The characteristics of bamboo image extraction as an environmentally friendly material

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Abstract. Bamboo is an environmentally friendly material. Various types of bamboos thrive in Indonesia. To differentiate good types of bamboos, this study uses the K-Means color segmentation method and shape measurement. Due to bamboo has fibers content and fibers adhesive which reflected the quality of bamboo. Then the research uses the morphological parameters of area and perimeter as a feature of size. The analysis is carried out on 45 bamboo images, namely 15 Wulung bamboo images, 15 Petung bamboo images and 15 Ori bamboo images. Based on the test results obtained, there are as many as 0.6 accurate images. The testing uses 15 types of bamboo imagery. The bamboo which has the largest fiber size is Wulung bamboo and then followed by Petung bamboo and the smallest is Ori bamboo.

1. Introduction

The identification of objects in digital image processing is by measuring the texture, shape and color of the object[1]. Measurement by image textures only uses spatial data has flaws so we need to measure objects based on the size of their shapes. Bamboo fiber is a natural fiber which is an environmentally friendly material, we can take many benefits from the bamboo fiber. Bamboo has a constituent namely fiber and fiber adhesive. Based on laboratory testing, the wider diameter of bamboo fiber is the better quality of the fiber[2]. Many types of bamboo thrive in Indonesia, so we need a method that allows us to identify and distinguish the characteristics of each type of bamboo. Characteristics are different characteristics in each image quality such as pixel intensity, edges, contours, regions and so on [3]. To determine the characteristics of the image, the image can be distinguished using the visual characteristics of the image in the form of color, shape and texture [4].

This study intends to measure the amount of bamboo fiber by knowing the characteristics of each bamboo. The method used in segmentation is color image segmentation with K-Means and measuring the amount of bamboo fiber with its visual parameters namely color texture and measuring the area of an object [5]. Bamboo image representation uses an internal region representation that is the ratio of pixels in a region. To measure the area of an object, the commonly used parameter is by calculating the area of an object segmented as well as calculating the length of the perimeter of an object segmented to identify a particular object[6].

2. Method

The method used to identify objects in this study is based on color image segmetation and shape features by measuring the area of the object (bamboo fiber) from segmentation results.
This study uses 3 types of bamboo images that are often used for industry in Semarang, including Ori bamboo, Petung bamboo and Wulung bamboo. The method of this image processing is shown in figure 1 below :

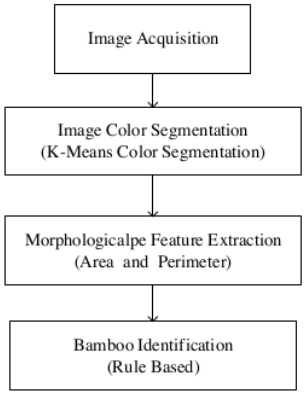


Figure 1. Step of Image Processing

2.1. Data Acquisition

Data acquisition is the process of getting data in the form of bamboo images. The tool used is the Canon D 60 camera. The process of shooting bamboo is done in the morning at 10-11 am where the sun is in bright conditions there is no cloud and no significant wind.

2.2. Pre Processing

Before processing the image, the image obtained from the capturing results in the crop into the same size is 400 x 400 pixel resolutions. After the image is of the same size then the image segmentation is then performed using k-means color segmentation.

2.3. Segmentation

This study use a color based segmentation. This study begins with the converting of original image color space RGB (Red Green Blue) color to HSV color. This study uses the HSV color space standard. The purpose of forming a color space is to facilitate color specifications in the form of a standard. Because HSV is a color space that is more representative of color as seen by the human eye, [7] this study converts the RGB color space into the HSV color space. H comes from the word "hue", S comes from the word "saturation", and V comes from the word "value". Hue is a color known to humans like red and green. Hue reflects the color that is captured by the human eye in response to the wavelength of light. Saturation expresses the degree of purity of color or how much white light is mixed with hue. Each pure color is 100% saturated and does not contain white light at all so pure colors mixed with white light have saturations between 0 and 100%. Value or sometimes called brightness states the intensity of the reflection of the object received by the eye.

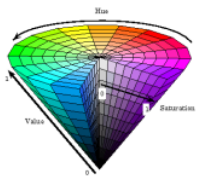


Figure 2. HSV color space

The HSV model was first introduced by A. R. Smith in 1978. To get the H, S, V values, the calculation is based on the values of R, G, and B.

- $H = \tan\left(\frac{3(G-B)}{(R-G)+(R-B)}\right)$
- $S = 1 - \frac{\min(R,G,B)}{V}$
- $V = \frac{R+G+B}{3}$

However, this method makes hue undefined if S is zero. The second method is found in Acharya & Ray [8]. The formulas used are as follows:

- $r = \frac{R}{(R+G+B)}$, $g = \frac{G}{(R+G+B)}$, $b = \frac{B}{(R+G+B)}$
- $V = \max(r, g, b)$
- $S = \begin{cases} 0, & \text{jika V} = 0 \\ 1 - \frac{\min(r,g,b)}{V}, & \text{V} > 0 \end{cases}$
- $H = \begin{cases} 0, & jika\ S = 0 \\ \frac{60*(g-b)}{S*V}, & jika\ V = r \\ 60 * \left[2 + \frac{b-r}{S*V}\right], & jika\ V = g \\ 60 * \left[4 + \frac{r-g}{S*V}\right], & jika\ V = b \end{cases}$
- $H = \text{H} + 360 \text{ jika H} < 0$

2.4. Morphological And Shape Feature Extraction

Morphological parameters that are used to distinguish the phases of development of bamboo in this study are the area ratio and perimeter. Shape feature is a feature obtained through shape object and can be expressed trough area , countour and transformation. This study use morphological features which can be extracted from an object in the image are the area ratio and perimeter. Area ratio is the ratio between number of pixels that make up an object and the image size. Measuring the area of the object segmented using the area and perimeter. The size feature extracted using region prop [9] . The perimeter gives good results when the edges of objects are connected with 4-neighbors, but it is not appropriate when connected according to 8-neighbors [10]. That happens because the distance between two pixels is not constant, whereas the distance is always 1 at 4-neighbors.

