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Identify the Color and Shape of Eggplant Using Back Propagation Method

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Abstract

Currently, artificial neural networks are being developed as a tool that can help human tasks. The problem so far in identifying and detecting eggplants carried out by a vegetable shop is still mostly using the manual method based on direct visual observation which is strongly influenced by the subjectivity of the sorting operator, so that under certain conditions the identification process is inconsistent. The main purpose of this study is to identify the structure of eggplants from the shape and color of some eggplants using a back propagation neural network learning method, so that the vegetable shop can distinguish the types of eggplant. The data is obtained from an image that will be entered into the program. The data used in the identification process are two photos containing two types of eggplant, the first eggplant is green and round in shape and the next eggplant is purple and oval in shape. The results of the identification process using this back propagation from the tests that have been done previously, the highest calculation results obtained with the best results using a learning rate of 0.7 and epoch iterations of 500 and producing an accuracy of 73.33%.

Keywords: Neural Networks, Back Propagation, Accuracy, Eggplants

1. Introduction

Problem During this in identifying and detecting fruit what a vegetable shop does is still a lot using the manual method based on direct visual observation which is strongly influenced by the subjectivity of the sorting operator, so that under certain conditions the process is inconsistent identification. The development of information technology allows identification of fruit based on color characteristics with the help of computers. This computational method is carried out by indirect visual observation using a camera as an image processor from the recorded image (image processing) and then processed using computer software. In this study, identification of eggplant species was carried out based on the color and size of the eggplant eggplant structure. This identification uses an Artificial Neural Network (ANN) application with the back propagation learning method. The objects observed were eggplants with different shapes, round and oval along with purple, white and green colors. Image information of the observed eggplant using the help of image files.

Eggplant (Solanum melongena , better known in Java as eggplant) is a fruit-producing plant that is used as vegetables. Its origin is India and Sri Lanka. Eggplant is closely related to potatoes and leunca, and somewhat distant from tomatoes.

Eggplant is a plant that is often grown annually. This plant grows to 40–150 cm (16–57 in) in height. Wide leaf, with hard skinery. It measures 10–20 cm (4-8 in) in length and 5–10 cm (2-4 in) in width. The semi-wild species are larger and grow to a height of 225 cm (7 ft), with leaves that exceed 30 cm (12 in) and 15 cm (6 in) in length. The stems are usually thorny. The color of the flowers is from white to purple, with a crown that has five lobes. The stamens are yellow. The powdery fruit is fleshy, with a diameter of less than 3 cm for the wild, and larger for the planted species [1].

How to plant eggplant is sowing, after growing 4 true leaves, then planted (became seeds first). Harvesting begins 70-80 days after sowing, then every 5 days. From a botanical point of view, fruits classified as berries have many small, soft seeds. The seeds are edible, but have a bitter taste because they contain nicotine, an alkaloid that many tobaccos contain.

The main objective of this study was to identify the structure of eggplant from the shape and color of several eggplants using the back propagation neural network

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learning method, so that stores vegetable can distinguish the type of eggplant.

The algorithm used to distinguish the types of rambutan plants using the backpropagation algorithm. The hidden layers used in this algorithm are 19 layers with 1000 epochs . Based on the testing of rambutan leaf images using data testing, the results show that 18 rambutan leaf images have correct results [2].

Purple eggplant quality identification system is using the backpropagation algorithm. From the tests that have been carried out previously, the highest calculation results with the best results are using a learning rate of 0.6 and iterations / epochs of 500 and produces an accuracy of 63.33% [3].

Artificial Neural Network is a method capable of performing mathematical processes for predicting the availability of food commodities. the results of training and testing of artificial neural networks, the architectural model that has the smallest RMSE value is architecture 7-14-1 with an error value of RMSE 0.0033438208, the percentage of accuracy is 99.99% and performance is 0.2185 [4].

Backpropagation algorithm can perform the prediction process, but whether or not the resulting value is highly influenced by the determination of parameters such as the amount of learning rate and the number of neurons in the hidden layer. In the research training process, the learning rate used for daily data is 0.5, the epoch process stops at the 27088th iteration for daily data, with a gradient achievement of 0.0081822 and an R value for training data of 0.99494 which means it is very good because it is close to value 1. Then the data was tested and obtained an R of 0.48638 which means it is still said to be good for predicting the test data [5].

