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Identification of Banana Fruit Types Using the Backpropagation Method

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Abstract

Identification of types of bananas and assessment of their maturity level is an important process in the agricultural and distribution industries. In an effort to automate this process, the authors propose an approach to identify bananas and their level of ripeness using a Backpropagation neural network. Through digital image processing, images or pictures of bananas will be extracted with images such as RGB (red green blue), metric and eccentricity (shape features). The results of the image data training process are as many as 55 image data input, obtained by the training process data on banana types with 11 iterations from the maximum input epoch 10000, target error or performance 0.00642 with an accuracy value of 80%. Furthermore, the training process obtained data on the maturity level of bananas with 4 iterations from the maximum input epoch 10000, the target error or performance is 0.00606 with an accuracy value of 90%. From the test image process that has been carried out, the system can identify the type of banana and its maturity level based on the feature extraction input from the image of the banana. This study also aims to test and determine the accuracy of the application of the Backpropagation method in identifying the types of bananas and their level of maturity.

Keywords : *Backpropagation, RGB (red green blue), metric and eccentricity.*

1. Introduction

The development of computer technology has undergone extraordinary transformations since its inception, one of which is digital image processing technology which makes it easy to process an image so that it can be utilized in various fields. The development of this technology makes people want to increase effectiveness and efficiency in various fields, one of which is in agriculture. Bananas are widely preferred by all groups to be consumed directly as fruit or processed into other consumption products such as banana chips, banana jam, banana sale and so on. Bananas have good nutritional content and are a source of vitamins, minerals and carbohydrates. So that bananas are popular with many people from all walks of life [1] .

This research topic can contribute to the understanding of banana fruit variations, and has practical implications in various fields, such as trade, plant classification agriculture, image recognition technology, consumer interest and awareness of healthy food. As more people are interested in healthy food and understand the importance of fruit consumption, accurate identification of bananas can help consumers differentiate between different types of bananas, thereby enabling them to make more informed and healthy choices. Mistakes that occur in choosing bananas will certainly make you disappointed in yourself because you don't have sufficient knowledge of the various types of bananas. For this reason, it is necessary to build a system that can identify the type of banana by utilizing digital image processing.

In digital image processing certainly requires a method that can identify an image. There are many digital image processing methods, including using the Backpropagation method. Backpropagation method is a method found in Artificial Neural Networks (ANN). ANN is a computational science that is based on and inspired by the human nervous system.

The application of the Backpropagation method has been carried out by many previous researchers in identifying an image. Among the researchers is the title Application Design for Identification of Strawberry Ripeness Based on Digital Image Processing and Backpropagation Neural Networks. With the research results the level of accuracy obtained from the maturity identification system is 67.36% for data without image selection and 74.44% for data using image selection. The system is able to identify 97 of the 144 images inputted for data testing without image selection and 67 images of 90 images for data testing using image selection. The system is designed through the stages of image acquisition, image preprocessing, segmentation, feature extraction, and identification using backpropagation neural networks [2] . Subsequent research entitled "Learning Vector Quantization Artificial Neural Networks for Signature Recognition Applications", the use of the learning vector quantization (lvq) method in identifying a person's signature can be applied by combining digital image processing (image processing), the first stage is processing the signature image with image processing techniques that use the Edge Detection Method. After the digital image processing is completed, the results of edge detection (Edge Detection Method) are

used as input for the classification or signature recognition process using a learning vector quantization neural network. One of the results obtained from this study is an application that can perform signature recognition using a learning vector quantization neural network with an identification accuracy of 98% [3] .
Based on the description of the background above which makes the problem to test how much accuracy the identification of types of bananas has, the authors are interested in conducting research entitled "Identification of Types of Bananas Using the Backpropagation Method".

