Journal of Computer Science and Technology Studies
ISSN: 2709-104X
DOI: 10.32996/jcsts
Journal Homepage: www.al-kindipublisher.com/index.php/jcsts

JCSTS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

The Use of Simple Neural Algorithm in Classifying Single Toraja Coffee Beans

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| ABSTRACT
One of the well-known plant commodities in Tana Toraja Regency is coffee. Gandangbatu Sillanan is one of the areas that produce coffee at large capacity every year. Even the livelihoods of these residents are generally coffee farming and coffee plantations. Coffee is a popular beverage since it offers pleasure and health advantages. In addition to the taste of coffee, the other attraction related to coffee is the selling value which tends to increase. One type of coffee that has a relatively high selling value is single coffee or *Lanang coffee* (monocot). This type of coffee is obtained from sorting coffee beans after going through the process of peeling and drying. However, farmers still manually sort coffee beans, which is time-consuming. In this study, researchers identified the type of *Lanang coffee* using Neural Network software. The results showed that the shape of Toraja *Lanang coffee* beans could be identified using the Neural Network, where the physical form of *Lanang coffee*, both Arabica and robusta types, had a different shape from dicotyledonous coffee beans.

| KEYWORDS

Coffee, *Lanang*, digital image, neural network.

| ARTICLE INFORMATION

ACCEPTED: 17 December 2022 **PUBLISHED:** 20 December 2022 **DOI:** 10.32996/jcsts.2022.4.2.21

1. Introduction

Coffee is a strategic plantation plant that is typically consumed as a cool beverage. The rapid development of coffee has made consuming it a part of public customs and culture in both rural and urban areas. Consumption of coffee differs from other beverages as the factors of calm and focus obtained include health factors [Ding, 2025], unlike when someone consumes alcoholic beverages. Excessively consuming alcohol will cause drunkenness, which could make somebody lose consciousness [Solina, 2018].

There are many types of coffee on the market, but in general, the largest are Arabica and Robusta. Arabica and Robusta coffee differ in appearance, agroecological suitability (climate and altitude), chemical properties, and presentation, where all of which affect the taste. Light intensity affects the taste and caffeine content of Robusta coffee. Moderate light intensity will produce optimal taste, while higher light intensity will result in higher caffeine levels. The altitude also affects the optimization of fermentation, affecting the taste. The higher the planting site, the better the coffee taste [Arboleda, 2018].

Tana Toraja Regency is one of the regencies in South Sulawesi Province, which is located at an altitude of 1100 – 2000 meters above sea level. This is very suitable for coffee plantation land. In general, the Toraja people have coffee plantation land, which is one of the assets of the Toraja area. One type of coffee that is quite popular in today's society is single coffee or Lanang coffee. The shape of the coffee bean is different from coffee beans in general because it is classified as a monocot bean. Various media discuss this single coffee's distinctive taste and high selling value. However, farmers experience problems grouping coffee types, [Effendi, 2017] including Lanang coffee because so far, it is still done manually where farmers still choose manually with detailed attention to the manual form of the coffee. Getting a group of monocotyledonous coffee beans will take a long time.

The rapid development of technology has led to the creation of automatic equipment to facilitate human work [Pineng, 2018]. Equipment automated is form performance from application technology including technology processing image with sensor combination in the circuit electronics simple. This automated equipment is a form of performance from technological applications, including image processing technology with sensor alloys in simple electronic circuits. Image transformation (translation, rotation transformation, scaling, geometric), selecting optimal feature images for analysis purposes, storing reduced and compressed data, data transmission, and data processing time are all possible with digital image processing. [Munantri, 2020]. With these various image processing methods, we use image processing to identify various types of coffee beans, especially those produced by farmers in the Toraja area. [Aristanto, 2020]. A neural network programming language is used to identify the coffee bean's shape as the final decision maker [Rahmadewi, 2018]. Thus, the identification of the types of Toraja coffee beans (monocots or dicots) can be made with image processing technology and neural network programs, which are expected to assist coffee farmers in classifying coffee types.

2. Literature Review

2.1. Coffee Beans

Coffee *belongs to the Rubiaceae family* and consists of many types, including *Coffea Arabica,* Coffea *Robusta,* and *Coffea Liber*ica. Coffee is widely believed to have originated from an ancient kingdom in Ethiopia named Abyssinia, and coffee plants there grow in the highlands. In general, the physical form and parts of the coffee are shown in Figure 1 and Figure 2.