An artificial neural network algorithm that can be used to recognize the pattern of the number of new students. The best architecture found is to use data patterns for input 12, hidden neurons 8, and output 1, using the logsig-purelin activation function. Based on the network architecture, it is predicted that the number of students in the coming year will be 115 students in 2021 [6].

Disease symptoms oranges that occur in the field are inputs that become input data on a system consisting of 23 variables. The network consists of 4 layers, 1 input layer, 2 hidden layers and 1 output layer, in which there are 15 first hidden layers and 15 second hidden layers and 4 output layer cells. The maximum iteration on this network is 35000 , the learning rate is 0.0001 , and the target error is 0.0001. The accuracy results obtained from this study reached 83.33% of the 24 test data [7].

From the results of testing (testing) 10 patient data, information was obtained that the best identification results for the K-NN algorithm were using the values of K=3, K=7 and K-9 with an accuracy of 100%, while for the backpropagation algorithm , the accuracy level for disease identification was obtained. by 90% with a learning rate of 0.1 and an error tolerance value of 0.001 [8].

Backpropagation artificial neural network in predicting the area of pest attack on onion plants in Brebes Regency for six months in 2016 obtained the smallest error percentage (MAPE) when predicting 0.194% or has an accuracy rate of 99.81%. From the high level of accuracy and the small MAPE value, it shows that network can predict well [9].

In the prediction process using an application that has been made, the prediction of graduation for STMIK Banjarbaru students using 97 data samples from the 2011 2012 and 2013 batches obtained an accuracy of 98.97% [10].

Backpropagation Artificial Neural Network with Principal Component Analysis , it will produce a faster face recognition. This study tries to implement both methods into a face recognition application. And as a result, the system performs facial recognition faster [11].

Backpropagation training includes 3 phases. The first phase is the forward phase. The input pattern is calculated forward from the input screen to the output screen using the specified activation function. The second phase is the backward phase. The difference between the network output and the desired target is an error that occurs. The error is propagated backwards, starting from the line directly related to the units on the output screen. The third phase is weight modification to reduce errors that occur.

The results of the research predict the yield of vegetable crops with backpropagation algorithm The best architectural model is the 2-1-1 model with an accuracy rate of 75.0% and an epoch of 1392 iterations in 00:07 seconds [12].

The mango plant used consists of: of 10 types, namely Golek mango, Honey, Arumanis, Apple, Manalagi, Lalijiwa, Shrimp (Curut), Keweni, and Pakel (Ambacang), and Kemang. The highest accuracy was obtained in testing the scanner data using 450 image data with a comparison of 90% training data: 10% test data, which is 49% using 1 hidden layer consisting of 1000 neurons with a learning rate of 0.01. While testing on training data, leaf images can be recognized well up to 100%. Canny's algorithm can be used for edge detection, but in the case of this study it is not able to recognize the leaf bone structure because the image used is resized [13].

The test results, the parameters of the BPNN algorithm with a data ratio of 4:1, the architectural model of 5-10-10-10-1, the learning function trainlm, the learning rate

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of 0.5, the error tolerance of 0.01 and the epoch of 1000 have obtained good accuracy with the mean value. square error (MSE) of 0.00015464 [14].

The results of the research predicting the yield of vegetable crops with the backpropagation method obtained the best architectural model is the 2-1-1 model with an accuracy rate of 75.0% and an epoch of 1392 iterations in 00:07 seconds [15] .

Study previously method backpropagation used for identify type plant rambutan from image leaves, identification only quality eggplant purple with extraction feature color use room CIELAB color, symptoms disease orange and for predict pest area on plant onion, availability commodity food, pattern amount student new graduation student, introduction face, type plant mango, and results harvest plant vegetables.

On this study method backpropagation used two photos/ images containing two types of eggplant, the first eggplant is eggplant with green color and round shape using metric parameters and the next eggplant with purple color and oval shape using the eccentricity parameter, which was before only eggplant purple and no using eccentricity and metric parameters, as well as increase learning rate from study previously 0.6 to 0.7.

