Chicken Meat Freshness Identification using the Histogram Color Feature

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Abstract— **Identifying the chicken meat freshness level is necessary since it involves the quality of the meat consumed. This research aims at identifying the freshness level of chicken meat based on the histogram color feature. The histogram color feature used is Red, Green, and Blue color (RGB) channel. RGB histogram value acquired from image sample dataset of chicken breast meat. First Order Statistical Method is used to reduce the color feature dimension such as Mean, Max, and Sum. The value is then classified using Naïve Bayes Classifier, Support Vector Machines (SVM) Classifier and C4.5 Decision Tree. The Classification method compared for analyzing their accuracy. The freshness of chicken meat level defined in three class, fresh, medium, and old. The chicken meat labeled as fresh from 0 to 4 hours after slaughtered, 4-6 hours labeled as medium, and more than 6 hours labeled as old. The result of color histogram feature by Naïve Bayes method shows 33.33%, Support Vector Machine (SVM) shows 58.33%, whereas C4.5 decision tree method shows 50% classification accuracy. The classification process of the chicken meat's freshness level based on the color histogram feature suggests using Support Vector Machine (SVM) method which indicates the highest classification accuracy of the experiments result.**

Keywords—component; histogram color; chicken meat freshness; chicken meat;

I. INTRODUCTION AND BACKGROUND

The chicken meat is one of a popular meat in many countries as it has high protein and can be bought at an affordable price [1]. Being aware the rise of intensity of the social education and economy of people, the requirements also increase in the standard of quality and food safety [2]. As a meat consumed product, freshness is one of the most important factors to be considered for end user buyers and industry [3]. From the client perspective, one the easiest way to distinguished chicken meat is by observing the meat color [4]. The traditional method of distinguished chicken freshness is based on physical, chemical, microbiological and human sensory evaluation. The human sensory evaluation is expensive, while other methods, including microbiological measurements and chemical methods, all take long, tiring and damaging [1]. The imaging technology could provide the value of chicken meat consistency and accuracy, which is beneficial to the chicken meat industry.

Since 1996, researchers have been started measuring the quality of chicken meat using image analysis [5]. For color rating, image analysis techniques have been used to various requirements, predict meat species, freshness identification and predict beef fat levels [6, 7], pork color [8, 9], and seafood quality [10, 11]. When the color features extracted the variant color space [12] like RGB (Red, Green, Blue), HSV (Hue, Saturation, Value) and L*a*b* (Lightness, Red, and Blue) can be used.

Previous research has demonstrated that several analytical techniques could be developed for rapid and non-destructive measurement of freshness, such as computer vision which is combined with infrared rays [13, 14, 15].

Our contribution in this research is to create a chicken breast meat dataset and can be used for future research. Moreover, not much research about the freshness level of chicken broiler meat based on RGB color histogram feature. The goal of this study is to classify freshness level of chicken meat have a basis the result of RGB color extraction. The RGB extracted features is then reduce their dimension using first-order statistical method. This research also described the effect of using red, green and blue or RGB channel in the classification process.

II. MATERIAL AND METHOD

A. Chicken chop preparation and data collection

The type of chicken which is used in this research is Broiler. The parts of the chicken which is used for testing are chest, leg, neck, wings, claw, and head. The whole of the data sample of chicken meat that will be analyzed are 60 parts. Firstly, chicken meat put at room temperature of 26° C. Afterwards, the chicken meat cut to some parts, then their image is acquired using normal resolution smartphone camera to be used as a dataset. It defines as three parts, first the meat is captured after 0 - 4 hours it slices and categorized as a fresh class is shown in Fig.1 (a), 4 – 6 hours categorized as a medium class is shown in Fig.1 (b), and the more than 6 hours categorized as an old class is shown in Fig.1 (c). Each grade freshness will be shown in Fig. 1.

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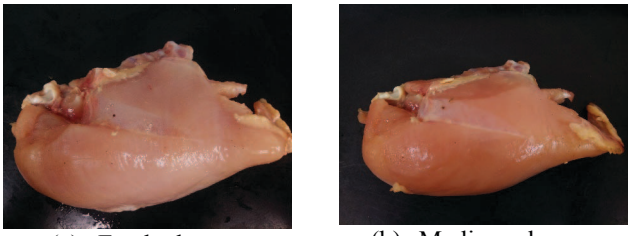


(a) Fresh class (b) Medium class

(c) Old class

Fig. 1. Class freshness of chicken meat

The extraction of the data set from chicken meat is put in an outdoor environment. The camera used for acquiring the image dataset is the smartphone camera with 8MP (Megapixel) resolution since the future research of the application is developing the freshness level of chicken meat in a mobile application. Also in the future, we want to try to compare the results of classification chicken meat freshness from the dataset with regulated light and unregulated light. Therefore, the effect of light is still not known in the process classification of this chicken meat.

