IMPLEMENTATITION OF RUN LENGTH METHOD AND ARTIFICIAL NEURAL NETWORK HOPFIELD CLASSIFICATION FOR SKIN DISEASE BASED ON SKIN TEXTURE

Tegar Sembada[1]
[1] Teknik Informatika – Univesitas Komputer Indonesia
Jl. Dipatiukur 112 - 114 Bandung
E-mail : tegar_gila@yahoo.co.id[1]

ABSTRACT

The recognition of texture is one technique that can be done in the process of image processing. In addition to recognize of texture in the image processing classification process is also needed in order to obtain a more optimal result. The recognition of texture can be used to perform the recognition of skin diseases, because it is basically a skin disease can be recognized from some aspects of which are based on the pattern and texture

Methods for obtaining the characteristics of the image texture is to calculate the matrix run length of the image data, the characteristics of which are used for image classification in this study using the Short Run Emphasis (SRE), Long Run Emphasis (RLE), Grey Level Uniformity (GLU) , Run Length Uniformity (GLU) and Run Percenttage (RPC). Results of these characteristics are then used for classification by using Hopfield neural network that determines the classification based on the results of texture.

Key words : *Hopfield, Artificial neural network, classification, Run Length, Texture.*

1. Introduction

Introduction texture is one technique that can be used in image recognition. In addition to the introduction of texture in the image recognition process is also needed so that the introduction of the classification process which has produced good results. Based on previous research recognition process can be performed to detect diseases of the skin. Basically, the skin disease can be identified based on a number of aspects such as pattern and texture.

The method can be used for the introduction of the texture of one of them is a method of run length. This method distinguishes the texture of coarse and fine texture, since this method to obtain the characteristics of an image using a distribution of pixels with the same intensity in sequence in one particular direction as primitive.

In the method of artificial neural network has many types one of which is the Hopfield neural network. This method is one of the optimization methods to search the minimum value of a combination of objective, and any related neurons in full which allows to obtain a more optimal result than other methods.

1.1 Image processing

To perform the introduction of an object owned by the texture of the object is then a technique was needed for doing so, such techniques are image processing techniques. An image processing and image analysis processing that involve a lot of visual perception. This process has the characteristic of data input and output information in the form of images. The term digital image processing is generally defined as a two-dimensional image processing with a computer. In a broader definition, digital image processing also includes all two-dimensional data.

1.2 Image element

In the image processing object used is an image of a specific object image which contains a number of basic elements. The basic elements in the manipulation of the image processing, these elements are color, brightness, contrast, contour, shape, texture, time and movement and detection and recognition.

1.3 Texture

In image processing there are various techniques that the introduction of an image of one of them is the introduction of image based on texture analysis. Texture analysis plays an important role in digital image processing for texture analysis was developed with the aim that the computer can understand, model making, as well as the process to be able to mimic the texture of the learning process of the human eye or vision.

1.4 Run Length method

Methods of using the run-length distribution of a pixel with the same intensity in sequence in one particular direction as primitive. Each - each primitive is defined over the length, direction, and gray levels. The length of the primitive texture in different directions can be used to describe a texture.

To perform feature extraction by using run-length, gray level image with a matrix of f (x, y) must be

transformed first into a matrix Grey Level Run-Length (GLRL), B(a,r).

$$F(x,y) \xrightarrow{GLRL} B(a,r)$$

GLRL matrix elements of B (a, r) calculate the number of primitives (run) with a length r and a gray level. Number of primitives (run) can be obtained by the following equation:

$$K = \sum_{a=1}^{L} \sum_{r=1}^{Nr} B(a,r)$$

with: L : sum of grey level
Nr : pixels length
K: sum of run
M,N : image dimension
a :grey level
r :length of run

The characteristics of the texture can be obtained from the equation - the following equation [2] :

1. *Short Run Emphasis (SRE)*

SRE measuring the distribution of short-run. SRE is highly dependent on the number of short-run and is expected to be greater in a smooth texture.

