2. Color Based Segmentation Using Fuzzy C Means For Bamboo As EnvironmentallyFriendly Material
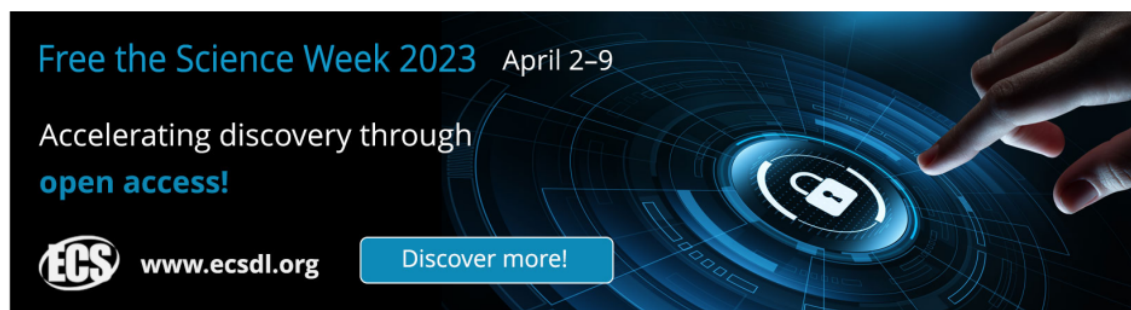
by Joko Siswanto

PAPER · OPEN ACCESS

Color Based Segmentation Using Fuzzy C Means For Bamboo As EnvironmentallyFriendly Material

To cite this article: Khoiriya Latifah *et al* 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **835** 012045

View the article online for updates and enhancements.

Color Based Segmentation Using Fuzzy C Means For Bamboo As EnvironmentallyFriendly Material

Khoiriya Latifah, Joko Siswanto, Bambang Supriyadi, Abdul Rochim

[1,2,3]Faculty of Engineering and Informatics, Universitas PGRI Semarang, Jl. Sidodadi-Timur No.24 Semarang, Central Java 50232, Indonesia
[4]Faculty of Engineering and Informatics, Universitas Islam Sultan Agung Semarang

khoiriyalatifah@upgris.ac.id, jokosiswanto@upgris.ac.id, b_4mbs@yahoo.co.id, abdulrochim@unissula.ac.id

Abstract. Bamboo is an environmentally friendly material. Many benefits of bamboo that we can get. Indonesia as a bamboo-producing country needs easy techniques to make good classification of bamboo. Bamboo is composed of fibers and fiber adhesives. There are various kinds of bamboo in Indonesia. This study uses digital image processing with fuzzy c means based segmentation to identify bamboo. Segmentation is an important thing in image processing. By using fuzzy c means in segmentation in this study obtained good segmentation results. This study uses 4 types of bamboo, namely Javanese bamboo, Ori bamboo and Petung bamboo and Wulung bamboo. There are 40 images as training images and 12 test images. The results of segmentation show that fuzzy c means produces good segmentation with the number of iterations between 20-23 and time ranging from 0.11 to 0.15. The accuracy of this test reaches 80%.

1. Introduction

Bamboo is an environmentally friendly material. Indonesia is the third bamboo producing country in the world after China and India. So that Indonesia has good potential to develop bamboo into an environmentally friendly material for example to produce bamboo fiber which is a natural fiber. There are various kinds of bamboo that grow in Indonesia so we need an easy and inexpensive way to classify bamboo. One of them is using digital image processing methods. In image processing an important step is segmentation. The most important part of image processing is image segmentation. [1.]. Segmentation accuracy determines the likelihood of success or failure of the computerized image analysis procedure. [2.] Segmentation is an image processing step by dividing the image into a number of regions or objects. The level of division depends on the problem being solved so that the development of segmentation techniques is carried out to obtain good and quality segmentation results for a particular image. Because the image quality is influenced by several factors such as lighting, degraded images or blurred colors, and images that contain noise, each image requires a different segmentation technique. Fuzzy clustering as a good method to be used in grouping spatial data and image analysis (Laboratory of Data analysis and Pattern Recognition) [5]. Fuzzy C-Means is a data grouping technique where the existence of each data point in a cluster group is determined by the degree of membership and each object can be a member of several clusters. Fuzzy C-Means is simple,

easy to implement, has the ability to group large data, is more robust against outlier data and produces good segmentation [6]. Based on the provisions of the cluster validation that the values closer to one have better cluster quality. [7].

