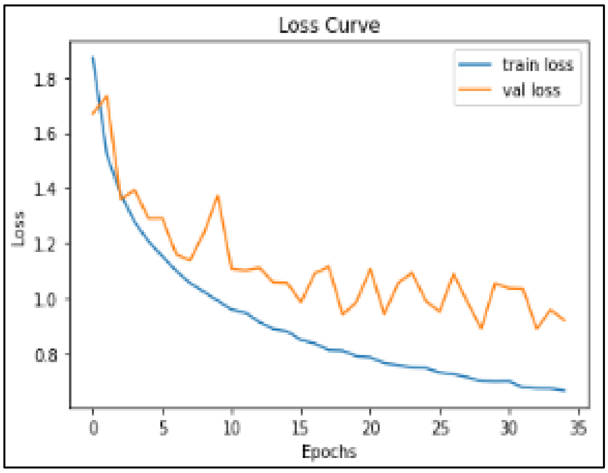

Figure 1.15 Figure Graph of Losses in Binary Classification

And the last test using the VGG16 architecture with a percentage of 90%: 10% produces an accuracy of 0.7870% and 0.6649%.

From the results of the experiments carried out, the resulting accuracy and loss in both architectures are summarized in the table.

Persentase	Arsitektur	Akurasi	Loss
70%:30%	VGG16	0,5718%	1.4025%.
80%:20%	VGG16	0.6729%	1.0183%
90%:10%	VGG16	0.7933%	0.6567%
70%:30%	VGG19	0.5695%	1.2925%
80%:20%	VGG19	0.5998%	1.2336%.
90%:10%	VGG19	0.7870%	0.6649%

Figure 1.16 The accuracy and loss results in each percentage

VI. RESULT

Confusion matrix summarizes the complete classification results based on on true and false objects.

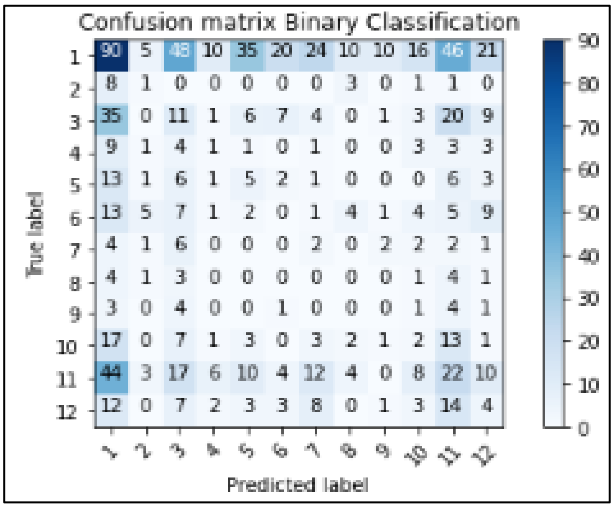

Figure 1.17 Confusion Matrix in Multi-Label Classification with VGG16 architecture

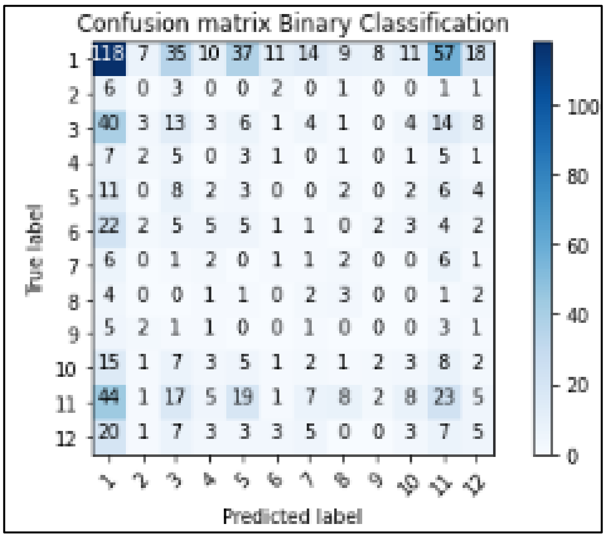

Figure 1.18 Confusion Matrix in Multi-Label Classification with VGG16 architecture

VII. CONCLUSION

In this study, the wood grain classification compares two different architectures and different percentages to produce a classification of 0, 79%. And the use of VGG19 architecture with a percentage of 70%: 30% results in a classification of 0.56%, whereas using a percentage of 80%: 20% results in a classification of 0.59%, and using a percentage of 90%: 10% results in a classification of 0.78%. Therefore, in this study, it is concluded that in performing wood classification, VGG16 architecture with a percentage of 90%: 10% produces a training accuracy that is better or higher than other training percentages. For the next work, we are reviewing to use some other CNN architectures and preprocessing other images to get the accuracy of the better training in classification. a good classification. Using the

VGG16 architecture with a percentage of 70%: 30% results in a classification of 0.57% while using a percentage of 80%: 20% results in a classification of 0.67%, and using a percentage of 90%: 10% results in a

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