$$SRE = \frac{1}{K} \sum_{a=1}^{L} \sum_{r=1}^{Nr} \frac{B(a,r)}{r^2}$$

2. *Long Run Emphasis (LRE)*

LRE distribution measure long run. LRE is highly dependent on the number of da expected long run of great value on a rough texture.

$$LRE = \frac{1}{K} \sum_{a=1}^{L} \sum_{r=1}^{Nr} r^2 B(a,r)$$

3. *Grey Level Uniformity (GLU)*

GLU measure the degree of gray value equation entire image and is expected to be small if the value of a similar degree of gray around the image.

$$GLU = \frac{1}{K} \sum_{a=1}^{L} \left(\sum_{r=1}^{Nr} B(a,r) \right)^2$$

4. *Run Length Uniformity (RLU)*

RLU equation measure the length of the run throughout the image and is expected to be small if a similar run length across the image.

$$RLU = \frac{1}{K} \sum_{r=1}^{Nr} \left(\sum_{a=1}^{L} B(a,r) \right)^2$$

5. *Run Percentage (RPC)*

RPC measure the distribution run of an image in a particular direction. RPC-value is greatest when the run length is 1 for all degrees of gray in a particular direction.

$$RPC = \frac{K}{\sum_{a=1}^{L} \sum_{r=1}^{Nr} rB(a,r)} = \frac{K}{MN}$$

1.5 Artificial neural network

The artificial neural network is one of the artificial representation of the human brain is always trying to simulate the learning process of the human brain. Artificial term is implemented using a computer program that is able to resolve a number of the calculation process during the learning process (Kris A, 2004).

The human brain contains millions of nerve cells that are processing information. Each nerve cell (neuron) will have a single cell, the cell's nucleus that will be tasked to perform information processing.

1.6 network Arcitectur

1. Network with a single layer (single layer net)
a. One layer with a weight connected
b. receive direct input process into output without having to pass through the hidden layer.

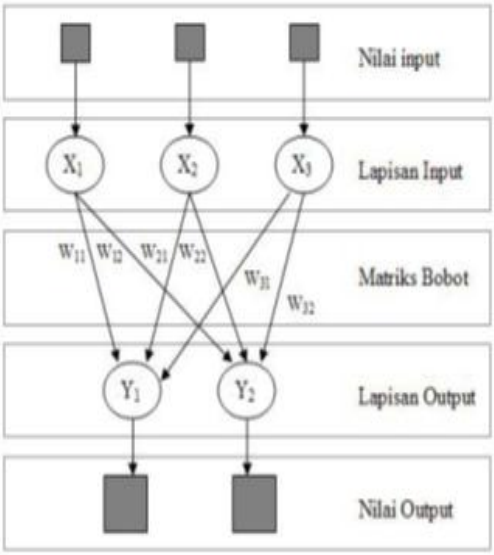


Image 1. Model Single Layer

2. Network with many layers (multi-layer net)
a. Having one or more layers located between the input layer and output layer.
b. There are weighty layer located between two adjacent layers.

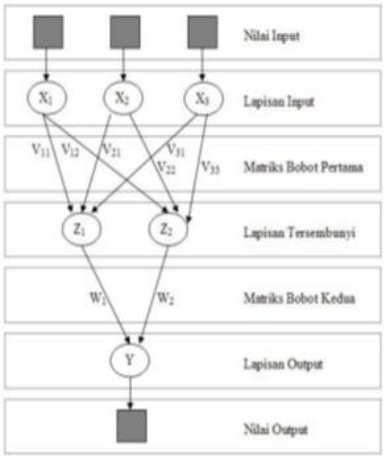


Image 2. Model Multi Layer

3. Competitive layer net

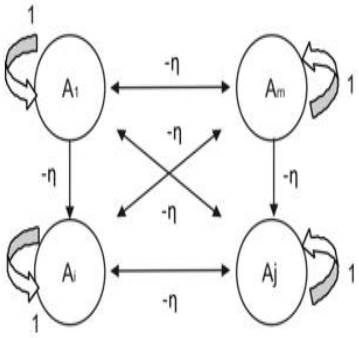


Image 3. Model Competitive Layer

1.7 learning process

The learning method consists of several methods (Muis S 2006):