2. Literature Review

2.1 Digital Image Processing

Image is another term for an image as a multimedia component which plays a very important role as a form of visual information. Images have characteristics that text data does not have, namely images that are rich in information. Literally, an image *is* an image in a two-dimensional (two-dimensional) field. From a mathematical point of view, the image is a continuous function *of* the light intensity in the two-dimensional plane [4] **.**

2.2 Feature Extraction

The feature extraction process is carried out by looking for the value of the RGB (*Red-Green-Blue*) area, metric and eccentricity. The RGB (*Red-Green-Blue)* area value refers to the total intensity of the pixels in the three main color components namely red (*Red*), green (*Green*) and blue (*Blue*) in a certain area of a digital image. Each pixel in a digital image has a combination of the intensity values of these three color components, which are used to create various colors [5] . In image processing and computer graphics applications, RGB area values can be used to measure the distribution and proportions of certain color components within an area or image as a whole. It can assist in color analysis, color manipulation or extraction of visual information from digital images. Metric is used because it can calculate the ratio between the area and the circumference of an object. Meanwhile, eccentricity is a comparison value between the distance of the minor elliptical foci and the major elliptical foci of an object. The process of extracting the pattern of the banana image is obtained by using the Matlab software. Target data is data determined by the user to achieve the desired target [6] .

2.3 Backpropagation

Backpropagation is a systematic method on artificial neural networks using supervised learning algorithms and is usually used by perceptrons with multiple screen layers to change the weights in the hidden layer Backpropagation is a controlled type training which uses a pattern of adjusting the weights to achieve a minimum error value between the predicted output and the real output [7] . The backpropagation process involves using a learning algorithm that calculates the gradient error and then derives it back through a neural network. The error gradient is used to update the weights and biases of each neuron in a neural network. In practice, architectural backpropagation is generally used for classification and regression problems, where the ultimate goal is to predict the class or value of the input data [8] .

2.4 Banana

Banana is a shrub with *pseudostem* , the height varies between 1-4 meters, depending on the variety. The leaves are wide, long, the veins are large, and the edges of the leaves do not have a compact bond so they are easily torn when exposed to strong winds. The stem has a large hump (tuber) and there are many eyes that can grow into saplings. The flower is single, comes out at the end of the stem and only blooms once during its life (monocarpic) [9] .

3. Research methods

3.1. Research Supporting Data

In identifying a data, of course, previous data is needed which will be a support for analyzing the calculation of a method so that later the best alternative can be obtained based on predetermined data. In the identification system to identify the type of banana fruit. The data used are image data or photos of types of bananas. Based on these data, the data that has been collected by photographing 5 types of bananas can be seen in the table below:

Table 1: Data

No.	Types of Bananas	Picture	Code (Target)
1.	Plantain		1

2.	Kepok Banana		2
3.	Banana Goods		3
4.	Banana Candles		4
5.	Banana Crew		5

Figure 1: Image of types of bananas

3.2. *Flow chart*

The first step in designing this program is to design the work process of the system, described in a flowchart. The flowchart of the system program for identifying types of bananas using the Backpropagation method can be seen as shown in the following figure:

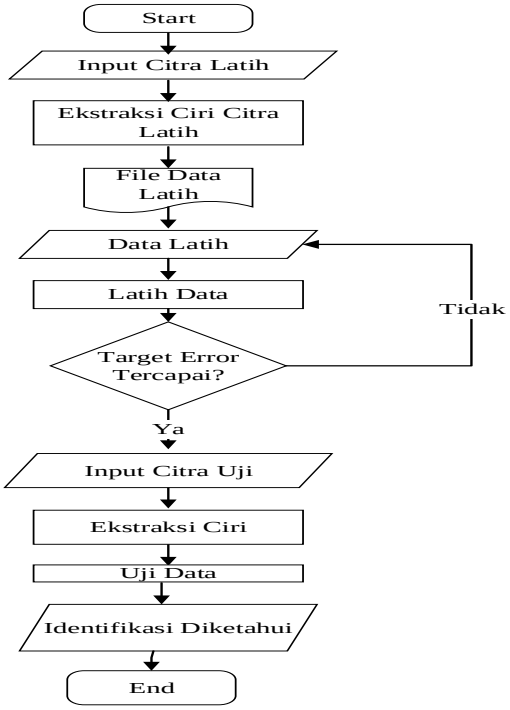

Figure 2: Flowchart of Identification of Banana Fruit Types Using the *Backpropagation Method*

In the picture above it can be explained how the workflow of identifying types of bananas is as follows:

1. Start
2. Input the image of the type of banana fruit
3. Banana image feature extraction
4. The results of image feature extraction become training data used for the data training process
5. Train image data
6. The results of the data training whether the target error is reached, if not then do the training process again until it converges . If the convergent target error has been reached then,
7. Test Image data
8. The identification results of the types of bananas are known.
9. end

3.3. Backpropagation Method Calculation

The following are values beginning for training using the *Backpropagation method* .

