

Image Processing Implementation to Classify Coconut Quality Based on Its Color

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ABSTRACT

At this time the processing of coconut into coconut flour is widely carried out by factories, especially in areas that have a large population of coconuts. This is because the benefits derived from the processing of coconut can get big profits. This is because the profits obtained from the results of coconut processing can get large profits. The problem that has occurred so far is that there are many people who want to process coconuts, but are not accompanied by sufficient knowledge and knowledge of the quality of coconuts that the factory wants, so it is undeniable that there are also many coconuts that have been processed into coconut flour but are not sold in the market. The analysis method used in this study used an image processing method based on digital images with a GUI (Graphical User Interface) media interface that utilizes MATLAB software. Image processing consists of several processes, the first of which is the operation of changing the color to grayscale. The second process is a grayscale to binary color change operation using the threshold method. The third process is the morphological process of filling holes to remove noise from the threshold image results. The results of the study using the Image Management method are expected to provide knowledge and knowledge to the public about the quality of coconuts expected by the factory, especially to identify the differences between rotten coconuts and rotten coconuts.

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1. INTRODUCTION

The development of technology today is really very rapid, especially technology in the field of information technology which can be widely utilized in many other fields. One of the technologies that is developing rapidly is in the field of digital imagery, namely two-dimensional images that can be displayed on a computer screen as a discrete set of digital values called pixels / picture elements. The imagery referred to here is both a still image (photo) and a moving image (which comes from a webcam). While digital here means that image processing is carried out digitally using a computer [1]. The data on coconuts based on the quality of heavy coconuts can be seen in table 1.

The quality of coconut A+ is marked with 1.5 kg and above, the quality of coconut A is characterized by a weight of 1.2 kg to .5 kg, the quality of coconut B weighing 0.9 ounces equals 1.2 kg, and the quality of coconut C weighing 0.6 to 0.9 ounces [2].

Table 1. Coconut Data

NO	Coconut Quality	Weight
1	Coconut A+	1,5 Kg and above
2	Coconut A	1,2 Kg – 1,5 Kg
3	Coconut B	0,9 Ounce – 1,2 Kg
4	Coconut C	0,6 Ounce – 0,9 Ounce

Judging from previous studies that the determination of coconut quality is based on its weight, while for now researchers will conduct a study on the quality of coconuts based on their color level. The good quality of coconut to be used as coconut flour is categorized into 3 kinds, namely white color indicates that coconut has good quality then yellow indicates the quality of coconut is not good and brown color indicates that coconut can no longer be used. This can be seen in figure 1 below:



Figure 1. Coconut quality level

Discoloration that occurs during the processing process is highly undesirable. So that a way is sought to maintain the white color of the coconut flesh. During the drying process, there can be caramelization of the sugars contained in the grated coconut so that the color can change. During the storage process, there will be discoloration caused by the growth of microorganisms due to the high moisture content ($> 3\%$) in coconut flour as a result of an unfavourable drying process and a humid state at the time of packing because the coconut flour is put in a bag in a hot state. The growth of microorganisms during storage of coconut flour will increase the level of free fatty acids due to the destruction of oil content [3].

Basically, the process of processing coconut flour begins with the selection of old coconut fruits, then separated between the shell and the flesh of the fruit. The brown skin of the flesh of the coconut fruit is peeled off, then the flesh of the coconut fruit is ground. The ground flesh of the coconut fruit is heated with steam after which it is dried with a drying machine [4].

2. RESEARCH METHOD

The methods carried out in this study consist of several stages, namely literature study, design of designs and programs, testing, and analysis [12].

1. Literature Studies

Literature studies are carried out by seeking information and references from various sources related to image processing and their implementation.

2. Design Of Designs

The design consists of a cover design, a MATLAB GUI design and an exit design. The cover design is in the form of a design to start the application using 1 button and named start.

MATLAB's GUI design is a design to process imagery with: (1) 4 axes used to display images; (2) 6 edit texts are used to display imagery information; (3) 4 labels are used to provide information; (4) 3 buttons; (5) Open image is used to select the image; (6) The results are used to start the editing process. (7) Exit is used to exit the GUI.