1. Method of supervised Training

Methods of learning in neural networks called unsupervised if the expected output has been known before. These methods include the nature of data output targets for the training process. Some methods guided them: Single Network Perceptron, Hebb Rule, Rule Delat, Backpropagation, Hetroassociative Memory, Bidirectional Associative Memory and Learning Vector Quantization.

2. unsupervised Training Methods

Unguided training method is the training without the need for targets on output. The training process is based on a process of transformation of forms of continuous variables into discrete variables, known as vector quantization. Network used for training unguided process is a feedback network (feedback network). Unguided Several methods are: Method Kohonen / Self-Organizing Map (SOM) and Hopfield method.

1.8 Metode Hopfield

In 1982, John Hopfield of the California Institute of Technology to design an artificial neural network that became known as the Hopfield network. In the Hopfield network, all interconnected neurons full. Neurons that secrete the output and then be input to all other neurons. The process of sending and receiving signals between neurons in a closed and continuous feedback to achieve stable condition (Kris A, 2004).

In the model diskritnya, weight sinaptiknya Hopfield network using n-dimensional binary vectors. This model contains n neurons and its network consists of n (n-1) interconnect two lanes. The easiest way of understanding Hopfield neural network based on the above concepts can be presented in the general picture is as follows:

If there is a neural network composed of neuron NxN where N is the number of variables of the object to be optimized. Each neuron fully connected to each other. Illustration of the statement is as follows:

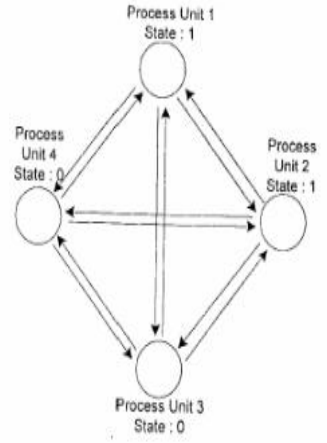
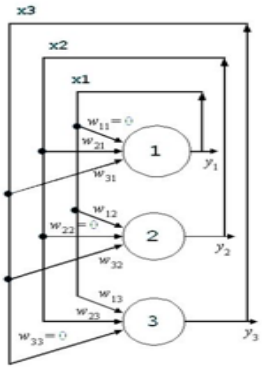


Image 4. Layout ANN Hopfield

Hopfield neural network is one of the optimization methods to search the minimum value of the combination of the objective function. In Figure 5 all full of interconnected neurons. Neurons that secrete the output and then become input for other neurons ouptut of each node diumpanbalikan to input from other nodes through the connection weights.



Gambar 5. Topologi ANN Hopfield

there are several versions of Hopfield network algorithms. For a description of the algorithm Hopfield using the input vector in the form of binary numbers. To save a set of binary patterns used notation s (p), p = 1, ..., P,

Where:
Wij = Σ_p [2si (p) -1] [2sj (p) -1]
for i | = j and Wij = 0
while the version of the description of other Hopfiled algorithms using the numeric input vector bipolar. To save a set of bipolar pattern used notation s (p), p = 1, ..., p, where:
Wij = Σ_p [si (p) sj (p)]
for i | = j and Wij = 0
to calculate the shortest distance with the formula is as follows:
√ ((a-c) ^ 2 + 〖(b-d)〗 ^ 2)

