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Artificial Neural Network for Healthy Chicken Meat Identification

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ABSTRACT

Indonesia is the country with the largest number of Muslims in the world. Every Muslim is taught to consume thoyyiban halal meat or healthy chicken because it is slaughtered in the right way and stored in a good way too. But the reality in the market of many chicken meat on the market can not meet that criteria. Identification of healthy chicken meat can be done with laboratory experiments, but that is not simple and takes time. This experiment offers a cheaper, faster approach, with very high accuracy. The experimental approach is based on color and texture analysis on 5 types of meat quality based on healthy value. Color analysis was performed using artificail neural network (ANN) while texture analysis used Canny edge detection. Experimental results show that the color histogram approach with ANN is better than the texture approach, ie 94% versus 66%. It can be concluded that the freshness of a chicken does not have much effect on the texture of the meat but it has an effect on the color change in the meat.

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1. INTRODUCTION

Indonesia, as the largest Muslim population country in the world, makes the guarantee of food and its ingredients important. Moreover for meat, especially chicken meat has to complete and have some criteria such as safe, healthy, intact, and halal. Some samples taken from traditional market often cannot meet those ASUH criteria. In fact, there are some cases revealed such as stale meat (old) and fresh but contains formalin. It will be difficult condition for common people to identify, so they often buy those kinds of meat. So, it needs practical guide to identify chicken meat which is healthy, consumable, and meet the ASUH criteria. The research based on image managing with pixel component value R, G, and B (RGB color extraction) can be used to identify the freshness level of broiler meat, and edge Canny detection method can be predicted for identifying chicken meat [1].

Edge Canny detection is modern edge detection, which has advantage in edge detecting such as having good detection, locating well, and having good response [2]. Canny's operator told by John Canny in 1986, is famous as optimal edge detection operator [3].

2. RELATED STUDY

2.1. Chicken Meat

Chicken meat ASUH is the meat which has the following criteria:

1. Safe: is not containing biological, chemical, and physical damage which can cause the disease and ruin the health.

2. Healthy: is having good and crucial substances, which is needed to grow.
3. Intact: is not blended with the other body part of that animal and others.
4. Halal: cutting and handling based on Islamic rules [4].

2.2. Image Processing

The quality of an image can be done by processing the image in two dimensions which is the function of light intensity f (x,y), where in every point of x, y has RGB pixel value. So, the characteristic of an image can be extracted, edge detected, and drawn a histogram.

2.2.1. Colored Image

The original image consists of 16.777.216 color variances or 24-bit, but this research uses 8-bit image or has value for 0-255. Colored image or usually said RGB image means every pixel has component R,
G, and B.

2.2.2. Gray Scaled Image

This color has intensity 0 point for black and 255 point for white and also shows color gradation from black to white.

2.2.3. Binary Image

This color has two conditions, namely 0 for black and 1for white, which is used for edge detecting of image object.

2.2.4. Edge Canny Detection

Edge Image is the drastic intensity value change between two boundries in two areas. [3]. Edge detection can be done using first differential or edge detection type 1 toward the function of an image, so two maximum absolute values can be gotten in the first differential. It also can be done using second differential or second type of edge detection toward the function of an image, so zero-crossing in the second differential is gotten. As shown in Figure 1.