Fuzzy c-mean clustering is an iterative algorithm to find final groups of large data sets such as images so that it will take more time to implement. An improved fuzzy c-mean algorithm that takes less time in finding clusters and is used in image segmentation. [8]. Experimental results on segmentation of synthetic and real images demonstrate that the proposed Fuzzy C Menas algorithm is effective and robust [9]. FCM has been used with some success in image segmentation in general [10]. From the above background, in this study to segment bamboo writer's image using the fuzzy c means method. The purpose of this research is to implement the Fuzzy C Means algorithm to segment bamboo images as an environmentally friendly material.

2. Methods
The stages in this research include
1. Data collection
   Data collection is the stage where the author collects data by conducting library studies to collect data about bamboo fibers, the benefits of bamboo and image processing methods for images that have unstructured patterns or natural patterns, image segmentation methods
2. 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.
3. Pre Processing
   Initial processing is carried out to obtain sharper images and convert into HSV images of color spaces that represent colors as seen by the human eye. H comes from the word "hue", S comes from "saturation", L comes from the word "luminance", I comes from the word "intensity", and V comes from "value".

To get the values of H, S, V based on R, G, and B, there are several ways.
Acharya & Ray [2005]. The formulas used are as follows:

$$r = \frac{R}{(R+G+B)} , g = \frac{G}{(R+G+B)} , b = \frac{B}{(R+G+B)}$$

$$V = \max(r, g, b)$$

$$S = \begin{cases} 0, & \text{jika } V = 0 \\ 1 - \frac{\min(r,g,b)}{V}, & V > 0 \end{cases}$$

$$H = \begin{cases} 0, & jika\ S = 0 \\ \frac{60*(g-b)}{S*V}, & jika\ V = r \\ 60*\left[2 + \frac{b-r}{S*V}\right], & jika\ V = g \\ 60*\left[4 + \frac{r-g}{S*V}\right], & jika\ V = b \end{cases}$$

$$\mathbf{H = H + 360\ jika\ H < 0}$$

4. Fuzzy C Means Segmentation
This stage serves to segment Fuzzy C Means based on bambo imagery. In this study the case of grouping in cluster analysis, the correlation matrix used is the similarity matrix of the objects to be grouped. The principle is that the higher the value of similarity between objects with one another, the value of observations between objects has many similarities (meaning it is possible to become one group).

2. Result and Discussion

Based on laboratory testing of fiber, bamboo which has fiber content, fiber length, inter-fiber adhesive, namely lignin and the diameter of bamboo fiber, the higher the bamboo stems will be stronger. So that bamboo has a larger fiber, including a good type of bamboo. This research will segment the image with the fuzzy c means method. The data used in this study were 32 test data and there were 7 training data on each bamboo. Researchers used four types of bamboo that are often used in Indonesia, especially in the city of Semarang, including Java Bamboo, Ori Bamboo, Petung Bambu and Bambu Wulung.

Table 1. Training image and test image

No	Jenis Bambu	Jumlah Citra Pelatihan	Jumlah Citra Pengujian	Format
1	Jawa	32	7	.jpg
2	Ori	32	7	.jpg
3	Petung	32	7	.jpg
4	Wulung	32	7	.jpg

	Bambu Jawa
	Bambu Ori
	Bambu Petung
	Bambu Wulung

Figure 2. Bamboo Image

In this research, to find out the size of bamboo fiber, the writer uses the Fuzzy C Means segmentation method.

