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COTTON TEXTURE SEGMENTATION BASED ON IMAGE TEXTURE ANALYSIS USING GRAY LEVEL RUN LENGTH AND EUCLIDEAN DISTANCE

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ABSTRACT

Combed cotton and viscose cotton (CVC) is 2 types of cotton commonly used as the main ingredient in manufacture of clothes. Clothes made from cotton combed known as good materials for clothes. CVC cotton, made by combining cotton combed and cotton viscose so that in the manufacture CVC cotton quality is assumed under the combed cotton. Manually distinguish combed cotton and CVC cotton is by wearing clothes made of combed cotton and CVC cotton. Basically the texture in combed cotton and CVC fabrics can be analyzed by image texture segmentation process based on image texture analysis to get patterns showing the type of cotton. In this research explains the texture of cotton that through the process of image texture segmentation can release the value of features that can be used for the classification process, so that can determine the type of cotton. In this image texture segmentation includes grayscaling process, image normalization and texture feature extraction. Feature Extraction uses the Gray Level Run Length (GLRLM) method to get a feature value on the texture used for the classification process. Classification using method euclidean distance with 4 testing images and 2 training images by changing the original image to 5x5 and 10x10 pixels generate 100% accuracy. These results indicate that accuracy using the euclidean distance method results in high accuracy.

Keywords: *Image Texture Segmentation, Texture Analysis, Gray Level Run Length (GLRLM), Euclidean Distance, Cotton.*

1. INTRODUCTION

Cotton is a very important material used in the garment industry, especially in the manufacture of clothes. The use of cotton in making clothes because cotton is easy to find and the price is quite affordable. In addition, the cotton used in the shirt is very well-worn for consumers who wear it. To differentiate cotton very easily, when a cotton burns like a paper or wood burned, it will become ash and the path of the fire slows down. Type of cotton itself there is various kinds, cotton Japanese, cotton combed, cotton viscose (CVC), cotton Lacoste and cotton pique. The cotton in this research are cotton combed 30s and cotton viscose.

In the garment industry, combed cotton have several types, including combed cotton 20s, 24s, 30s and 40s. Combed cotton 40s is the best quality cotton, while the standard cotton for garment industry is combed cotton 30s. Because the combed cotton 30s is very suitable for use as the basic material for making t-shirts. Viscose cotton (CVC) is included in the type of carded cotton which is very different from the combed cotton. The fundamental difference between combed cotton and carded cotton is that the finishing process is uncombed so that the remaining cotton fibers remain. CVC cotton itself is not a pure result of carded cotton because in the manufacture of CVC cotton combine combed cotton with CVC cotton with 55% percentage of cotton and 45% cotton CVC. Although the quality of CVC cotton under cotton but combed cotton has a cheaper price than cottoned cotton. In cotton and CVC cotton, there is a texture that can be used to segment the image texture based on image texture analysis using Gray Level Run Length method and Euclidean distance classification.

The Gray Level Run Length (GLRLM) method is used because the method has a function to produce the feature value. Using the feature values contained in the GLRLM method, can it be used for Euclidean distance classification of the cotton image texture? Classified using the Euclidean

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distance method to generate accuracy and matching values between the testing image and training image.

2. RESEARCH METHOD

2.1 Texture Analysis Of Image

In general, texture analysis refers to repetition on the texture of the image or commonly called the texture element. The terms of the formation of image texture:[2]

1. The existence of primitive patterns of one or more pixels. These primitive patterns can be a point, a straight line, a curve, an area and others that are the basic elements of a form.
2. Primitive patterns appear repeatedly with a certain distance and direction so that it can be predicted or found characteristic repetition.

2.2 Texture

The Texture is characterized by the spatial distribution of the gray degree within a set of adjacent pixels. Texture can be classified into 2 groups, namely:

2.2.1 Macrostructure

The macrostructure texture has periodic pattern repetition on an image area, usually present in man-made patterns and tends to be easy to be presented mathematically.

2.2.2 Microstructure

Microstructural textures have local patterns and unclear repetition, so it is not easy to give a comprehensive definition of texture.