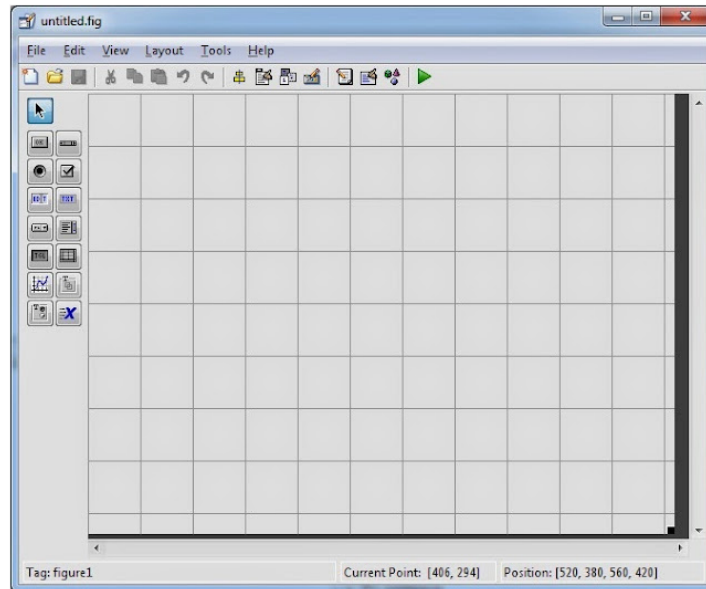


Figure 2. MATLAB User Interface

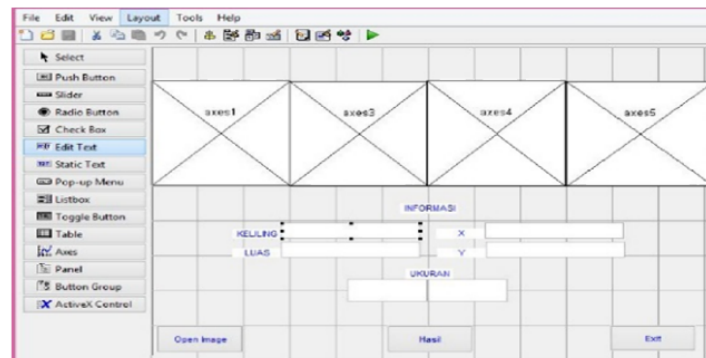


Figure 3. MATLAB GUI Design

The exit design is used to display a dialog question where the user can opt out or not.

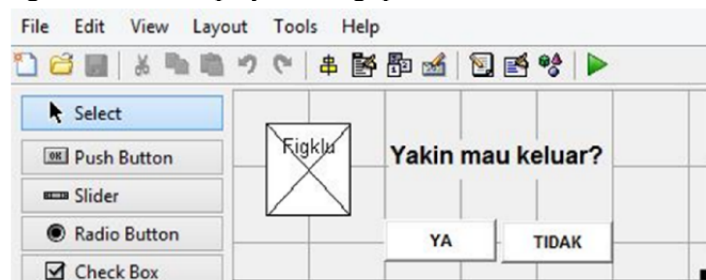


Figure 4. Exit Design

3. Program Design

Program design using MATLAB software with the programming language used is C programming language. Programs are created using m files and can be programmed in every icon toolbox used. The program also contains an intelligent system of fuzzy logic to process charcoal image reading data so that the GUI is able to give size decisions quickly [14]. The overall program flowchart can be seen in figure 4 below:

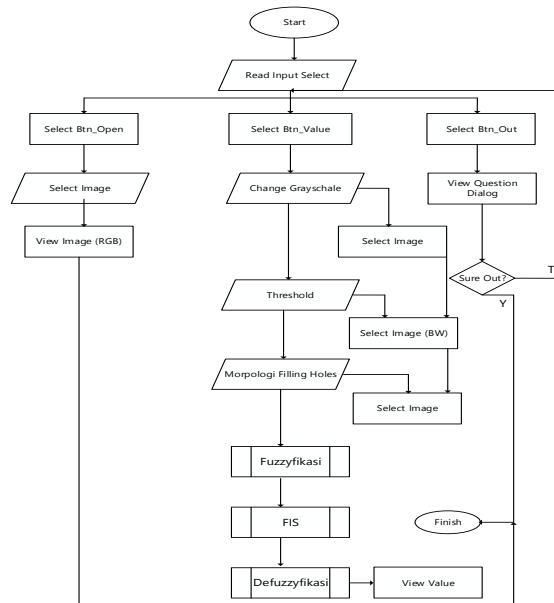


Figure 5. Overall flowchart

4. Testing

Imagery taking using a 5 MP cellphone camera with a distance of 15 cm. The image testing process uses the format (.jpg) and with a dark background with the same pixel dimensions of 720 x 1280.

5. Analysis

At this stage, data analysis of test results is carried out which aims to find out the results and conclusions of several tests that have been carried out. From this analysis will be known the shortcomings and advantages of image processing, the controller used and the intelligent system of fuzzy logic applied.

3. RESULTS AND DISCUSSION

3.1 Image Processing using MATLAB

Multi-level thresholding is an image segmentation method that uses two or more threshold values [13]. The equation used to convert the pixel value of a grayscale image to binary in the multi-level thresholding method is:

$$g(x) = \begin{cases} 0, & \text{if } F(x, y) < T1 \\ 1, & \text{if } T1 \leq F(x, y) < T2 \\ 0, & \text{if } F(x, y) \geq T2 \end{cases}$$

Where:

$f(x,y)$ is image grayscale

$g(x,y)$ is image biner

$T1$ is the lower threshold value

$T2$ is the upper threshold value

An illustration of the change in pixel values in the multi-level thresholding process is shown in the figure below.