2. reseacrh

1.1 Analytic problem

Hopfield neural network is one of the Machine Learning algorithms can classify an object image based on the training given. The classification process will be carried out after the extraction of the image in advance to obtain the main characteristics of the image. The method is used as an extraction process is Run Length method. Methods of using the run-length distribution of a pixel with the same intensity in sequence in one particular direction as primitive. Each - each primitive is defined over the length, direction, and gray levels. With 5 characteristic texture or parameters derived from the method Run Length namely Short Run Emphasis (SRE), Long Run Emphasis (LRE), Grey Level Uniformity (GLU), Run Length Uniformity (RLU) and Run Percentage (RPC) has been able to recognize textures image feature extraction results will then be used as an input value to determine the results of image classification based on the texture.
Image texture of skin diseases can be classified based on the information contained in the image of the skin disease. Because by using the image of the skin disease can be used as reference material for further handlers to deal with the skin disease. By recognizing the texture of an object's image is one of the ways that can be used for recognizing, identifying and classifying the image.

1.2 Analysis Proses

In the analysis of this process would explain the sub-processes that the analysis system to be built. Can be seen in Figure 8.

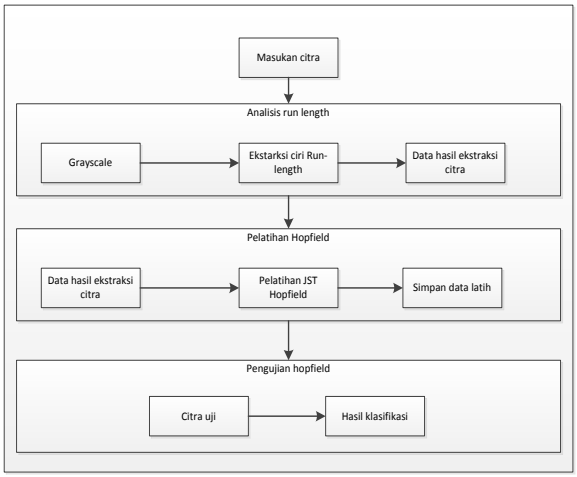


Image 6. flow analysis proses

In the analysis of this process would explain the sub-processes that the analysis system to be built. Can be seen in the picture 8.Dalam application run length method to perform image processing is divided into three steps: analysis of run length, training and testing Hopfield Hopfield. The third step is the proficiency level key steps performed in the process of implementation of the method and ANN Hopfield run length for the introduction of an image. In the analysis step run length, will feature extraction of an image then the feature will be used as input value in the next step is the training and testing Hopfield. Based on the figure 3.1 explained that the system to be built is the image processing system in which there are the following sub-chapters:

1.2.1 ***Analysis Run Length***

Analysis run length is feature extraction process whereby an image in which there are several processes such as converting the image into a gray level image that will then be made into a matrix of gray to be converted to run length matrix.

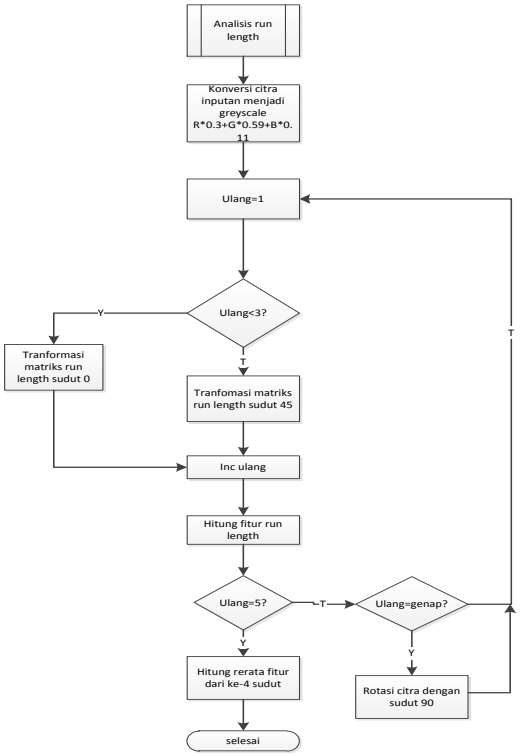


Image 7. flow Proses analysis run length

1.2.1 *Training Hopfield*

The purpose of this process is to train the image data which will then be used as a dataset. The dataset is the data that will be used in the testing process as comparative data with test data, this is necessary because of a growing number of datasets available the better the results that will be generated classification