2.3 Image Texture Segmentation

Image recording of real objects in nature does not necessarily represent image regions with uniform or homogeneous intensity or color. For example, the cotton surface image is not uniform, but it contains variations in the intensity of the colors that form repetitive patterns. Things like that can be categorized as textures. Therefore, texture analysis and image segmentation based on texture always refer to two things: (1) surface hardness level analysis and (2) pattern structure analysis and orientation. These two things have become the basis for the development of the theory of image texture analysis. Statistical analysis approach has been developed to know surface texture roughness while knowing texture form or pattern can be done through a structured approach. In the process of image texture segmentation includes three activities, namely: Pre-processing grayscaling, normalization and search for feature values from the Gray Level Run Length (GLRLM) method. Then classify using Euclidean distance.

2.4 Grayscaling

The original image is converted to the grayscale image for normalization process after this becomes easy. Because the grayscale image only displays black and white images.[6]

2.5 Normalization

The image that has been in grayscaling will get the matrix value according to the gray level. However, the matrix value that appears displays the value from 0 - 255, with the normalization process will get a new matrix value making it easier to find the value of each feature. The normalization formula as follows. [12]

$$IN = (I\text{-}Min)\frac{newMax\text{-}newMin}{Max\text{-}Min} + newMin$$

IN = Image Normalization Formula
I = Pixels to be normalized
newMax = The largest new value that has been determined
newMin = The smallest new value that has been detrmined
Max = Previous largest value level
Min = Previous smallest value level

2.6 Gray Level Run Length Matrix (Glrlm)

Gray Level Method Run Length or commonly abbreviated GLRM is feature extraction which is included in a statistical method of texture analysis used to generate feature value from every angle. The angle orientation used there are four names, 0 °, 45 °, 90 ° and 135 °. The GLRLM method is performed by creating a series of value pairs (i, j) on the pixel row. We need to know the purpose of the run length itself is the number of consecutive pixels in a certain direction that has the same degree of gray / intensity value. If a matrix of run length is a matrix with the matrix element $q(i, j \mid \theta)$ where i is the gray degree of each pixel, j is the run length value, and θ is the orientation of a certain shift direction expressed in degrees. There are several variables used to obtain feature values from the GLRM method [11]:

i = Gray level
j = Successive pixels (run)
M = Number of gray degrees in an image
N = The number of consecutive pixels in an image
r (j) = The number of consecutive pixels based on the many sequences (run length)

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g (i) = The number of consecutive pixels based on their gray degree values

s = Total number of run values generated in a particular direction

n = Number of rows * number of columns

From the above variables are used to find the feature value as follows.

2.6.1 SRE (*Short Run Emphasis*)

SRE measures the distribution of short runs. SRE is highly dependent on the number of short runs and is expected to be of little value to the fine texture and of great value to the rough texture.

$$SRE = \sum_{i=1}^{M}\sum_{j=1}^{N}\frac{p(i,j)/s}{j2} = \sum_{j=1}^{n}\frac{r(j)/s}{j2} \quad (1)$$

2.6.2 LRE (*Long Run Emphasis*)

Long runs emphasis (LRE) LRE measures the distribution of long runs. LRE is highly dependent on the number of long runs and is expected to be of a substantial value of fine textures and small values on coarse textures.

$$LRE = \sum_{i=1}^{M}\sum_{j=1}^{N} j2p(i,j)/s = \sum_{j=1}^{N} r(j)j2/s \quad (2)$$

2.6.3 RLU (*Run Length non-Uniformity*)

Gray level non-uniformity (GLN) GLN measures the equation of gray-level values throughout the image and is expected to be of little value if the grade of gray is similar to the image.

$$RLU = \sum_{j=1}^{N}\left(\sum_{I=1}^{M} p(i,j)\right)2/s = \sum_{J=1}^{N} r(j)2/s \quad (3)$$

2.6.4 GLU (*Gray Level non-Uniformity)*

Run length non-uniformity (RLN) RLN measures the equation of run length throughout the image and is expected to be of little value if the length of the run is similar to the image.

$$GLU = \sum_{i=1}^{M}\left(\sum_{J=1}^{N} p(i,j)\right)2/s = \sum_{i=1}^{M} g(i)2/s \quad (4)$$

2.6.5 RPC (*Run Percentage*)

Run percentage (RP) RP measures the compatibility and distribution of runs of an image in a particular direction. RP is the greatest value if the run length is 1 for all degrees of gray in a particular direction.

$$RPC = \sum_{i=1}^{M}\sum_{J=1}^{N} p(i,j)/n = \sum_{J=1}^{N} r(j)/n \quad (5)$$

2.7 Classification Of Euclidean Distance

The classification process using Euclidean distance is to obtain accuracy and matching values between the testing image and training image. The formula in the Euclidean distance as follows.[5]

$$D = \sqrt{\sum_{i=0}^{N}(x_1 - x_2)}$$

D = Distance Value

x = Testing image Pattern

x = Training Image Pattern

Euclidean distance has a resemblance to the naïve Bayes method but this method underwent some sophistication. The simplification is due to the fact that all existing classes have equal equiprobable probabilities and also the same covariance matrix and are diagonal matrices.