Figure 1. The physical form of the coffee cherries [9]

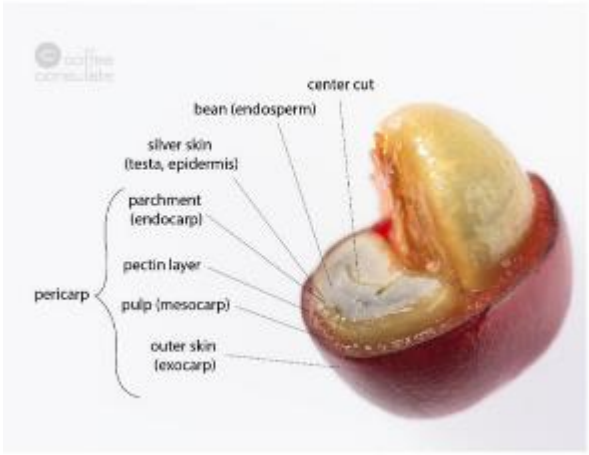

Figure 2. Parts of coffee cherry [10]

The cultivation of Arabica and Robusta coffee plants has developed in Indonesia. Besides being used as a drink, coffee can also reduce the risk of cancer, diabetes, gallstones, and various heart diseases. Indonesia itself can produce more than 400 thousand tons per year so coffee plants can become one of the country's economic strengths.

Several types of defects are registered in SNI coffee beans, but only two types of defects were studied: young beans and moldy beans. The sample data for the research were 75 image data divided into 3 groups: 25 regular seeds, 25 young seeds, and 25 moldy seeds. The images used had the extension JPG or JPEG. Each group was divided into 2 parts: 5 samples of training data were taken, and 20 data for each group for test data samples.

The term "Lanang coffee" often appears when ordering coffee at a cafe or buying coffee beans. Many people are confused when faced with this name, considering that "Lanang" itself means boy in Indonesian. Judging from the structure of the coffee berry, when opened, there are two beans (seeds) because the coffee plant is dicot. The forms of both monocot coffee beans are shown in Figure 3.

Figure 3. Single coffee bean [12]

2.2. Digital Image

Image, as one of the multimedia components, plays a vital role as a visual form. Image has characteristics that are not owned by textual data because it is richer in information. An image can provide more information than information presented in textual form.

Literally, an image is visual data in a two-dimensional or dimensional field (Widiarti, 2013). The image can be defined as a continuous intensity function in a two-dimensional plane where each point can be written as in equation 1 below.

$$0 < f(x, y) < \infty \quad (1)$$

Where f (x,y) is the light intensity at location (x,y) [14]. Since an image is a two-dimensional visual data that can be represented in terms of length and width, like a matrix, an image can be represented in an m x n matrix with pixel intensity as its constituent component.

In a digital image, the color displayed represents the light intensity value captured by the sensor in the digital image acquisition process. Basically, in color digital images, there is a combination of three color intensity values, namely Red, Green, and Blue. Color features are a form of processing results of these intensity values, which can later represent a color characteristic in the digital image.

2.3. *Neural Network* (NN) Algorithm

Neural Network is a category of *Soft Computing science*. *Neural Network* adopts the human brain's ability to provide stimulation or stimulation, carry out processes, and provide output. Output is obtained from various stimulations and processes that occur in the human brain. The human ability to process information results from the brain's complex processes. For example, children can learn to do recognition even though they do not know what algorithm to use. The extraordinary computational power of the human brain is an advantage in the study of science. One of the functions of the Neural Network is to classify patterns.

The development of *Neural Network* science has existed since 1943 when Warren McCulloch and Walter Pitts introduced the first computational neural network model. They combined several simple processing units, which can increase computing power.

Generally, the number of layers depends on the complexity of the problem to be solved. There are four main steps in the classification process using NN; initialization, activation, training, and iteration. Even though it is in the activation stage, it can change based on the problem to be solved. The basic information processing element of a neural network starts with neurons connected by links [Michael, 2021]. Each link has its own weight, and each neuron consists of one or more adjustable ones. From the input neuron, the link will move toward other nodes. *The process of Artificial Neural* Network in general is shown in Figure 3.