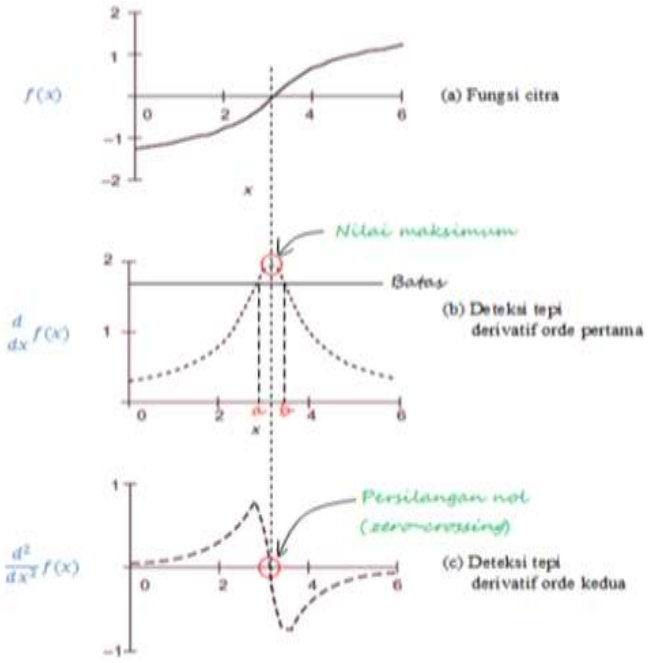


Figure 1. First and Second edge Detection in X area

There are some operators in edge detection, such as edge detection with Sobel, Prewwit, Roberts and Canny operator, but edge Canny detection can detect the edge accurately with minimum mistake [5] and has

advantage to detect the edge [6]. Because edge canny detection uses Gaussian Derivative Kernel to soften image perform, so there are three targeted criteria of edge canny detection:

1. Good detection, maximizing signal to noise ratio (SNR) in order to be able to detect whole edge well.
2. Good location, minimizing the real edge detection distance and result of process edge detection, so the edge detection location is detected similar to the real edge.
3. One response to signal edge, giving one edge not the other edge.

Edge Canny detection Algorithm has five steps, namely:

1. Smoothing, using Gaussian filter. To soften the image.
2. Edge strength, using Gaussian operator to get edge strength.
3. Finding gradient, with kernel Sobel gradient direction in each estimated point.
4. Non-maximum-suppression, gradient for each pixel comparing to two closed scales which has the same direction with the gradient. Two pixels with the smallest gradient value will be deleted. Then, it will be applied to all pixels until meet the edge which has 1 pixel width.
5. Edge tracking by hysteresis, to delete the edge with the smallest gradient scale will be applied limit value. But, if the edge with the smallest gradient scale connects to a pixel with too high gradient, the edge will not be deleted.

2.2.5. Histogram of Image

The definition of image histogram is a diagram to know the spread of pixel intensity, where the frequency of the highest pixel intensity can be determined [3]. Histogram can be done for image type RGB, HSV or binary image. The advantages of histogram in managing the image are:

1. Used for observing the spread of color intensity and made for taking decision.
2. Used for determining the object margins toward the background.
3. Used for giving the percentage of color composition and texture intensity in color identification.

But, histogram cannot be used to know the form of an image.

2.3. Back Propagation Artificial Neural Network

Back propagation artificial neural network is neural network with supervised treatment method, the treatment minimizes output error and usually be used multilayer architecture containing input layer, hidden layer, and output layer [7]. After doing the treatment, the test of treating ANN is done. As shown in Figure 2. There are the three following step of doing ANN treatment:

1. Forward propagation, add data to NN input, each input unit (Xi) is propagated to hidden layer (Zj) with functioned activation; hidden layer will have output and be propagated to the next level with activated function. This process will be until output network part (Yk), result of output from (Yk) will be compared to an achieved target (tk). Range of (tk-Yk) will be a error happened δk, if the error smaller than certain threshold limit so iteration will be stopped, but if the error is still higher than threshold limit, so the load of each network line will be modified to reduce error.
2. Back propagation, propagation process from output to hidden layer and error δk happened (the multiplication of target, output result, and first differential activation function) whish is used to change the weight for the better output. This is also happened for hidden part toward input.
3. Weight Changing
   From the error of weight modification done in each line and repeat the third process of this step so the condition fulfilled, the process is stopped based on the iteration and certain MSE.