3. RESULT AND ANALYSIS

3.1.1 System Procedure Analysis

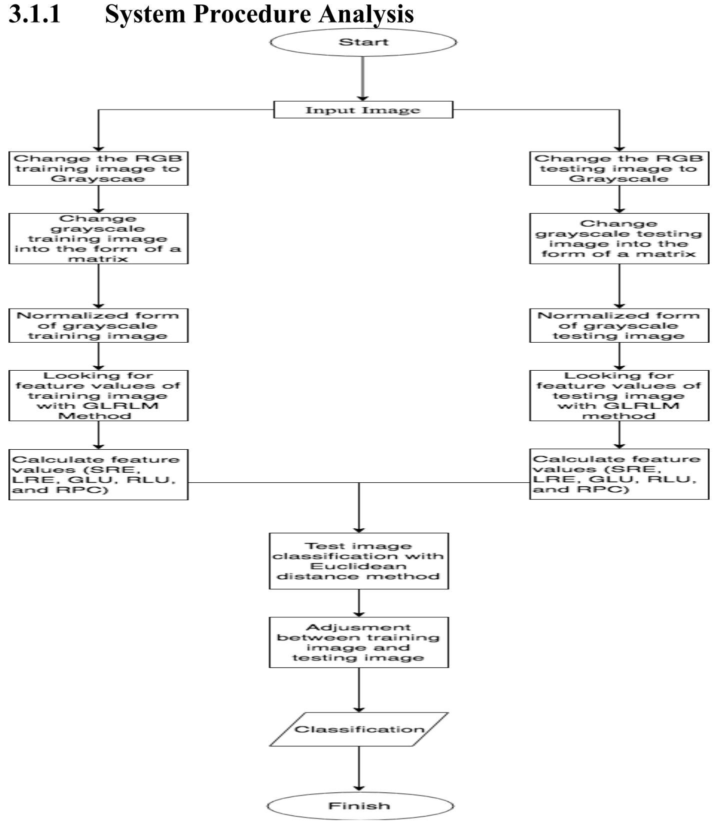

Figure 1: Flowchart

The procedure is a series of interconnected tasks that are sequences according to time and certain procedures to perform a repetitive work.

Figure 1 is the sequences in segmenting the texture of images based on texture statistical analysis.

3.1.1 Input Image

Is the stage to take the image of the input media. The image is a cotton fabric that measures 200x200 pixels and is formatted .png

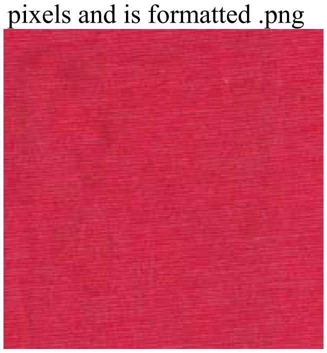

Figure 2 : image RGB 200x200

3.1.2 Change RGB Image to Grayscale

The inserted image is converted to grayscale image while reducing the pixel format to 5x5 to make it easier for the next step and getting the matrix value from the grayscale image

3.1.3 Normalization of Image Form

The matrix value of the grayscale image is normalized to obtain a new matrix value to be used to find the feature value.

3.1.4 Finding Feature Value With GLRLM From Normalization Matrix Value

Normalized matrix values are used to find the feature values of the GLRM method according to the predetermined shift direction of 0 °, 45 °, 90 °, 135 °.