Initialization is set as follows:

1. *Learning rate* (α) = 0.2
2. Target *error* = 0.01
3. *Maximum Epoch* = 10000
4. Target (T) = 1

The Backpropagation architecture used is shown in Figure III.3 below. This ANN consists of an input layer with 5 nodes (according to the number of types of bananas), a hidden layer with 5 nodes and an output layer with 1 node.

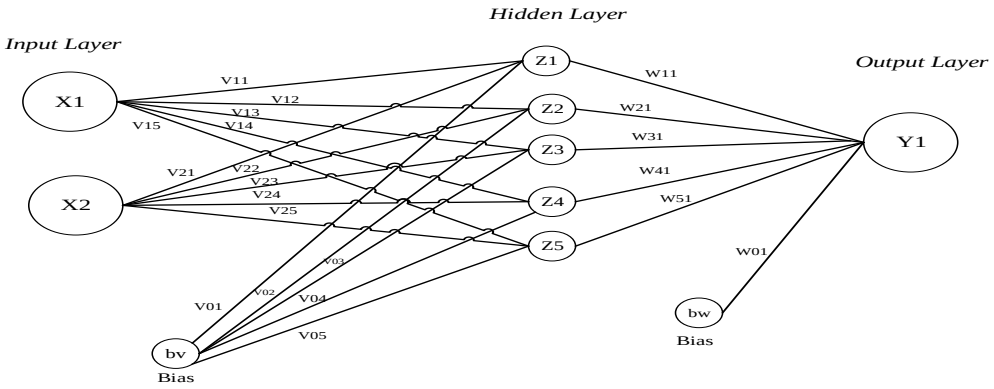

Figure 3: Design of an Artificial Neural Network

4. Results and Discussion

The main menu is the main display the first time the system is run the main menu has several menus such as extraction and training, identify the type of banana and exit. The home menu display is as shown in the image below .

Figure 4: Main Menu

4.1. Extraction and *Training*

The extraction and training menus are used to extract image features of banana species which will later be used for the training process. This image feature extraction uses metric and eccentricity image feature extraction. To carry out the extraction process, which is done by clicking the select folder button, then clicking the feature extraction button, wait until the process is complete, then the extraction results will be displayed in the table. After the extraction process is complete, then carry out the training process by inputting training data and training target data, then clicking Backpropagation training, wait until the process is complete and displays the results of training accuracy. The extraction and training menu displays are as shown in the image below.