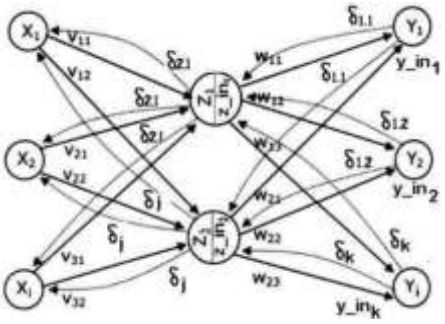


Figure 2. ANN Backpropagation Treatment Process

3. METHODOLOGY

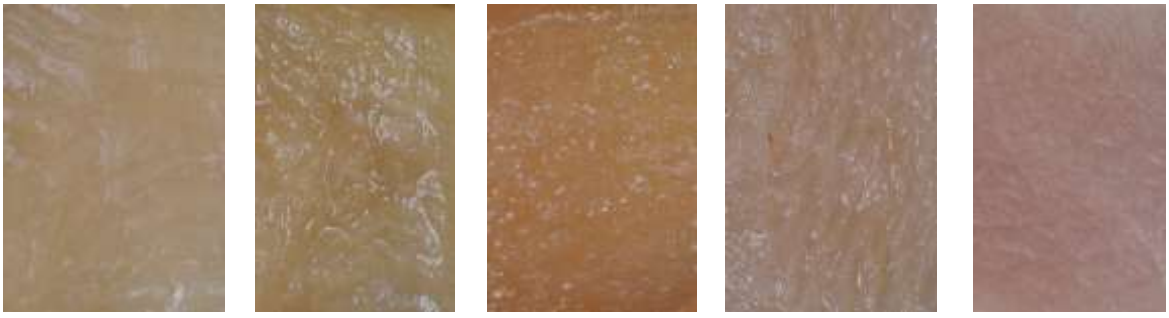
Fresh meat has different color and texture comparing to not too fresh ones and also different with injected chicken meat. Therefore, the image management approach and pattern identification are chosen. In this case, RGB image extraction to identify meat color characteristic and edge Canny detection to identify chicken meat texture are predicted to be able to differentiate fresh and healthy meat with unhealthy ad containing addictive substance meat.

The data collection is done by buying some meat in traditional market which further will be laboratory tested and the result will be labelled into 5 categories, namely fresh meat (DAS), freezer meat (DAF), rotten meat (DAKS), injected fresh meat (DASS) and formalin injected meat (DASF).

3.1. Image Acquisition

To keep the color consistency and texture, it is needed the similar camera and condition from the light intensity edge and color. The different lighting can cause changing color distribution and decrease the function of tool accuracy. In this in this experiment, closed box completed with lighting Pada percobaan ini digunakan box tertutup yang dilengkapi dengan TL 10 WATT and NIKON D90 camera. Figure 3 is the example of 5 kinds of chicken meat based on its freshness and chemical substances content. Each captured picture is cropped in size 354x472 pixel.

1. Chicken meat which is taken as the sample is the breast because it has lots of meat and the part for inject chemical substance. The meat is cut using sharp knife, so the texture is clearly seen. The pieces of those chicken meat then captured using digital camera in Figure 3.



(a) (b) (c) (d) (e)

Fugure 3. Example of 5 chicken meat types (a) Fresh Chicken meat (b) Freezer Chicken meat (c) Rotten chicken meat (d) Injected fresh chicken meat (e) formalin injected chicken meat.

2. Color extraction and doing histogram become 3 matrixes based on Red, Green and Blue (RGB) color.
3. Edge Canny detection and doing histogram, binary matrix is gotten, and compared to the pattern with combination of binary matrix 4 or 16 patterns (pattern 1-16), to get more objective data..
4. Start from matrix 0,0, 0,1, 1,0 and 1,1 if the matrix value is same to the pattern, so matrix position 0,0 is similar to 1 if different, the value will be 0. The column and line of binary matrix is moved and compared to pattern. The value 1 as result of matrix comparison is added so the data of each pattern are gotten (pattern1-pattern16).

3.2. Image Histogram

3.2.1. RGB Color Extraction Histogram Result

The example of 5 categories histogram namely namely chicken fresh meat (DAS), chicken freezer meat (DAF), chicken rotten meat (DAKS), chicken injected fresh meat (DASS) and chicken formalin injected meat (DASF) as the following Figures 4-8. Each histogram has different form to R, G and B component which means every type of meat has different color composition. Histogram of R component from those 5 types has the biggest value, then followed by G component and the smallest is B component. Except rotten chicken meat or DAKS G component value is similar with R component, but in different variable range.