1. In fuzzy clustering, each point has a degree of belonging to clusters, as in fuzzy logic, rather than belonging completely to just one cluster
   uk (x): the degree of being in the kth cluster

$$u_k(x) = \frac{1}{\sum_j \left(\frac{d(center_k, x)}{d(center_j, x)} \right)^{2/(m-1)}}.$$

3

$$\text{center}_k = \frac{\sum_x u_k(x)^m x}{\sum_x u_k(x)^m}.$$

For m = 2, this is equivalent to normalising the coefficient linearly to make their sum When m is close to 1, algorithm is similar to k-means

X_l – sample feature vectors

V_i - vector of cluster centroid

M - number of sample feature vectors

N - dimension of the sample feature vectors

K - number of cluster centroids

2. Fuzzy membership

$$R_{lj}(t) = \frac{1/d_{lj}^2(t)}{\sum\limits_{m=1}^{K}(1/d_{lm}^2(t))}, \; 1 \le l \le M, \; 1 \le j \le K.$$

3. Cluster centroid initialization

first frame : random select

otherwise : prediction from previous frame

4. Cluster centroid update

$$V_{ji}(t+1) = V_{ji}(t) + \frac{\sum\limits_{l=1}^{M} R_{lj}(t) \cdot w_l \cdot (X_{li} - V_{ji}(t))}{\sum\limits_{l=1}^{M} R_{lj}(t) \cdot w_l}$$
$$1 \le i \le N, \; 1 \le j \le K$$

5. Dynamic Growing of Centroids
   - entering and leaving regions are manually defined
   - Creation
   - we find a subset of samples where the Euclidean distance between each of these samples and its associated cluster centroid j exceeds a threshold Φ_j
   - Erasure
     The position of cluster centroid j is within a leaving region
     The number of the samples corresponding to cluster centroid j is too small to represent the smallest object in the scene.

6. Modeling of Cluster Centroids
   There may be objects which correspond to two or more cluster centroids in one frame
   For two centroid trajectories exist over the same sequence of frames, if the differences between the centroids in each frame are approximately constant and small, two trajectories are merged
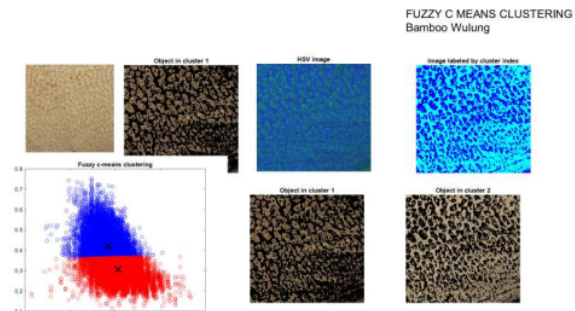   The results of the Fuzzy C Means segmentation for bamboo Wulung are as follows:

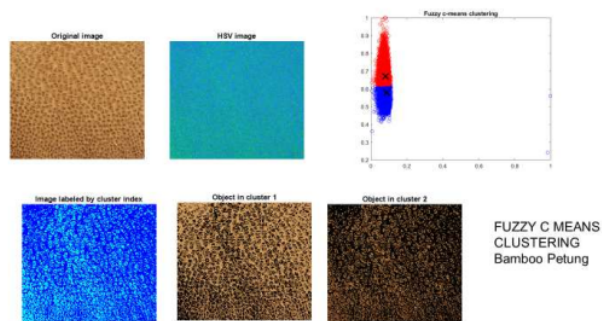**Figure 3.** The results of segmentation for bamboo Petung are as follows

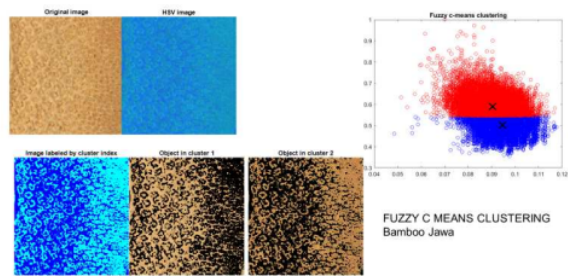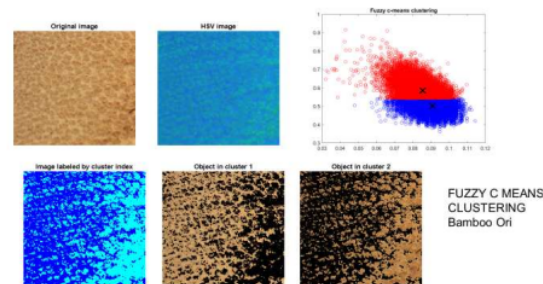**Figure 4.** The results of segmentation for bamboo Jawa are as follows