3.1.5 Calculate Feature Value (SRE, LRE, GLU, RLU, and RPC)

Calculates the feature value according to the predetermined shift direction so as to obtain feature values for use in the classification process

3.1.6 Image Classification With Euclidean Distance Method

The value of features that have been obtained then processed to get the results of classification and then the results of classification used for the next stage

3.1.7 Match Between Testing image and Training Image

At this stage, the testing image and training image are matched to determine that the value of the training image has a similarity from the testing image or not

3.1.8 Classification Data

After matching the testing image and training image obtained classification data to be used calculate the value of accuracy. Accuracy value used to know the result of classification with Euclidian distance method has good accuracy value or not.

3.2 Method Analysis

Method Analysis is an analysis of a system contained in the steps of the existing circuit in the flow of the producer system. This analysis aims to analyze the methods applied in this study. The following steps are performed in image texture segmentation based on texture analysis using Gray Level Run Length and Euclidean distance classification.

3.2.1 Analysis of Grayscaling Stages

Grayscaling stage analysis of a stage to convert RGB image into Grayscale image and get the matrix value of the image.

After the image is inserted then the image of RGB that was previously worth 200x200 pixels changed to 5x5 pixels and grayscaling process. So it removes the image matrix value in the following figure

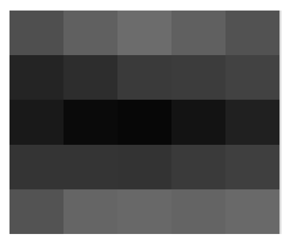

Figure 3: Image Grayscale

Image RGB in figure 3 has been resized to 5x5 pixels and became image grayscale.

79	96	108	96	82
35	45	58	60	66
25	10	7	19	32
52	52	51	58	63
83	101	104	100	105

Figure 4: Matrix Image Grayscale

In figure 4, matrix values from image grayscale have been obtained.

3.2.2 Analysis of Normalization Stages

The value of the matrix in the grayscaling process is normalized to obtain a new matrix value to make it easier to find the value of existing

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features in the GRLM method. Here is the result of normalization of matrix value in grayscale image

3	4	4	4	3
1	2	2	2	2
1	0	0	0	1
2	2	2	2	2
3	4	4	4	4

Figure 5: Matrix Normalization

In Figure 5, known matrix value has been normalization

3.2.3 Analysis of GLRLM Method Stages

The main step in the GLRLM method is to take the normalized grayscale matrix value. The value of the matrix is used to find the feature value on GLRLM ie, SRE, LRE, GLU, RLU, and RPC. At this stage before calculating the feature value is by determining the angle of the shift for each feature value. The predetermined angle is 0 °, 45 °, 90 ° and 135 °. The following will explain how to pair the run values contained in the 5x5, 4-degree gray matrix value with the direction of the specified angular shift.

In the figure 5 above can be seen that there are 25 values of intensity/degree of gray contained in the image and the pair (i, j) produced is

Table 1: Matrix Run Length 0°

Gray Level (i)	Run Length (j)					0° g(i)
	1	2	3	4	5	
0	0	0	1	0	0	1
1	3	0	0	0	0	3
2	0	0	0	1	5	6
3	3	0	0	0	0	3
4	0	0	1	1	0	2
r(j)	6	0	2	2	5	S=15

It can be seen that the matrix 5 x 5 with the angular direction 0^0 has 15 pairs of resulting run values.

Table 2: Matrix Run Length 45°

Gray Level (i)	Run Length (j)					45° g(i)
	1	2	3	4	5	
0	3	0	0	0	0	3
1	3	0	0	0	0	3
2	9	0	0	0	0	9
3	3	0	0	0	0	3
4	7	0	0	0	0	7
r(j)	24	0	0	0	0	S=24

It can be seen that the matrix 5 x 5 with the angular direction 45^0 has 24 pairs of resulting run values.

Table 3: Matrix Run Length 90°

Gray Level (i)	Run Length (j)					90° g(i)
	1	2	3	4	5	
0	3	0	0	0	0	3
1	1	1	0	0	0	2
2	9	0	0	0	0	9
3	3	0	0	0	0	3
4	7	0	0	0	0	7
r(j)	20	1	0	0	0	S=21

It can be seen that the matrix 5 x 5 with the angular direction 90^0 has 21 pairs of resulting run values.

Table 4: Matrix Run Length 135°

Gray Level (i)	Run Length (j)					135° g(i)
	1	2	3	4	5	
0	3	0	0	0	0	3
1	3	0	0	0	0	3
2	9	0	0	0	0	9
3	3	0	0	0	0	3
4	7	0	0	0	0	7
r(j)	34	0	0	0	0	34

It can be seen that the matrix 5 x 5 with the angular direction 135^0 has 34 pairs of resulting run values.