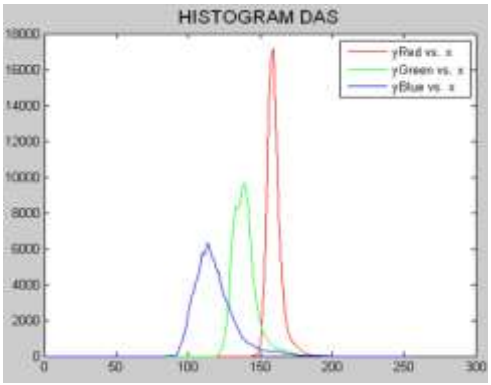


Figure 4. Image histogram extraction RGB of fresh chicken meat

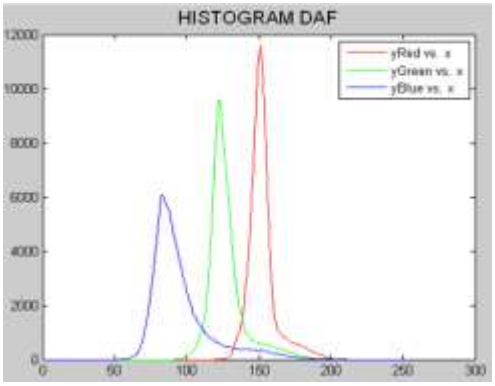


Figure 5. Image histogram extraction RGB of freezer chicken meat

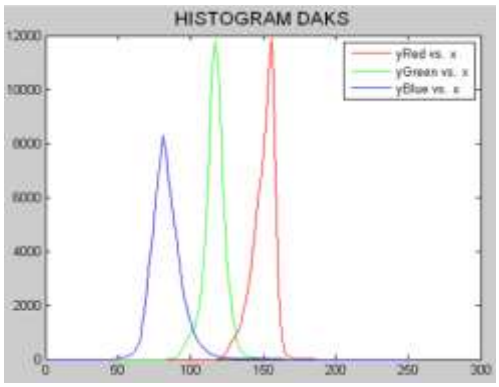


Figure 6. Image histogram extraction RGB of rotten chicken meat

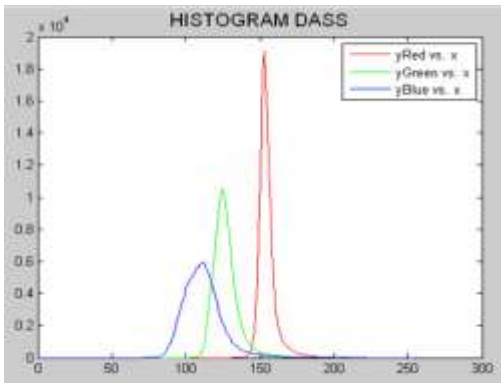


Figure 7. Image histogram extraction RGB of injected fresh chicken meat

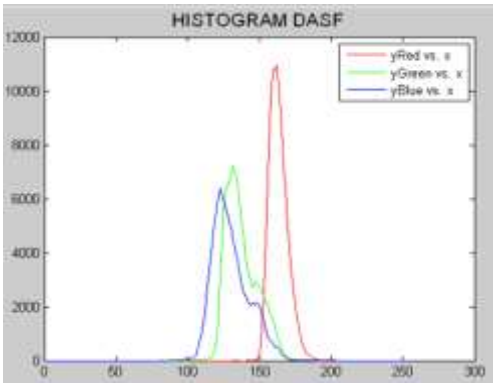


Figure 8. Image histogram extraction RGB of chicken formalin injected meat

3.2.2. Histogram Result of edge Canny Detection

Histogram is done after edge Canny detection process From chicken meat. The example of edge detection result from freash meat (DAS) and formalin injected meat (DASF) can be seen in the Figure 9 and 11. Histogram of edge Canny detection result for fresh met and formalin injected meat in Figure 10 and 12 are similar binary matrix, different with color extraction histogram.