2. Research Method

In this study, the research methods, as shown in Figure 1 include: pre-processing, identification process of eggplant color & shape (back propagation architecture design, back propagation training design, and back propagation identification process design) and application design:

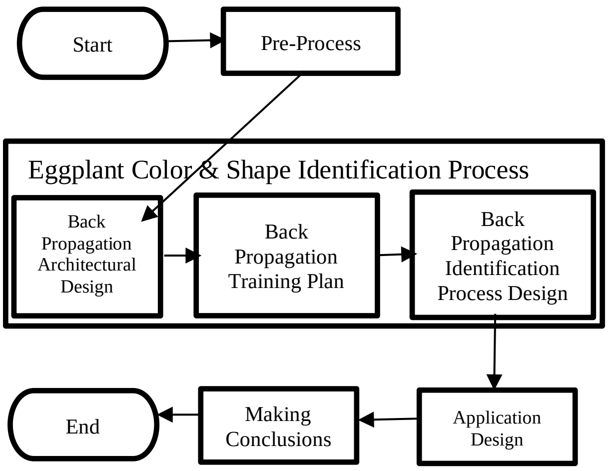

Figure 1. Research Method

2.1 Pre-Process

Pre-processing includes: image of eggplant in the form of an image file, the resulting image will undergo image processing, namely the color histogram process. Fruit image eggplant could seen on figure 2.

Figure 2. Fruit Image Eggplant

Training Data image fruit eggplant can be seen on figure 3.

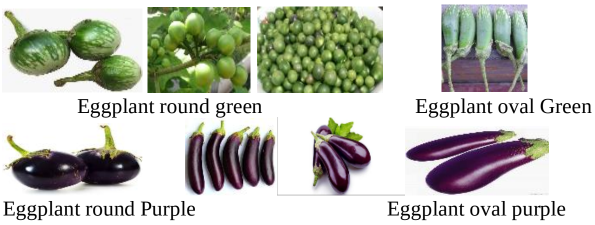

Figure 3. Eggplant Image Training Data

2.2 Identification Process of Eggplant Shape & Color

The process of identifying the shape & color of eggplant includes 3 things, namely:

2.2.1 Back Propagation Architectural Design

This back propagation architecture design uses 3 input units , 4 hidden layer nodes and 3 output units , as shown in Figure 4.

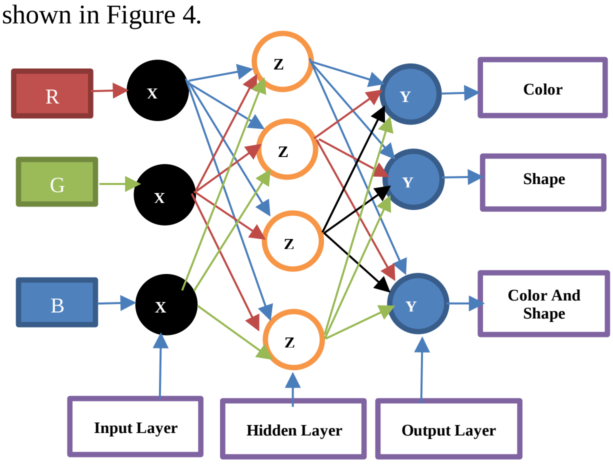

Figure 4 . Back Propagation Architectural Design

2.2.2 Lesson Plan (Training) Back Propagation

Image→color histogram→pattern→training→ weight.

2.2.3 Backpropagation Identification Process Design

Image→color histogram→pattern→(from weight) identification.

2.3 Application Design

Broadly speaking, the process can be grouped into two parts, namely the data training process (back propagation learning) and the process of identifying the color and shape of the eggplant. The training process is

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useful for training the system by entering input data into the Neural Network system then the data is processed using the back propagation method.

2.3.1 Data Training Process

The data training process (back propagation learning) can be seen in Figure 5.

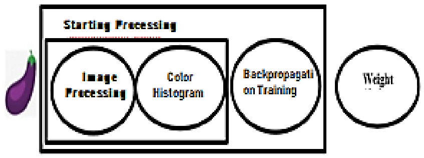

Figure 5 . Data Training Process

2.3.2 Data Identification Process

The process of identifying the color and shape of the eggplant can be seen in Figure 6 .

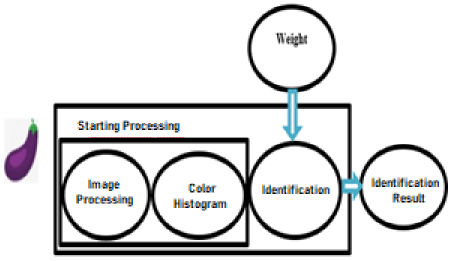

Figure 6 . Eggplant Color and Shape Identification Process

2.4 Making Conclusions

The final step of the research method is to draw conclusions from the results of application testing of application accuracy in identifying the color and shape of eggplant.