Calculate Matriks Run Length 0°

$$SRE = \left(\frac{\frac{6}{15}}{1^2}\right) + 0 + \left(\frac{\frac{2}{15}}{2^2}\right) + \left(\frac{\frac{2}{15}}{3^2}\right) + \left(\frac{\frac{5}{15}}{4^2}\right)$$

$$= 0.428 \qquad (1)$$

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Get the feature value SRE with 0^0 angular direction

$$LRE = \left(\frac{6*1^2}{15}\right) + 0 + \left(\frac{2*2^2}{15}\right) + \left(\frac{2*3^2}{15}\right) + \left(\frac{5*4^2}{15}\right) = 7.066 \quad (2)$$

Get the feature value LRE with 0^0 angular direction

$$GLU = \left(\frac{1^2}{15}\right) + \left(\frac{3^2}{15}\right) + \left(\frac{6^2}{15}\right) + \left(\frac{3^2}{15}\right) + \left(\frac{2^2}{15}\right) = 2.733 \quad (3)$$

Get the feature value GLU with 0^0 angular direction

$$RLU = \left(\frac{6^2}{15}\right) + \left(\frac{0^2}{15}\right) + \left(\frac{2^2}{15}\right) + \left(\frac{2^2}{15}\right) + \left(\frac{5^2}{15}\right) = 3.2 \quad (4)$$

Get the feature value RLU with 0^0 angular direction

$$RPC = \left(\frac{6}{25}\right) + \left(\frac{0}{25}\right) + \left(\frac{2}{25}\right) + \left(\frac{2}{25}\right) + \left(\frac{5}{25}\right) = 0.48 \quad (5)$$

Get the feature value RPC with 0^0 angular direction

Using the same steps for a 45 °, 90 ° and 135 ° angle shift direction, then the value will be obtained as follows.

Table 5: Value Features of Image Input

	SRE	LRE	GLU	RLU	RPC
0°	0.428	7.066	2.733	3.2	0.48
45°	1	1	6.541	24	0.96
90°	0.964	1.142	7.190	19.095	0.84
135°	1	1	6.541	24	0.96

In table 5, known all off feature values from any angular direction.

3.3 Training Analysis

At this stage, the feature values obtained in the GLRLM method will be used as a reference to classify the feature values contained in the image. The training image will be stored and made into a dataset for the Euclidean distance method classification process as well as matching between the testing image and training image. The value of the features used for the training image is a 5x5 pixel cotton combed and 5x5 pixel CVC cotton. Here is the dataset of the feature value of each image

Table 6: Value Feature of Cotton Combed 5x5

	SRE	LRE	GLU	RLU	RPC
0°	0.428	7.066	2.733	3.2	0.48
45°	1	1	6.541	24	0.96
90°	0.964	1.142	7.190	19.095	0.84
135°	1	1	6.541	24	0.96

In table 6, all feature values cotton combed 5x5 obtained for training image

Table : Value Feature of Cotton CVC 5x5

	SRE	LRE	GLU	RLU	RPC
0°	25.782	2.272	3.818	6.272	2.76
45°	26.016	1.266	7.6	15	9
90°	25.959	1.363	5	20.090	17.68
135°	25.954	0.954	5.363	20.0454	17.64

In table 7, all feature values cotton CVC 5x5 obtained for training image also.

With that results, there is two training image for classification.

3.4 Classification

The classification stage is done after the training image has the feature value and the feature value will be used to classify. This classification will perform the introduction of cotton textured image patterns of the 30s combed cotton and viscose cotton as a reference to determine the pattern at the testing stage. Here's an illustration of the classification step using the Euclidean distance method.