B. The RGB Color Feature and Color Space

Color images usually stored in a dataset of red, green and blue (RGB) and for reasons availability of RGB color model has become the dominant color in object detection [16]. This is an additive color scheme using the principal function of the human eye, sensitivity of three kinds of cones in the retina against the specific light spectrum [18]. The RGB color model the primary use is to display images/pictures in electronic devices, such as televisions, digital camera and computers.

RGB spaces can be displayed into a cube in a three-dimensional Cartesian coordinate system (Figure 2). One bottom corner stating the color black when R = G = B = 0, whereas the opposite corner it states the white color when R = G = B = 255 (8-bit color system for each of its components). The rest of the nodes represent the primary colors (red, green, and blue) and secondary colors (cyan, yellow, and magenta).

The RGB scheme has some of the weaknesses. It's not intuitive to human interpretation. Element luminance and chrominance cannot separate. Euclidean distance cannot be applied to capture the difference in color correction. All the components highly correlated with each other and in addition very sensitive to lighting changes and noise [17].

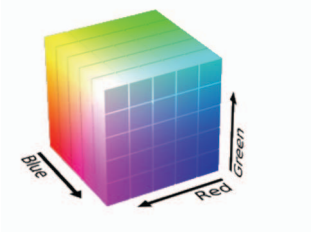


Fig. 2. Color cube of RGB

C. Design of Chicken Meat's Freshness System

Image dataset are processed and analyzed using Visual Basic .NET software. In this research, 6 parts of chicken - chest, leg, neck, wings, claw, and head, were collected from local farms. The broiler chicken was classified into three group, fresh, medium, and old. For each chicken meat, ten images were collected, the whole meat images in this experiment were 60 images. For each hold on validation, all images were divided into two sets of 90% for training and 10% for testing without overlapping. As a result, 60 meat images consisting of 54 training images and 6 testing images were performed.

The design of chicken meat's freshness system shown in Figure 3. The system is divided into two main parts: handling system of broiler chicken and module of image processing.

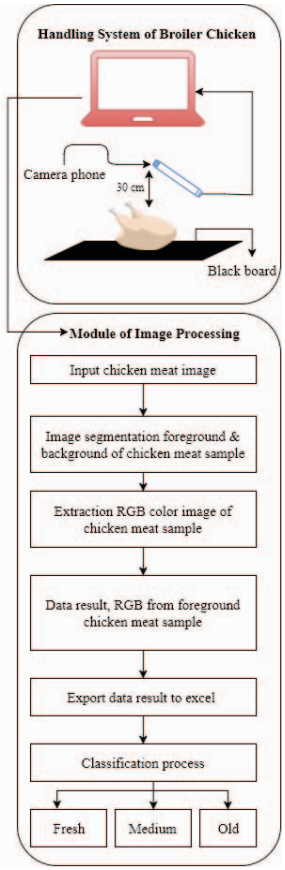


Fig. 3. Diagram process of retrieving a dataset

1) Handling System for Broiler Chicken

The system required for broiler chicken meat data acquisition blackboard for background panel and camera phone as the acquisition device. The distance between camera phone and object approximately 30 cm. Furthermore, the results of chicken meat's photo were collected in a computer to do the classification process.

2) Module of Image Processing

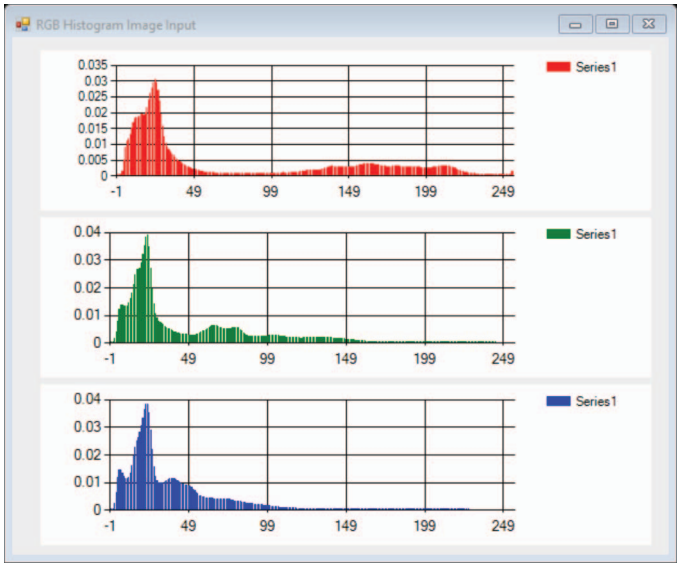
The module of image processing obtained using the following steps:

- *Input chicken meat image*. Pictures of chicken meat inputted into the existing system.
- *Image segmentation foreground and background of chicken meat sample*. Image segmentation to separate the foreground and background image and take foreground pixel color information only as a color feature.
- *Extraction RGB color image of chicken meat sample*. In the extraction process using RGB color feature. The extraction process of the chicken meat can be accomplished by taking the RGB value in each part of the chicken meat.
- *Export data result to Excel*. The result data from the extraction of RGB color feature, can be exported to excel.
- *Classification process*. After obtaining data, the classification process begins. In this study, the process of classification using three different methods, SVM classification, Naive Bayes and J48 to categorize types of chicken meat freshness.