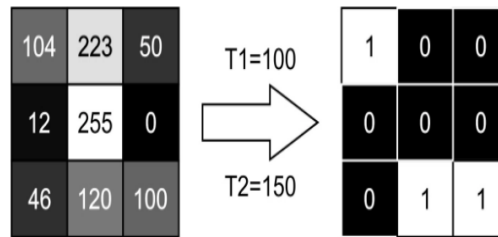


Figure 6. Pixel Change Illustration

3.2. Fuzzyfication

The fuzzyfication stage is the stage of formation of membership functions. In the Input section there are 2 input variables, namely the AREA variable and the PERIMETER variable. LinGUIstics AREA Variables and LinGUIstics Perimeter variables each have 3 linGUIstic values. The LinGUIstic value is determined from the experiment of 3 types of charcoal and each condition of 3 charcoal, so that it gets the linGUIstic value of each condition. Figures 5 and 6 show the area and PERIMETER membership functions [15].

Light Value	Enviromental Conditions	Process Result	Effect
0 Lux	Dark		The absence of light affects the system, resulting in very poor image capture with very poor framerate
1 Lux – 30 Lux	Equivocal		The lack of light affects the system, resulting in very poor image capture with very poor framerate
31 Lux – 1500 Lux	Bright		Light value which is ideal for research that uses a webcam as its input, so the resulting framerate is good
>1500 Lux	Very Bright		Excess light makes the system with a 5 MP resolution webcam enable to capture profile

Figure 7. PERIMETER Fuzzification

3.3 Rule Base

At this stage, each output of the fuzzification stage in the form of membership degrees and linguistic variables from both AREA and PERIMETER will be combined using rule evaluation. In the evaluation of the rule there are linguistic rules to determine the action of control over the input value of the fuzzification. The first step is the evaluation of the relationship or antecedent degree of each rule. Next is a search for the degree of truth for each rule, using the "AND" relationship or the minimum value. Once the degree of truth is obtained for each of the same actions, the highest value will be sought. This method is called "MIN-MAX" inference [16].

Table 2. Rule Base

Area/Perimeter	Chocolate	Yellow	White
Chocolate	Chocolate (R1)	Chocolate (R2)	Chocolate (R3)
Yellow	Chocolate (R4)	Yellow (R5)	White (R6)
White	Yellow (R7)	White (R8)	White (R9)

3.4 Defuzzification

The output of the rule evaluation stage will be used as the most correct rule and will be multiplied by the value of the degree of its membership. The method used in defuzzification is the Center of Gravity (COG) or centroid. The result of the summation of all outputs of the membership function multiplied by the singleton of each action. From these results, an average is then searched for the total fuzzy output. So, the end result is a firm value. This final value is used to determine the color of the charcoal [17].

3.5 Functional Testing

Testing is carried out by testing each process carried out.

1. Convert RGB image to Grayscale

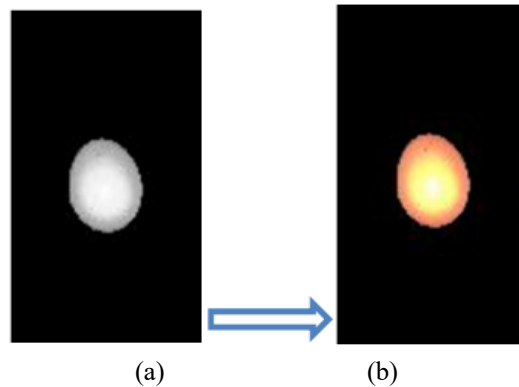


Figure 8. (a) RGB image (b) Grayscale image

In the first stage in the digital image processing process, the digital image taken is in the form of RGB imagery (red, green, blue) which is then converted into a grayscale image form.

2. Convert Grayscale image to Threshold

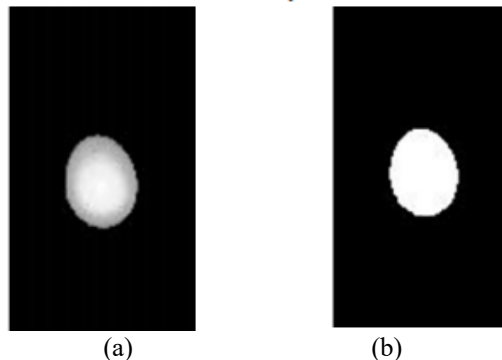


Figure 9. (a) Grayscale image (b) Threshold image

After the digital image is converted to a grayscale image form from an RGB image. Furthermore, the image with grayscale format is converted into a binary image using the Thresholding method.

3. Filtering using morphological filling holes

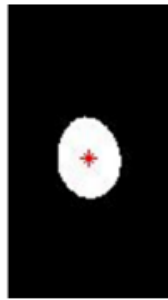


Figure 10. Image Filling Holes

The threshold image will then be filtered to smooth the image.

4. CONCLUSION

Based on the tests that have been carried out, it can be concluded: (1) "Image Processing Implementation to Classify Coconut Quality Based on Its Color" was successfully created with the MATLAB GUI. (2) The GUI is used as an output to display the results of digital image processing according to its stages, and can display the results of its quality. Fuzzy logic also works fine. (3) The software used to realize this system is MATLAB software to program the MATLAB GUI. Overall, the program created is already working according to the goal. The total success of testing the image processing system for the identification of coconut quality is 76% and the error is caused by the human error of experts working in the field of charcoal making.

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