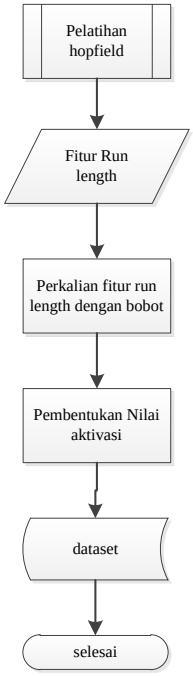


Image 8. Flow proses training Hopfield

1.2.2 *testing Hopfield*

In this process the input data will be compared with the existing dataset, the first image of its input will be sought in advance which will then be multiplied by the weight of Hopfield to get the value of activation. This activation value to be compared with the value of activation exist in the dataset

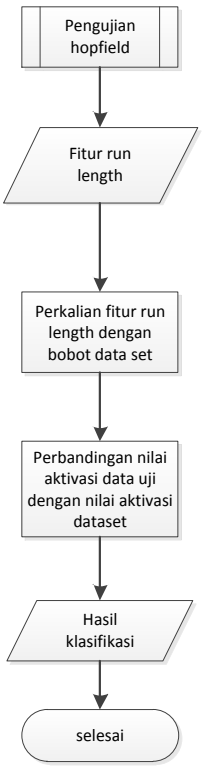


Image 9. flow Proses testing Hopfield

1.3 *Analysis data*

1.3.1 *Analilysis data input*

Data input is the image of the skin disease. Then the image will resize to a size of 32 x 32 pixels with true color that each pixel there are three values: RGB, then the image will be converted to grayscale This is done to simplify and facilitate further processing, with the aim of making each pixel has a value that is the value gray (gray value). Once the image is converted to grayscale will get the grayscale matrix, the matrix will be used as input image extraction process run length.

At this extraction process is used as a matrix-forming matrix grayscale run length, then from the matrix can be determined run length probabiltasnya value. The next step after the feature extraction feature extraction is obtained and will be used as input for the classification

1.3.2 *analysis data output*

` *Data output is the name of the image classification, the data obtained from a series of processes ranging from image processing, training*

and testing. In the image processing method that produces run length feature extraction with the help of grayscale to make the image of having a single value in each pixel, then in training artificial neural network Hopfield and image processing using the testing and training so that the resulting classification results. The class of the classification is dry eczema, eczema wet, eyelets, boils and pimples..

1.4 testing Metode

The aim of this algorithm testing to determine the performance of the method of run length and Hopfield neural network for image classification. Tests on this study was to measure the accuracy needed for image classification process with several scenarios have been prepared. The process of black box testing method to determine the performance of the system functionality along with the input value input into the system. In this test uses a method of K-fold with the help of tools Confusion matrix to determine the level of accuracy of the system built.

Here is the scenario planned to conduct testing using the K-fold:

1. Testing the effect of size 32x32 image, the results of the comparison between the classification of training data and test data.

2. Test the effect of size 64x64 image, the results of the comparison between the classification of training data and test data.

3. Test the Effect of the image size of 128x128, the results of the comparison between the classification of training data and test data.

In the K-fold using a method that should be done is to determine the value of K-fold that will be used, K-fold value will be used as many difference. Suppose if there are as many as 40 data and the data has 2 classes. Grades K-fold like 2, the test is carried out by dividing the entire data in the class into 2 to A1 and A2, where A1 and A2 are training data is test data. After comparison with the provisions of the above comparison was repeated with the provisions of A2 and A1 so the training data into test data. After having the test will get a percentage of accuracy.