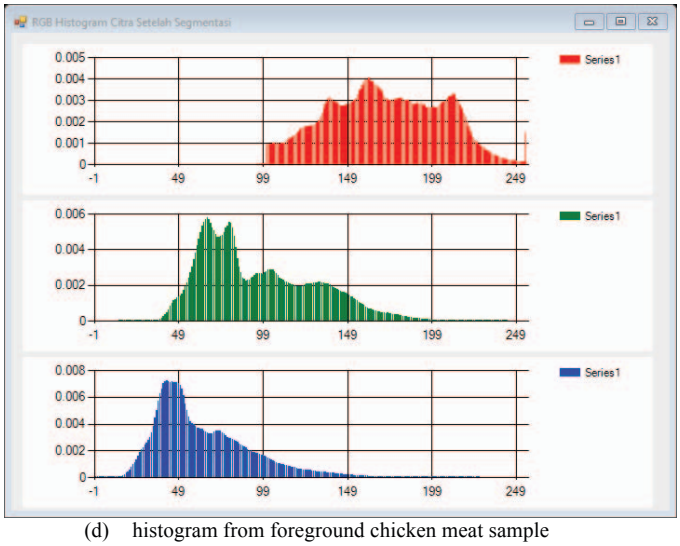
The original chicken meat picture obtained by the camera phone is shown in Figure 4(a). The process of separating background and foreground using the method of gray level histogram based the threshold value is shown in Figure 4(b) and histogram RGB from original chicken and histogram of foreground chicken meat sample after separating background and foreground is shown in Figure 4(c) and 4(d).

(a) Original chicken

(b) The process of separating background and foreground using the method of gray level histogram based the threshold value



(c) histogram from the original image



(d) histogram from foreground chicken meat sample

Fig. 4. Chicken meat color image segmentation results.

For each image, the RGB value calculations performed on each pixel. First order statistical method then used to reduce the

dimension of the image pixel value such as sum, maximum and mean.

D. Data Analysis

In this research, calculation using first-order statistical method that is counting the sum, maximum and mean from the recent RGB value. Nine color features (sum R, sum G, sum B, maximum R, maximum G, maximum B and average R, average G and average B values) were used as a feature dataset to quantify chicken color attributes.

E. Decision Tree Algorithm C4.5

C4.5 builds the decision tree with the help of information entropy. At each tree node, the most selected attributes are effectively split into several subsets. Separation is done on the value of Information Gain (IG). For decision making, attributes with the highest normal IG are used. This algorithm has limited handling of numerical data only [19].

F. Classification using Naïve Bayes method

Naïve Bayes is a subset of Bayesian decision theory. Using probabilities can sometimes be more effective than using hard rules for classification. Bayesian probability and Bayes' rule gives us a way to estimate unknown probabilities from known values [20]. Bayes' theorem states the following relationship:

$$X_{NB} = argmax\ P\ (c) \prod P\ (d\ |c) \quad (1)$$

$$P\ (c|d) = \frac{P(d\ |c)\ P(c)}{P\ (d)} \quad (2)$$

Where d is word, c is category, P(d|c) is word probability in category c, P(c) is probability of category c and P(d) is probability of d word.

G. Support Vector Machines (SVM)

For now, the SVM is the best method for performing classification tasks, ranging from text classification to genomic data. SVM can be applied in the complex data types outside of feature vector with designing kernel function for these data. Support Vector Machines is a system for efficiently training linear learning machines in feature space induced by the kernel, while respecting the insights of generalization theory and the theory of optimization of exploitation [21]. SVM is a learning machine method that works on the principle of Structural Risk Minimization (SRM) with the aim of finding the best hyperplane that separates the two classes on the input space.

H. Calculate Accuracy

Accuracy used to measure the similarity and results at the same time by comparing with absolute value. Using the formula:

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \quad (1)$$

where TP is true positive, TN is true negative, FN is false positive, and FP is false negative.

III. RESULTS

The process of separating background and foreground using the method of gray level histogram based the threshold value. After separating background and foreground, do the RGB value extraction to continue the classification process of the value.