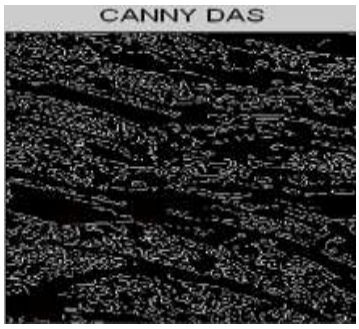


Figure 9. Edge Canny Detection DAS

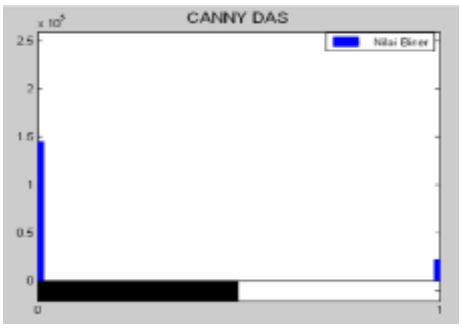


Figure 10. Histogram of edge Canny Detection DAS

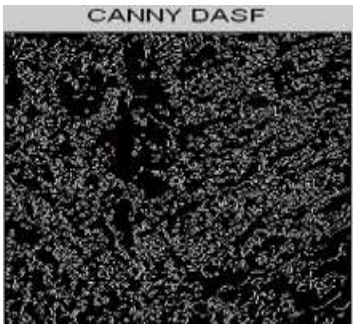


Figure 11. Edge Canny Detection DASF

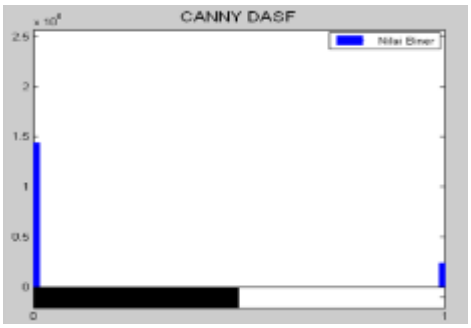


Figure 12. Histogram of edge Canny Detection DASF

3.3. Image Identification

In this experiment, histogram pattern result from color extraction or different edge Canny detection for each type of meat made as the main feature to identify healthy meat. Artificial neural network is used to identify the pattern. By pixel input of R, G, and B extraction and edge Canny detection which is about the addition of point 1 from matrix of comparison result for pattern 1 to 16 and the output is 3 bit representing 5 groups of meat type. ANN model used is *Back Propagation Neural Network (BPNN)*, with the same architecture but different input. Neural network architecture with color input extraction is shown in Figure 13 where there are 3 neuron inputs, 1 block of hidden layer (10 neurons) and 3 neurons for output. While neural network architecture with edge Canny detection input is shown in Figure 14. where there are 16 buah neuron inputs, 1 block of hidden layer (10 neurons) and 3 neurons for output. Input contains data of comparison for pattern 1 to pattern 16 and delete data which have relative wide range.

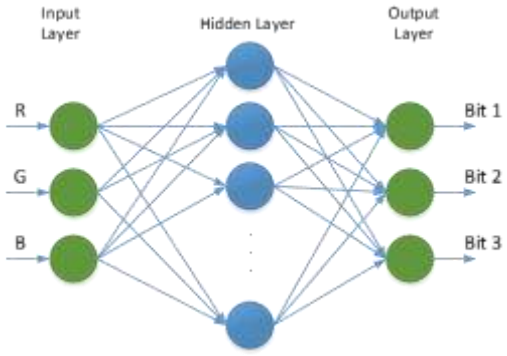


Figure 13. Architecture of ANN chicken meat identification with color extraction

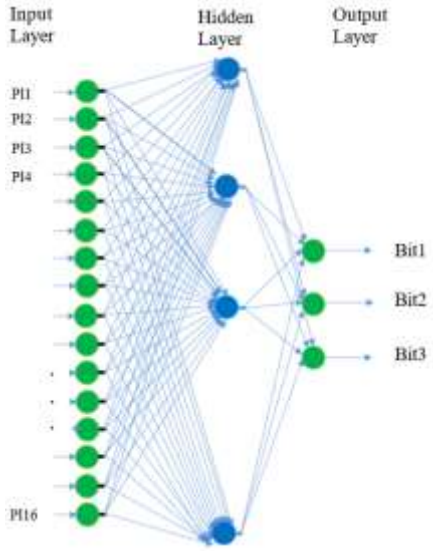


Figure 14. Architecture of ANN chicken meat identification

3.4. Evaluation

Process of BPNN identifying after having output with MSE value toward certain target data in every meat category, the process of rounding is done also to know the accuracy level of identification. Accuracy level will be determined by knowing the error happened in every sample testing.