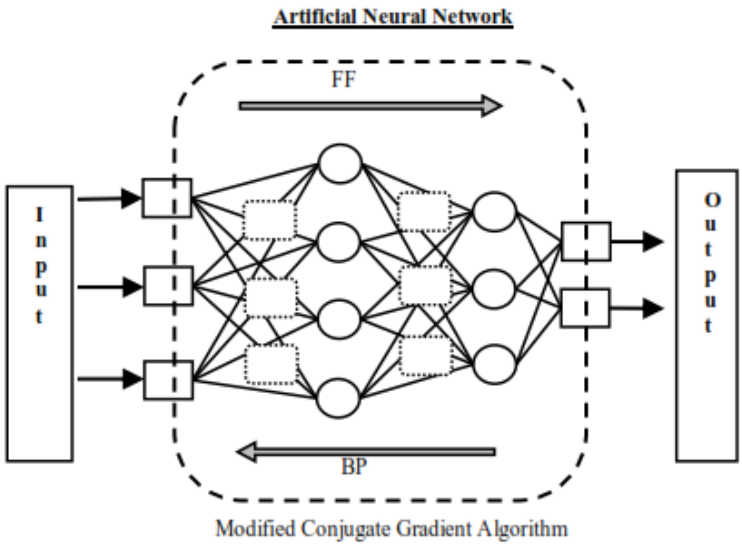

Figure 3. Artificial Neural *Network* Process [Farizawani, 2020]

3. Research methods

3.1. Place and time of research

Data collection in the form of coffee beans was carried out in Gandasil Village, Tana Toraja Regency, one of the Arabica and Robusta coffee-producing villages. The data was obtained when the coffee harvesters arrived, which was between February and September. Furthermore, data processing was carried out at the Computer Laboratory of the Christian University of Indonesia Toraja, where in the laboratory, both software and hardware facilities supported each lecturer's and student's research. This research was done in one year (12 months).

3.2. Observed/measured variables

In this study, the physical form of the coffee bean (dicot or monocot) was observed, which was then compared to the form of results of taking pictures in the form of digital images, which were the main object in the preparation of artificial neural algorithms.

3.3. Research Model

The model used in this study is the *Research and Development* (R&D) model. The R&D model is a powerful research method strategy for improving practice. Models produce objects (hardware) or software (software). Development research is also defined as a process or steps to develop a new product or improve an existing product that can be accounted for.

3.4. System Design

The application developed is designed to run without the internet. This is done to make it easier for users (coffee farmers) to stage field use. Users simply enter data in images, and then the sensor will convert it into digital data. Figure 5 shows the system work system.

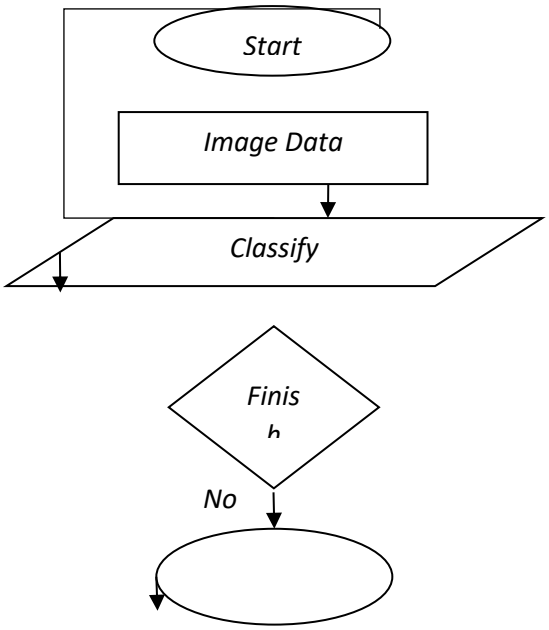

Figure 6. The work *of system*

3.4.4 System

Requirements

Functional and non-functional system requirements are described in table 1.

Table 1. Requirements System

No.	System	Requirements
1	Functional	a. The application runs without an internet network. b. Applications can read color data. c. Provide a search facility. d. Can provide information on each study.
2	Non-Functional	a. Using artificial neural programming language. b. Making programs on the Windows operating system.

3.5. Data Collection and Analysis Techniques

In this study, the data collection technique was in the form of measurements carried out in the Computer Laboratory. This measurement aims to get results that are in accordance with the theory, analyze the program based on the design results, and analyze the circuit system.

4. Results and Discussion

In general, the research has reached the target of obtaining the physical form of digitally managed Lanang Toraja coffee beans using Neural Network software. This software has a fast response in identifying digital images.

4.1. Sampling

The coffee bean sampling process was carried out by selecting samples randomly and manually, as shown in Figure 7.

Figure 7. The coffee bean sampling process

Furthermore, the coffee bean sampling process was carried out on single Arabica and dicot Arabica coffee types as well as single Robusta and dicot Robusta as shown in Figure 8.