3. Results and Discussion

This stage is implementing the methodology and application design by making an application with the Matlab programming language , so that an application is obtained that can recognize or identify the color and shape of the eggplant based on the color and shape of the eggplant.

3.1. Test Data Results of Color Histogram Data Training Process

Initial processing was carried out by taking several histogram data for eggplants that had different colors and shapes. Figure 7 is one of the data from several data collections on the histogram value of the color and shape of the eggplant.

The results of the Test Data are inputted with an eggplant image as shown in Figure 7, after the color and shape identification application process is carried out, the results of the histogram of the color and shape of the eggplant using the back propagation method can be identified as " **Purple Round Eggplant** ".

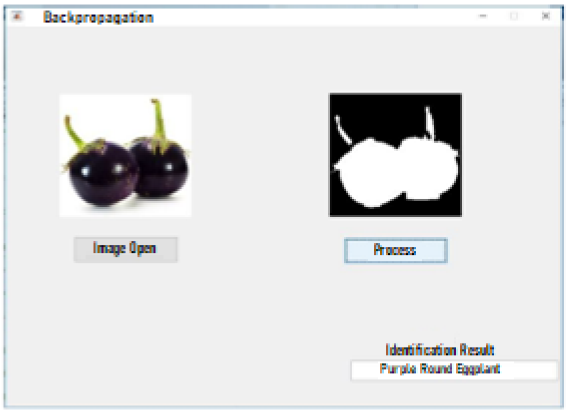

Figure 7 . Eggplant Color Acquisition

3.2. Results of the Eggplant Identification Process

The results of color and shape image processing of **Green Round Eggplant** fruit can be seen in Figure 8 .

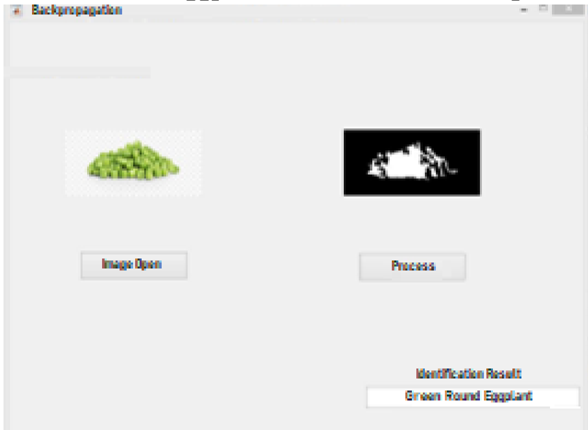

Figure 8 . Image Processing

The results of the Back Propagation Subplot process from the color and shape image of the eggplant can be seen in Figure 9 .

Steps processing image eggplant: open image original RGB eggplant, convert room color image Eggplant again is at on room RGB color to HSV (Hue, Saturation, Value), extract each component image HSV eggplant that is component Hue, component Saturation, and component Value, do thresholding to component Saturation so that obtained image binary eggplant results segmentation, do operation morphology in the form of filling holes and opening area for perfect image eggplant results segmentation, visualize results segmentation on image deep RGB eggplant form bounding box, doing labeling and extraction characteristic eggplant to each segmented objects, as well as showing results extraction eggplant features for all segmented object.