4. Experiment Result And Analysis

4.1. Color Extraction

After all categories of image sample is drawn as histogram, the data of RGB color extraction result are used for inputting in the built ANN system. This is the training process of ANN system to identify type of chicken meat. Table 1.10 shows the data of fresh chicken meat type (DAS). It is known that 9 point is predicted for fresh chicken meat and the rest 1 is predicted as DASF.

Table 1. Chicken Meat Identification using ANN Prediction to image extraction

Kategori	Prediksi					Jumlah	Error
	DAS	DAF	DAKS	DASS	DASF		
DAS	9				1	10	1
DAF		9		1		10	1
DAKS		1	9			10	1
DASS				10		10	0
DASF					10	10	0
Total Data						50	
Target	9	9	9	10	10	47	
Jumlah Eror							3
% Target						94	
% Error							6

For freezer chicken meat (DAF) and not fresh chicken meat (DAKS), from 10 data, there is 1 which is predicted unsuitable for each. And for injected fresh meat and formalin injected meat, 10 data are predicted suitable to the meat category type. The next step is doing ANN system test, by this method such as training process but by giving different input, prediction result in identification process causing similar accuracy result. From 50 data or 10 samples for each meat category type, the result of prediction is 47 data on target and 3 data does not match. So, from identification using ANN for colour extraction approach, 94%accuracy level or 6% error level is gotten.

4.2. Edge Canny Detection

The result of comparing binary matrix with pattern configuration 1 to 16, the pattern data used for inputting data in ANN system is pattern data 2 to 15 (14 data). Pattern 1 and 16 are not used because they have wide range. ANN architecture such as Figure 14, training process is gotten from 50 prediction data related to target data amounted 33 pieces and 17 data do not match the target in identifying the meat type category as Figured in Table 2. Moreover the prediction is out of the target of meat type category namely *FALSE*, it is happened on the process of ANN system test. So, by identifying using ANN for edge Canny detection approach, the accuracy level 66% or 34% error is gotten.

Table 2. Chicken Meat Identification using ANN Prediction to edge Canny detection

Kategori	Prediksi						Jumlah	Error
	DAS	DAF	DAKS	DASS	DASF	FALSE		
DAS	5	1	3		1		10	5
DAF		5		3	1	1	10	5
DAKS	4		6				10	4
DASS		1		8		1	10	2
DASF	1				9		10	1
Total Data							50	
Target	5	5	6	8	9		33	
Jumlah Error								17
% Target							66	
% Error								34

5. CONCLUSION

The result of this research shows that identifying chicken meat using ANN and RGB color extraction approach more accurate in identifying characteristic pattern of meat's color than edge Canny detection does in identifying meat texture pattern. Color extraction accuracy is 94% while using edge Canny detection
is only 66%.

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REFERENCES

[1] W. Prima, W. Oyas, and S. Indah, "Identifikasi Tingkat Kesegaran Daging Ayam Broiler Berdasar Ciri Tekstur Dan Warna Daging," *Al-Mabsut J. Stud. Islam dan Sos.*, vol. 6, no. 1, pp. 186-195, 2013.
[2] M. Kamal and R. S. Basuki, "Segmentasi Citra Daun Tembakau Berbasis Deteksi Tepi Menggunakan Algoritma Canny," 2013.
[3] A. Kadir and A. Susanto, *Teori dan Aplikasi Pengolahan Citra*. Penerbit Andi, 2013.
[4] P. Produksi and P. D. A. yang Higienis, "Direktorat Kesehatan Masyarakat Veteriner dan Pascapanen," *Direktorat Jenderal Peternalan dan Kesehat. Hewan, Kementrian Pertan.*, 2010.
[5] J. W. Yodha and A. W. Kurniawan, "Pengenalan Motif Batik Menggunakan Deteksi Tepi Canny dan K-Nearest Neighbor," *Techno. com*, vol. 13, no. 4, pp. 251-262, 2014.
[6] Nailis, "Variasi Filter pada Deteksi Tepi Metode Canny untuk Mendeteksi Kanker Payudara."
[7] S. Kusumadewi, "Membangun Jaringan Syaraf Tiruan Menggunakan MATLAB & EXCEL LINK," *Yogyakarta Graha Ilmu*, 2004.