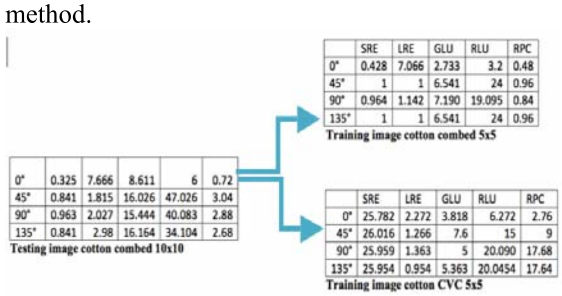

Figure 6: Illustration of Classification Euclidean Distance

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In figure 6, the determination between testing image and training image. Here are formulas to find Euclidean Distance

$$D = \sqrt{\sum_{i=0}^{N}(x_1 - x_2)} = 130.452$$

$$D = \sqrt{\sum_{i=0}^{N}(x_1 - x_{2.1})} = 25.759 \qquad (2)$$

x_1 = Testing image

x_2 = Training image cotton combed

$x_{2.1}$ = Training image cotton CVC

The classification results of the minimum Euclidean distance is cotton CVC, therefore the test images is expressed as cotton fabric with a distance of 25.5759

3.5 Testing Analysis

In this stage will be tested by using a new texture image and matched with the existing training image on the dataset. After that, the image of the test results gets the classification data showing that the matching succeeded and issued a value of accuracy. Here are the results of a matching experiment between training image and testing image.

Table 8: Results of a matching experiment using Euclidean Distance

	Cotton	CVC
Cotton 5x5	0	129.211
Cotton 10x10	103.452	25.759
CVC 5x5	129.211	0
CVC 10x10	46.699	82.512

In the table above it is known that the test results using Euclidean distance method resulted in the distance of CVC 5x5 image and 5x5 Cotton is 0. Because the image is actually a training image but also be used as the test images, thereby producing an exact resemblance.

The recognition similarity is obtained by calculating the Euclidean distance on each test image, the smaller the distance value the more likely it will be. So that the image textures are sorted by type and the minimum distance value. The following table sorting the least distance value according to type.

Table 8: Sorting of minimum value Euclidean Distance

Types of Input Image	Cotton	Type of Input Image	CVC
Cotton 5x5	0	CVC 5x5	0
CVC 10x10	46.699	Cotton 10x10	25.759
Cotton 10x10	103.452	CVC 10x10	82.512
CVC 5x5	129.211	Cotton 5x5	129.211

Then classified to know the recognizable pattern of the test image in accordance with the known minimum distance value. The results of classification and accuracy value using the Euclidean distance method as follows.

Table 9: Classification and Accuracy

	Recognized Cotton	Recognized CVC
Cotton 5x5	1	0
CVC 5x5	0	1
Accuracy	100%	
Cotton 10x10	0	1
CVC 10x10	1	0
Accuracy	100%	

4. CONTRIBUTION

In the previous research on reference [11], the classification of liver cell nuclei by using the matrix class distance method then obtained the value used in the gray level run length adaptation. Adaptive values of gray level run length are used to classify textures and only two feature values in the classification process.

In our research, the difference is that we use the 5 feature values of GLRLM to perform the classification process based on the Euclidean distance method.

The accuracy value obtained from the classification process is 100% while in research that has been done before, still get the value of error rate. Accuracy is obtained by classifying the testing image and training image using Euclidean distance that can produce accuracy up to 100%.

Our Research	Research ini reference [11]
Used image normalization for find values feature	Didn't use image normalization for find values feature
Used five values features of method Grey Level Run Length	Only use two values feature of method Grey Level Run Length
Got 100% accuracy from classification using Euclidean Distance	Didn't get 100% accuracy
Classification uses Euclidean distance with the result of the training image as the dataset with the image to be tested.	Classification uses only the distance between the matrices of each feature value.

5. DISCUSSION

The results of this research are in accordance with the objectives to be done, namely to the texture image segmentation based on texture statistical analysis using the Gray Level Run Length Matrix (GLRLM) to obtain the feature values of the segmented image and to classify the Euclidean distance. The disadvantage of this study is to use only 2 types of cotton and CVC cotton as a training image and 4 testing images as a classification test. This study has limitations that can only use image features the texture. For the future, the methods used in this study can be developed in order to obtain better results, the feature values present in the GLRLM method can be added to 7 feature values or reduced by only 3 feature values only.

6. CONCLUSION

Based on the results of tests that have been done then got the conclusion that texture image segmentation method based on texture analysis using Gray Level Run Length can make pattern recognition which there is a value of feature used to do classification by Euclidean distance method. From the results of all tests, the Euclidean distance method generates a level of accuracy 100% with 2 testing images and 4 training images. GLRLM feature value in this research can be determined and used as the image of training and testing image, so that the purpose of the research in accordance with what has been done.

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