If the edge of an object is processed using the perimeter, it can be estimated using the formula:

$$P = N_e + N_o\sqrt{2}$$

with Ne stating the number of even codes and No stating the number of odd codes..

Meanwhile, to calculate the area of an object, a simple way is by counting the number of pixels on the object[11].

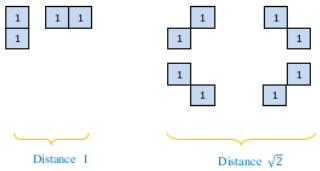


Figure 3. Distance between pixels in 8-neighbors

3. Result and Discussion

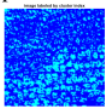
3.1. K-Means Color Segmentation

This study used 45 training images data and 15 testing images data. The process of this study consists of two stages, which are color segmentation using K-Means clustering and morphology feature extraction and make classification using rule-based. The segmentation process is an important step in digital image processing[12]. Because the results of segmentation determine the shape of the object of research[13]. The segmentation process begins with converting the original image color space based on RGB component (Red, Green, Blue) to HSV color space (Hue, Saturation, Value). Than apply K-means Color Segmentation method to segment fibers content and fibers adhesive. K-Means segmentation method uses several steps as follows select a value of "K" , select a feature vector for every pixel, define a similarity measure between feature vectors (Euclidean Distance). Apply K-Means Clustering Algorithm a. Choose a fixed number of clusters, b. Choose cluster centers and point cluster allocations to minimize errors

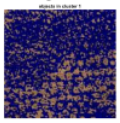
$$\sum_{i\in\text{clusters}}\left\{\sum_{j\in\text{elements of }i\text{th cluster}}\left\|x_j-\mu_i\right\|^2\right\}$$

Apply Connected Components Algorithm, merge any components of size less than to an adjacent component that is most similar to it. K-Means Color Segmentation process is shown in Figure 4 below:

a. Original Image



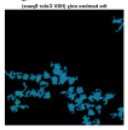
b. Image Labeled by Cluster Indeks



c. Object in cluster 1

d. Object in cluster 2

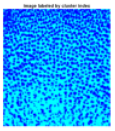
e. Segmented Image RGB Color



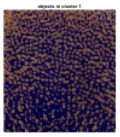
f. Segmented Image HSV Color

Figure 4. Original Bamboo Segmentation

a. Original Image



b. Image Labeled by Cluster Index



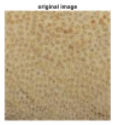
c. Object in Cluster 1

d. Object in Cluster 2

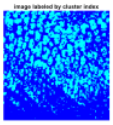
e. Segmented Image RGB Color

f. Segmented Image HSV Color

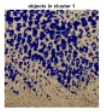
Figure 5 . Petung Bamboo Segmentation



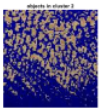
a. Original Image



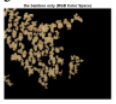
b. Image Labeled Cluster Index



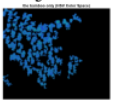
c. Object in cluster 1



d. Object in cluster 2



e. Segmented Image RGB Color



f. Segmented Image HSV Color

Figure 6. Wulung Bamboo Segmentation

3.2. Feature Extraction

This study measuring the area of the object segmented using the area and perimeter. The area ratio is the ratio between number of pixels that make up an object and the image size. The size feature extracted

using region prop [14] . The results of segmentation are used to get the size of bamboo fiber. To get the fiber size of this study using the shape feature by calculating the area and perimeter of the bamboo image [15]. Area A is the sum of the constituent pixels of the object.
A = number of pixels in line 1 + line 2 + ... line N
While the perimeter P of an object is the length of the object's boundary. This research uses 8 pixel neighbor .
P = number of area boundary pixels in line 1+ the number of pixels limit the area in the line to N.
We used Matlab for calculated area and perimeter of bamboo fiber. So from the size and diameter (perimeter) of the image, the size of each type of bamboo will be identified to identify the type of bamboo.

Table 1. Area and Perimeter of Bamboo

No	Bamboo	Area	Perimeter
1	Ori	21.594,47	3.232,8
2	Petung	20.575,53	2.533,73
3	Wulung	40.392,1	3.745,3

From the results of measurements of area and diameter, Wulung bamboo has the largest area and the longest diameter. This is consistent with the results of laboratory tests that the larger the size of the fiber, the better the quality of the bamboo.

The tests are carried out using 15 bamboo images and obtained as many as 0.6 results in accordance and as many as 0.4 which is not suitable. Accuracy generated by classification training with the area ratio and perimeter parameters is:

$$Accuracy = \frac{number\ of\ right\ identified\ \ data}{number\ of\ identified\ data}\ x\ 100\ \%$$

$$Acuracy = \frac{6}{10}\ x\ 100\ \%$$
$$= 0{,}6$$

4. Conclusion

This study use the color segmentation method with K-Means and shape feature extraction based on morphological parameters (area ratio and perimeter). The result of accuracy is 0.6. so a better method for measuring bamboo fiber is needed. In the future work could be carried out with more features like eccentricity, vigour and more number of input so that we can improve the performance of the proposed system.

Acknowledgments

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