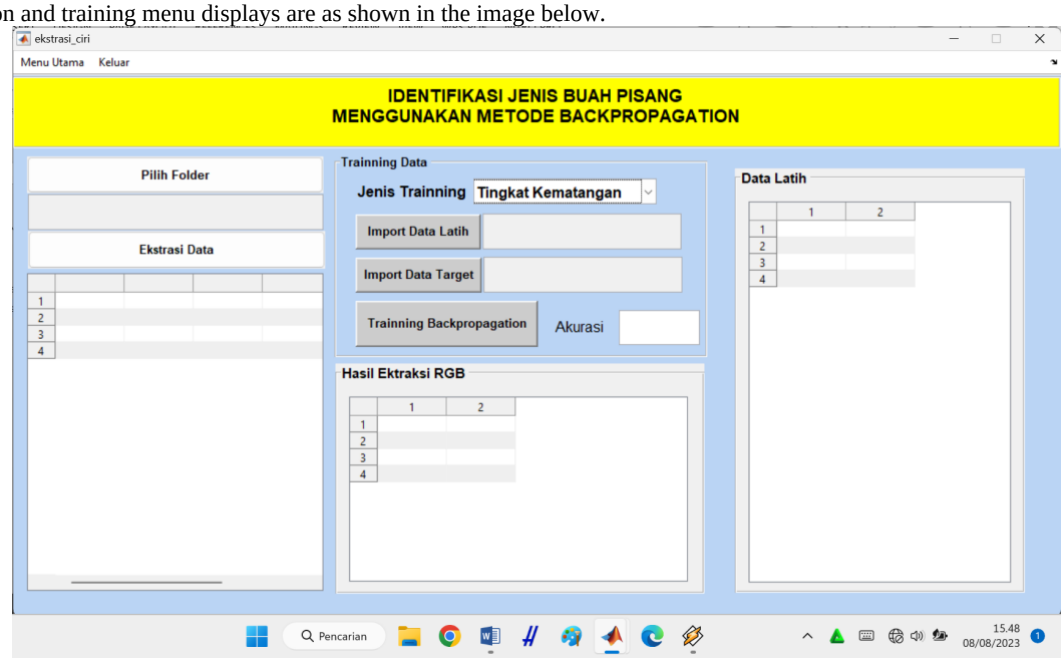

Figure 5: Extract Menu And *Training*

4.2. System Implementation

The process of identifying types of bananas is carried out in 2 stages, namely the data training stage to be trained and data testing with new images. The training data consists of 50 X 2 image data, while the target data used is 1 X 50 data. Then the data will be trained until the training process is complete. The training data used is the result of image feature extraction with the following process.

Figure 6: Extraction Process

Furthermore, the data mentioned above will be processed by training using the Backpropagation method. The data training process that will be carried out can be seen in the image below.

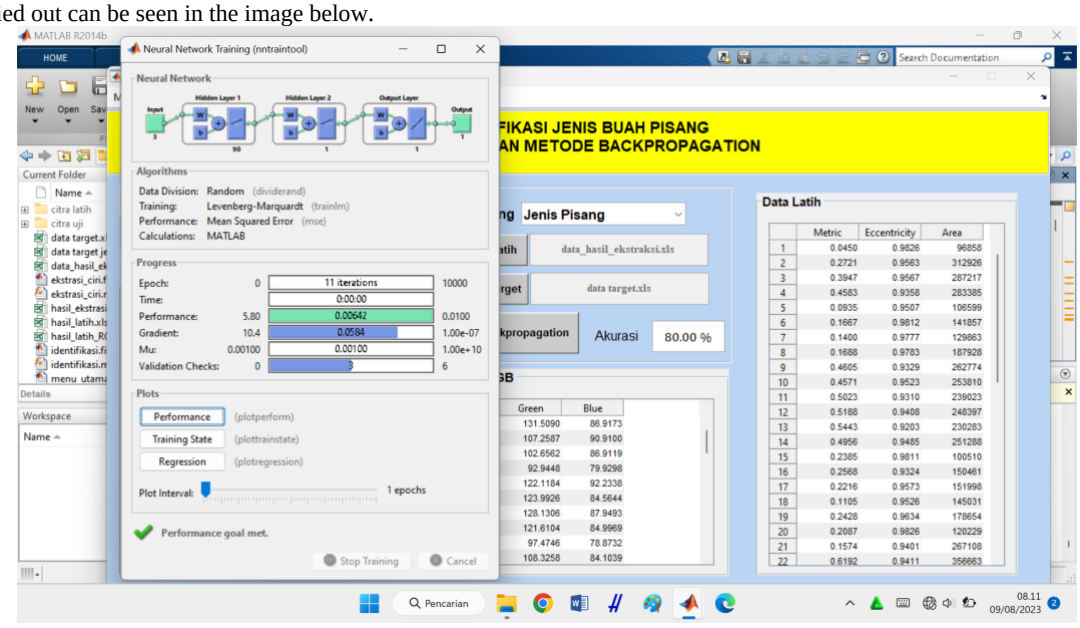

Figure 7: Process *Training* Data Types Banana

From the above process, the training process for banana type data with epoch 11 iterations is obtained with a maximum input epoch of 10,000, the target error or performance is 0.00642 with an accuracy value of 80%. In the next stage, I analyze the test results to observe how changes in the number of nodes in the hidden layer affect the accuracy of the artificial neural network. The following shows a comparison of accuracy for each variation in the number of nodes in the hidden layer, which can be seen in the image below.