Here are the results of testing of methods k-fold:

1.4.1 Testing Method with size 32x32

1.4.1.1 Testing with values Kfold=2

Testing with the value of k-fold 2 is testing 2 times round, meaning that the dataset is divided into 2 equal a lot, in this research data used as many as 100 data, and will be divided by 2, ie the data A1 = 50 and the data A2 = 50, testing is done as much as the value of k is used, testing 1 = Data A1 as training data and the data A2 as test data. Testing 2 is the opposite, the data A1 = as test data and the data A2 as training data.

Tabel 1. Confusion matrix test 1 with A1 as data test

Kelas		Prediksi						Akurasi
		Eksim kering	Eksim basah	Bisul	Jerawat	Mata ikan	Jumlah Citra	
Target	Eksim kering	9	1	0	0	0	10	90%
	Eksim basah	2	7	1	1	0	10	70%
	Bisul	0	1	8	0	1	10	80%
	Jerwat	0	0	0	9	1	10	90%
	Mata ikan	0	0	0	0	10	10	100%
Rata-Rata								86%

Tabel 2. Confusion matrix tests 2 with A2 as data test

Kelas		Prediksi						Akurasi
		Eksim kering	Eksim basah	Bisul	Jerawat	Mata ikan	Jumlah Citra	
Target	Eksim kering	10	0	0	0	0	10	100%
	Eksim basah	1	8	0	1	0	10	80%
	Bisul	0	0	9	0	1	10	90%
	Jerwat	0	0	1	9	0	10	90%
	Mata ikan	0	0	1	1	8	10	80%
Rata-Rata								88%

1.4.1.2 Testing with values k-fold=4

Testing with the value of k-fold 4 is testing 4 times a round, meaning that the dataset is divided into 4 equal a lot, in this research data used as many as 100 data, and will be divided by 4, ie the data A1 = 25, the data A2 = 25, the data A3 = 25 and the data A4 = 25, testing is done as much as the value of k is used, testing 1 = the data as test data A1 and the data A2, A3, A4 as training data. Testing 2 = Data A2 as test data and the data A1, A3, A4 as training data. 3 = Data A3 testing as test data and the data A1, A2, A4 as training data. 4 = Data A4 testing as test data and the data A1, A2, A3 as training data.

Tabel 3. Confusion matrix test 1 with A1 as data test

Kelas		Prediksi						Akurasi
		Eksim kering	Eksim basah	Bisul	Jerawat	Mata ikan	Jumlah Citra	
Target	Eksim kering	5	0	0	0	0	5	100%
	Eksim basah	1	4	0	0	0	5	80%
	Bisul	0	0	4	0	1	5	80%
	Jerwat	0	0	0	5	0	5	100%
	Mata ikan	0	0	1	1	3	5	60%
Rata-Rata								84%

Tabel 4. Confusion matrix test 2 with A2 as data test

Kelas		Prediksi						Akurasi
		Eksim kering	Eksim basah	Bisul	Jerawat	Mata ikan	Jumlah Citra	
Target	Eksim kering	5	0	0	0	0	5	100%
	Eksim basah	0	5	0	0	0	5	100%
	Bisul	0	0	4	0	1	5	80%
	Jerwat	0	0	0	5	0	5	100%
	Mata ikan	0	0	0	0	5	5	100%
Rata-Rata								96%

Tabel 5. Confusion matrix test 3 with A3 as data test

Kelas		Prediksi						Akurasi
		Eksim kering	Eksim basah	Bisul	Jerawat	Mata ikan	Jumlah Citra	
Target	Eksim kering	4	1	0	0	0	5	80%
	Eksim basah	0	4	0	1	0	5	80%
	Bisul	0	0	5	0	0	5	100%
	Jerwat	0	0	0	5	0	5	100%
	Mata ikan	0	0	1	0	4	5	80%
Rata-Rata								88%