Figure 5. The results of segmentation for bamboo Ori are as follows

Fuzzy C Means method produces good segmentation, the results of image segmentation clearly visible difference between which fiber and which fiber adhesive. This Experimental results show that the FCM method is effective and robust. Fuzzy C Menas segmented around 20-23 iterations with a duration of about 0.11-0.15. As for more clearly in the following table 1:

Tabel 2 IterasiCount Fuzzy C Means pada citra bambu

No	Bamboo	Iteration Count	Time	Partition Matriks
1	Wulung	23	0,15	137.080677
2	Petung	23	0,17	124.043284
3	Ori	22	0,12	232.093546
4	Jawa	20	0,11	134.880044

3. Conclusion

Experimental results show that the FCM method is effective and more robust in image segmentation. Future work will focus on adaptively deciding the penalized parameters of this algorithm as well as compensating for the intensity of homogeneity while segmenting the image data.

Acknowledgment

Reference

[1]. Reem Alzu'bi, Medical Image Segmentationvia Optimized K-Means, International Conference on Current Trends in Computer, Electrical, Electronics and Communication (ICCTCEEC-2017), 978-1-5386-3243-7/17/$31.00 ©2017 IEEE]

[2]. Eko Prasetyo, Pengolahan Citra Digital dan Aplikasinya Menggunakan Matlab, 2011, Yogyakarta : Andi Offset

[3]. Darma Putra, Pengolahan Citra Digital, 2010, Yogyakarta : Andi Offset.

[4]. Amiya Halder, Soumajit Pramanik. Dynamic Image Segmentation using Fuzzy C-Means based Genetic Algorithm. International Journal of Computer Application. 2011; 2(6)]

[5]. Klawonn dand Höppner, (2001), "What is Fuzzy about Fuzzy Clustering? Understanding and Improving the Concept of the Fuzzier". Science Journal, http://public.rz.fh-wolfenbuettel.de/klawonn.]

[6]. I Made Budi Adnyana, Implementasi Algoritma Fuzzy C Means dan Stastitical Region Merging Pada Segmentasi Citra, EKSPLORA INFORMATIKA, Vol. 6, No. 2, Maret 2017 hal 179-189].

[7]. Nur Indah Selviana1, Mustakim2, Analisis Perbandingan K-Means dan Fuzzy C-Means untuk Pemetaan Motivasi Balajar Mahasiswa, Seminar Nasional Teknologi Informasi, Komunikasi dan Industri (SNTIKI) 8, ISSN : 2085-9902, Pekanbaru, 9 November 2016. Hal 95-105

[8]. Hind Rustum Mohammed, Improved Fuzzy C-Mean Algorithm for Image Segmentation, (IJARAI) International Journal of Advanced Research in Artificial Intelligence, Vol. 5, No.6, 2016, pp 7-10, www.ijarai.thesai.org]

[9]. Yong Yang, IMAGE SEGMENTATION BY FUZZY C-MEANS CLUSTERING ALGORITHM WITH A NOVEL PENALTY TERM, Computing and Informatics, Vol. 26, 2007, 17–31.

[10]. S. M. Yammary AA, Farag,andS.Hsu,"Afuzzyhyperspectralclassifier for automatic target recognition (ATR) systems," Pattern Recogn. Lett., vol. 20, pp. 1431–1438, 1999.]

[11]. Acharya, T.; Ray, A.K. 2005; *Image Processing Principles and Applications*; New Jersey: John Wiley & Sons, Inc.

2. Color Based Segmentation Using Fuzzy C Means For Bamboo As EnvironmentallyFriendly Material