Table 2: Testing Influence Number of Nodes On *Hidden* Layer Against accuracy Network Nerve Imitation

Number of *Nodes Hidden Layers*	**accuracy**
5	14%
10	15%
15	20%
20	20%
25	25%
30	33%
35	35%
40	43%
45	46%
50	48%
55	50%
60	55%
65	58%
70	60%
75	63%
80	65%
85	70%
90	80%
100	80%

Based on the results of the tests and analysis performed, it can be concluded that the number of nodes in the hidden layer has a significant effect on the increase in the accuracy of the artificial neural network. The more the number of nodes in the hidden layer, the better the classification accuracy obtained.

Next, the maturity level training will be processed, which can be seen in the image below. From the training process in the 4th epoch, the target error or performance is 0.0606 with an accuracy value of 90%.

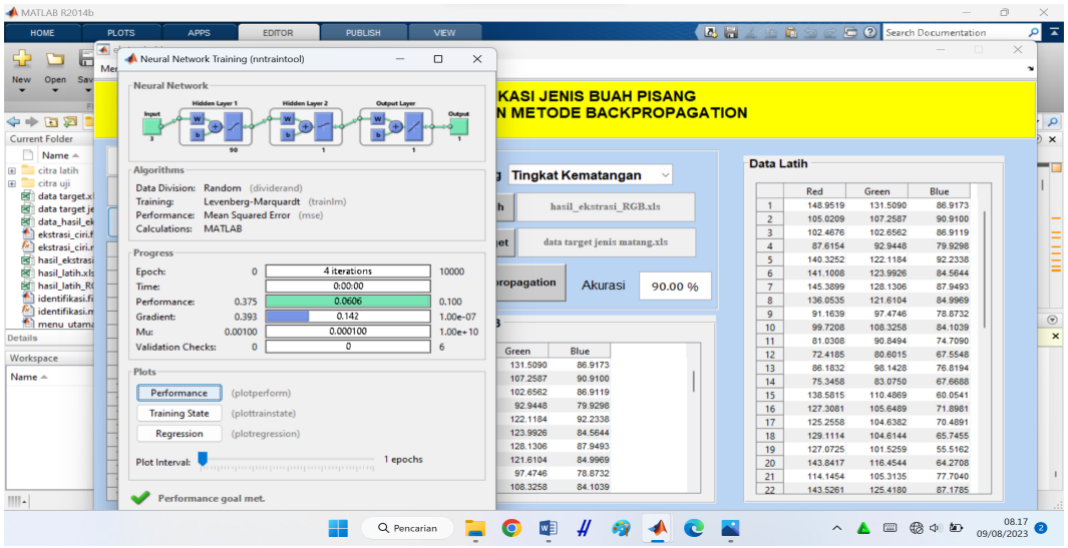

Figure 8: Maturity Level Data *Training* Process

Furthermore that is test the new data image data fruit banana For identify type fruit banana along level maturity . For identify type fruit banana along level maturity , yes done with way :

1. Choose *button* image
2. Choose *button* identification , for identify type fruit banana along level maturity And displays results extraction characteristic image .

As for appearance from process to identify type fruit banana along level maturity that is as following .

Figure 9: Identification Fruit Banana Crewman

From the above process, the system identifies the image of the crew banana with a level of ripeness that is ripe according to the type of image that is input.

Next is to test the type of kepok banana fruit with the following process.

Figure 10: Identification Fruit Banana Kepok

5. Conclusion

From the results of the research conducted, namely identifying the types of bananas using the *Backpropagation method* . From the training and testing process that has been carried out, the conclusions I get are:

1. *Backpropagation* method can be applied to identify the type of fruit and its maturity level with digital image input.
2. Based on the results of the analysis performed with using metric feature extraction , *eccentricity* , and image area , identify bananas can done by type. The results of the image data *training* process are as many as 50 input image data, the results of *training* data on banana types with epoch 11 iterations with a maximum input epoch of 10000, target *error* or *performance* 0.00642 with an accuracy value of 80%.

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