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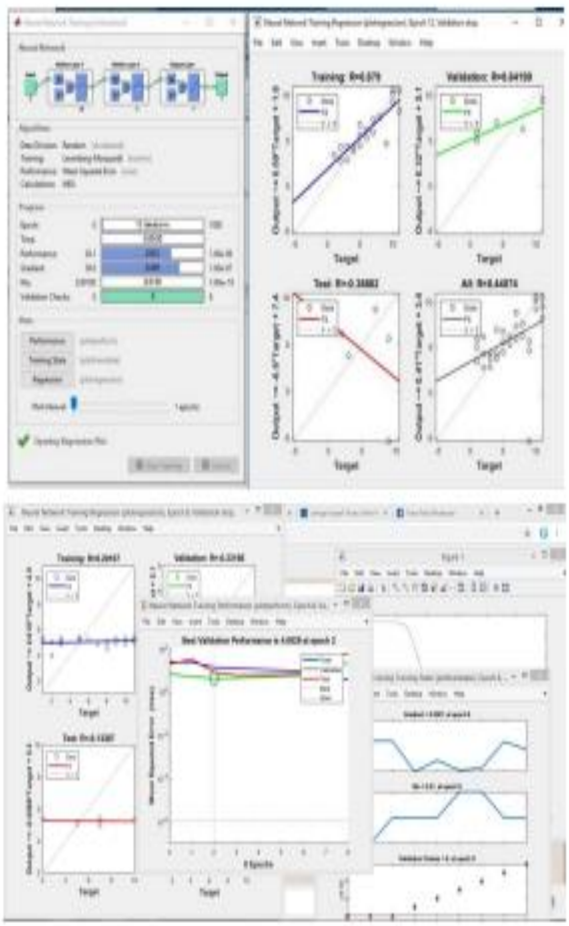
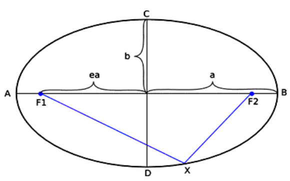


Figure 9 . Subplot Back Propagation

Extraction characteristic form used u for differentiate form object one with object other, can using a parameter called with **'eccentricity'**. Eccentricity is score comparison Among distance elliptical foci minor with major elliptical foci something object. Eccentricity has range score between 0 to 1. Shaped object_extend/ approach form line straight, value his eccentricity approach number 1, while shaped object_round/circle, value his eccentricity approach number 0. Counting eccentricity illustrated on figure 10.

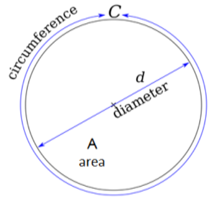


$$e = \sqrt{1 - \frac{b^2}{a^2}}$$

Where,
e = eccentricity
a = mayor axis
b = minor axis

Figure10. Counting Eccentricity

Other parameters that can be used for differentiate form something object that is **'metrics** '. Metric is score comparison Among large and around object. Metric have range score between 0 to 1. Shaped object _ extend/approach form line straight, value the metric approach number 0, while -shaped object_ round/circle, value the metric approach number 1. Counting metric illustrated on figure 11.



$$M = \frac{4\pi \times A}{C^2}$$

Where,
M = Metric
A = Area
C = Circumference

Figure 11. Counting Metric

3.3. Discussion of Application Testing Results

In the test recap in table 1 shows the number of purple eggplant images used is 10 samples. The level of accuracy of the application test results in identifying the color and shape of eggplant can be seen in table 1.

Table 1. Application Testing Accuracy

Learning Rate	Epoch	Color Accuracy Eggplant	Shape Accuracy Eggplant	Color and Shape Accuracy Eggplant
0.7	100	8 -- x 100% 10 = 80%	2 --x 100% 10 = 20%	(80% +20%)/2 = 50%
	200	4 -- x 100% 10 = 40%	10 --x 100% 10 = 100%	(40% +100%)/2 = 70%
	500	10 -- x 100% 10 = 100%	10 --x 100% 10 = 100%	(100% +100%)/2 = 100%
			Average	220%/3 = 73.33%

From the various accuracy values of the learning rate of 0.7 with various epoch variations (100, 200, and 500), the application of identifying the quality of purple eggplant based on color and shape using the back propagation artificial neural network method can be applied as well as identification of the color and shape of eggplant with the back propagation method is more accurate than the identification of eggplant color just or identification form only , due to the influence of lighting with an accuracy rate of 73.33%. Means have level error of 26.67 % due to image eggplant time taken with digital camera affected by lighting and corner position the camera.

4. Conclusion

Conclusion that can be taken from the results of research and testing of this application: identification of color and shape of eggplant with the back propagation method is more accurate than identification of eggplant color just or identification form only because of the influence of lighting and from the tests that have been carried out, the highest calculation results are obtained with the best results using a learning rate of 0.7 and iterations/epochs of 500 and producing an accuracy of

73.33%. Means have level error of 26.67 % due to image eggplant time taken with digital camera affected by lighting and corner position the camera.

Some suggestions are expected for the development of this application: it is hoped that the development of this application can overcome the lighting problem by including the method and specifications of the webcam, so that eggplants are identified more accurately and it is hoped that the development of the color and shape identification application of this eggplant can be done in real time.

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