Figure 8. The coffee bean sampling process

The sample data used in this study were 39 coffee beans classified as single, according to Figure 9.

Figure 9. Selected coffee bean samples

4.2. Digital Image Processing

Digital image processing is carried out with the help of *Graphical User Interface* (GUI) software. In principle, the GUI goes through several stages. These stages start from a rough sketch to get feedback used to refine the GUI design. The initial appearance of the GUI is shown in Figure 10.

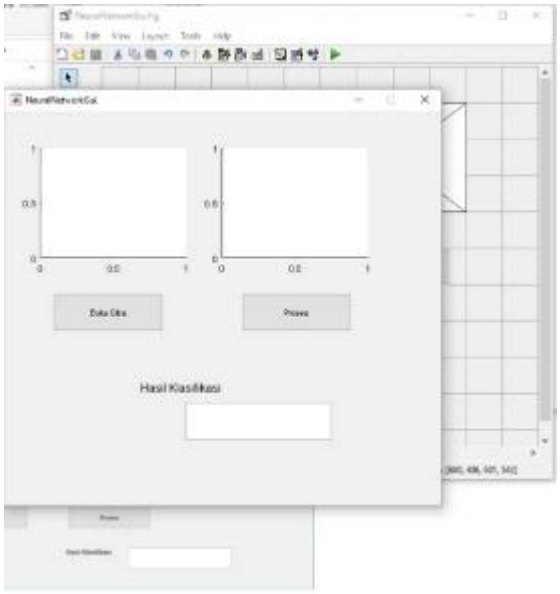

Figure 10. Initial GUI display

The next stage is to do the training data. The training data used is 24 data. This training data (390 is used to find the right pattern on coffee beans. The test data (24) is used to test the classification results based on the training data patterns that have been made. The process and results of the training data are shown in Figure 11.

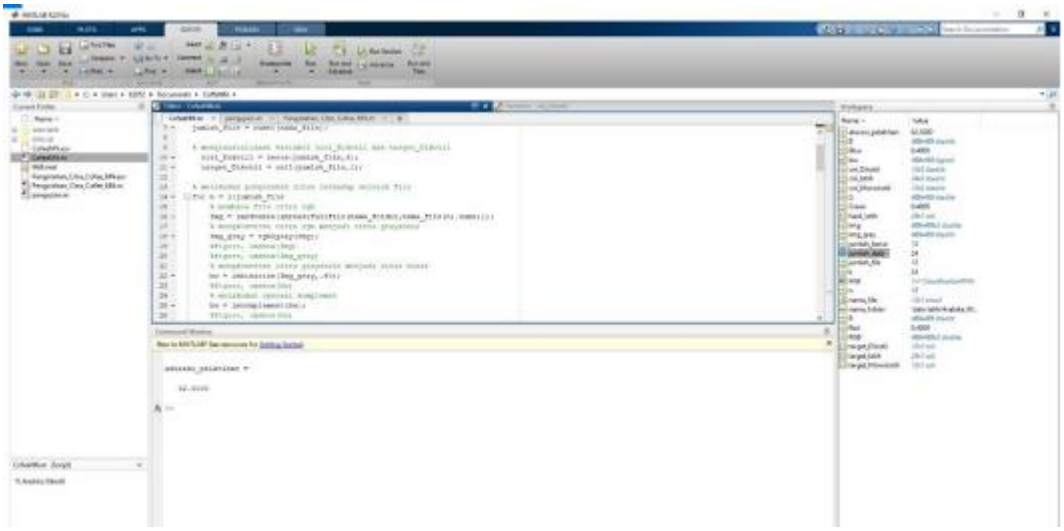

Figure 11. Training data with 62.5% accuracy

Stages of testing are carried out to classify coffee. Figure 12 below shows the classification results using a *Neural Network* for dicot Arabica coffee classification types.