Tabel 6. Confusion matrix test 4 with A4 as data test

Kelas		Prediksi						Akurasi
		Eksim kering	Eksim basah	Bisul	Jerawat	Mata ikan	Jumlah Citra	
Target	Eksim kering	5	0	0	0	0	5	100%
	Eksim basah	0	4	0	1	0	5	80%
	Bisul	0	0	5	0	0	5	100%
	Jerwat	0	0	0	5	0	5	100%
	Mata ikan	0	0	0	0	5	5	100%
Rata-Rata								96%

In the same way did against other scenarios are scenarios 2 and 3. Then the average value obtained from each test with values as follows:

Tabel 7.average of accuracy test

	K=2		K=4			
	A1	A2	A1	A2	A3	A4
32x32	86	88	86	96	88	96
64x64	90	90	88	96	88	96
128x128	90	90	88	96	88	96

1.5 Conclusion testing

Based on tests performed using the testing method k-fold and black box method can be deduced that the average level of the highest accuracy and lowest in the can when the value of k = 4 with respective values of accuracy is 84% when the value of k selected is 4 and the highest is 96% on average this applies to the image while the image 32x32 64x64 and 128x128 respectively the highest and lowest values are 86% and 96%.

Based on the above test can also be concluded that the amount of training data held will affect the level of accuracy, because the more training data, the classification process will have many choices in matching. As for the effect on the image size can be concluded that the size of the image is quite influential in the classification process because when an image resize will cause some of the information possessed by the original image is lost.

3. CLOSING

3.1 conclusion

From the research, the analysis of image processing, training and testing methods of run length and Hopfield neural network for image classification based on this texture, it was concluded that method of run length and Hopfield neural network method can be used in humans to recognize some skin diseases. The smallest average accuracy was 84% when the value of the selected k is 4, and

the highest was 96% on average this applies to the image while the image 32x32 64x64 and 128x128 respectively the highest and lowest values are 86% and 96%.

3.2 Suggestions

From the research, analysis, image processing, training and testing there were suggestions that it might be beneficial if there were going to conduct similar research, that ensure validation of the input image is in conformity with the image of the destination penelititan which in this study is an image of a skin disease

BIBLIOGRAPHY

1.Youlia Indriawati "IMPLEMENTASI MODEL BACKPROPAGATION DALAM MENGENALI POLA GAMBAR UNTUK MENDIAGNOSE PENYAKIT KULIT" Institut Teknologi Nasional
2.Mita indriani "ANALISIS TEKSTUR MENGGUNAKAN METODE RUN LENGTH".
3.Nirmawati (2004). Uji Banding Hasil Pengobatan Sulfur 10% Dalam Petrolatum dengan Salep 2-4 pada Penderita Skabies. Universitas Padjajaran, Bandung.
4.Muis, S., 2006. Teknik Jaringan Saraf Tiruan. Yogyakarta: Graha Ilmu.
5.Nalwan, A., 1997. Pengolahan Gambar Secara Digital. Jakarta: Elex Media Komputindo
6.Tavakoli Targhi Alireza, 2009. The Texture-Transform: An Operator for Texture Detection and Discrimination, Stockholm, Sweden.
7.Faradila, penyelesaian system persamaan nonlinier dengan metode jaringan saraf tiruan hopfield. Universitas Islam Negri Hidayatullah, Jakarta.
8.Kristanto, A., 2004. Jaringan Saraf Tiruan (Konsep Dasar, Algoritma dan Aplikasi). Jogjakarta: Gava Media
9.Pressman, S. R., 2010. Rekayasa Perangkat Lunak. Yogyakarta: Andi.
10.GASIM, "Jaringan syaraf tiruan untuk pengenalan jenis kayu berbasis citra" [tesis], Bogor: Program Pascasarjana, Institut Pertanian Bogor,
11.NAKANO K, "Application of neural networks to the color grading of apples", Computers and Electronics in Agriculture18 (1997) 105-116Ahmad, U., 2008. Pengolahan gambar digital dan teknik pemogramanya, Graha ilmu.
12.Ali, M., 2014. Kitab Belajar Pemograman C#. Jakarta: EbooK