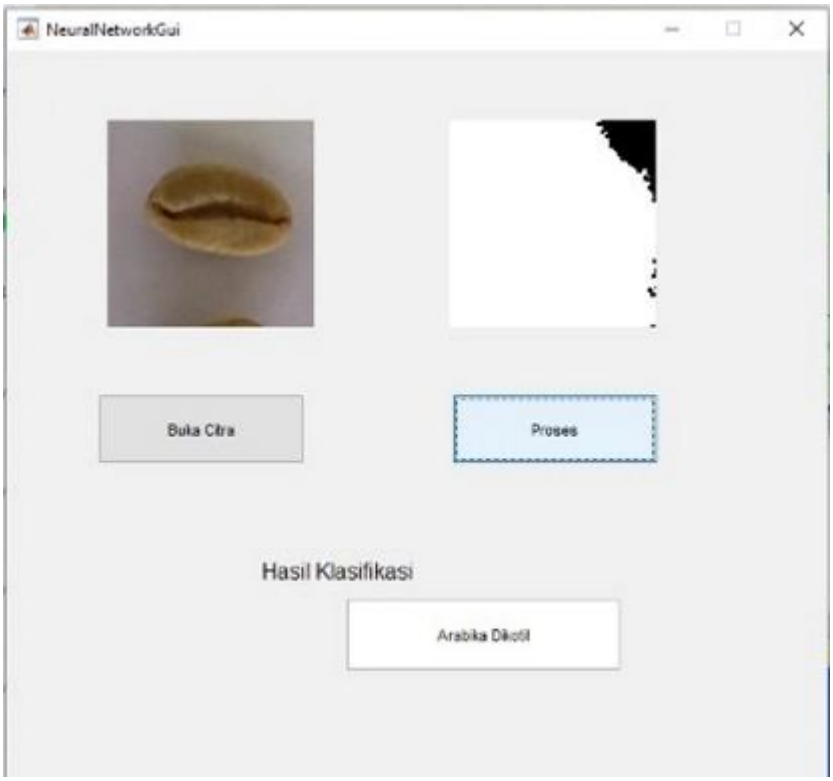

Figure 12. Classification results of dicot coffee beans

Figure 13 shows the results of the classification using the Neural Network for the type of monocot Arabica coffee classification.

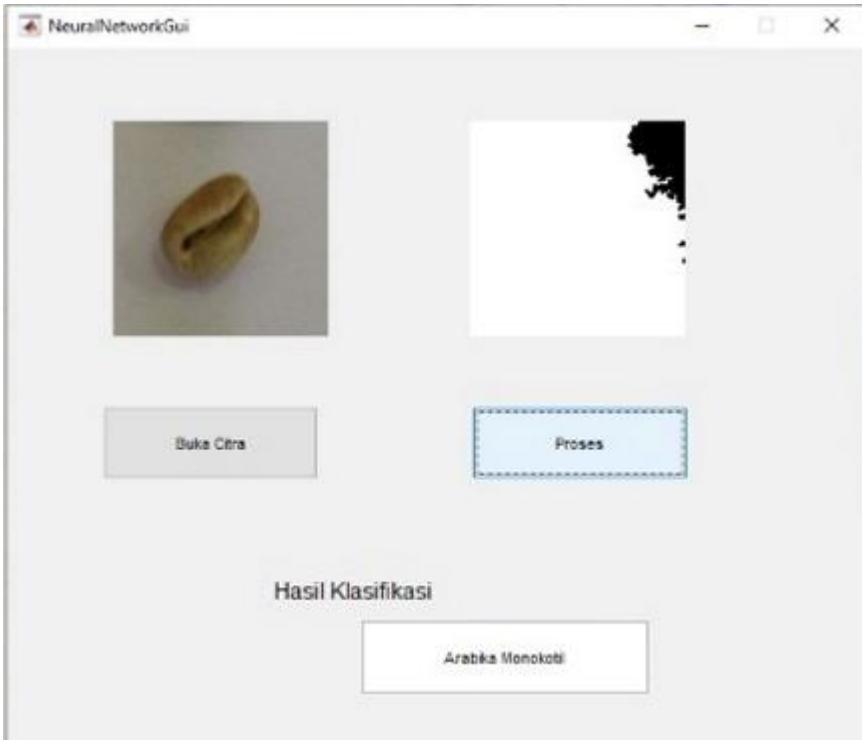

Figure 13. Classification results of monocot coffee beans

5. Conclusion

This research has been able to identify the type of Lanang coffee using *Neural Network* software. *Neural Network* Software has a fast response in identifying digital images. This is made possible by using relatively specific data by taking pictures of coffee beans directly from the field. The training data used is 39 data and 24 data as test data. The results showed that the shape of Toraja *Lanang coffee* beans could be identified using the Neural Network, where the physical form of *Lanang coffee*, both Arabica and robusta types, had a different shape from dicotyledonous coffee beans.

Funding: This research received no external funding.
Conflicts of Interest: The authors declare no conflict of interest.
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