The classification process of the chicken meat's freshness gets the value which is attached in Table I. On the classification process using 3 methods, those are Naïve Bayes, SVM and J C4.5 Decision Tree for ensuring the comparison aimed at gains the best method in classification process of the chicken meat's freshness.

Based on the Table I, the classification process uses 90% training and 10% testing data, with 60 total images data set. Next, First Order Statistical Method such as Mean, Max and Sum used for classification process with three difference method, Naïve Bayes, SVM Classification and C4.5 Decision Tree Method.

TABLE I. THE RESULT OF CLASSIFICATION WITH 3 METHODS

FEATURE	METHOD		
	NAÏVE BAYES	SVM	C4.5 DECISION TREE
SUM, MAX, MEAN RGB	33.33%	58.33%	50.00%
SUM RGB	50.00%	58%	58%
MAX RGB	16.67%	58.33%	33.33%
MEAN RGB	41.67%	58.33%	41.67%

Refer to Table I, discerning that in SVM classification, using RGB values shows the good accuracy that is 58.33%. In SVM classification method, the value of sum, maximal and mean RGB, does not significantly affect accuracy, almost all having same accuracy value.

IV. CONCLUSION

In this research, the accuracy of our computer systems is observed and analyzed. Thirteen on color feature (Sum, Max, Mean RGB, Sum RGB, Sum R, Sum G, Sum B, Max RGB, Max R, Max G, Max B, Mean RGB, Mean R, Mean G and Mean B) were collected to measure the color of chicken meat. In the process of classification method using Support Vector Machine (SVM) with training 90% and testing data 10% achieving 58.33% classification accuracy. In SVM classification method, the value of sum, maximal and mean RGB, does not significantly affect accuracy, almost all having same accuracy value.

Further research, we will reproduce datasets in the process of classification chicken meat freshness. We will also try to classify chicken meat freshness with the methods suggested i.e. moment invariant feature and use other colors like HSL and YCBcr color feature for later comparison with RGB color feature.

Accordingly, the prediction of chicken meat freshness uses the color feature, the result was satisfactory for advanced research and utilized in the production of chicken meat industry. Advanced research is needed to evaluate and improve the accuracy of systems.

V. ACKNOWLEDGMENT

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REFERENCES

[1] Chen, Quansheng, et al. "Evaluation of chicken freshness using a low-cost colorimetric sensor array with AdaBoost–OLDA classification algorithm." Lwt-Food Science and Technology 57.2 (2014): 502-507.
[2] Xiong, Zhenjie, et al. "Non-destructive prediction of thiobarbituricacid reactive substances (TBARS) value for freshness evaluation of chicken meat using hyperspectral imaging." Food chemistry 179 (2015): 175-181.
[3] Rzepka, M., Ozogul, F., Surowka, K., & Michalczyk, M. (2013). Freshness and quality attributes of cold stored Atlantic bonito (Sarda sarda) gravad. International Journal of Food Science and Technology, 48(6), 1318–1326.
[4] Glitsch, Kristina. "Consumer perceptions of fresh meat quality: cross-national comparison." British Food Journal 102.3 (2000): 177-194.
[5] Chen, Quansheng, et al. "Evaluation of chicken freshness using a low-cost colorimetric sensor array with AdaBoost–OLDA classification algorithm." Lwt-Food Science and Technology 57.2 (2014): 502-507.
[6] Sun, Xin, et al. "Prediction of pork color attributes using computer vision system." Meat science 113 (2016): 62-64.
[7] Wang, Fang-rong, et al. "Research on meat species and freshness identification method based on spectral characteristics." Optik-International Journal for Light and Electron Optics 124.23 (2013): 5952-5955.
[8] Chen, K., Sun, X., Qin, C., & Tang, X. (2010). Color grading of beef fat by using computer vision and support vector machine. Computers and Electronics in Agriculture, 70(1), 27–32.
[9] Chmiel, M., Slowinski, M., & Dasiewicz, K. (2011). Lightness of the color measured by computer image analysis as a factor for assessing the quality of pork meat. Meat Science, 88(3), 566–570.
[10] Girolami, Antonio, et al. "Measurement of meat color using a computer vision system." Meat science 93.1 (2013): 111-118.
[11] Hosseinpour, S., Rafiee, S., Mohtasebi, S.S., & Aghbashlo, M. (2013). Application of computer vision technique for on-line monitoring of shrimp color changes during drying. Journal of Food Engineering, 115(1), 99–114.
[12] Mateo, A., Soto, F., Villarejo, J.A., Roca-Dorda, J., De la Gandara, F., & García, A. (2006). Quality analysis of tuna meat using an automated color inspection system. Aquacultural Engineering, 35(1), 1–13.
[13] Du, C. -J., & Sun, D. -W. (2005). Pizza sauce spread classification using colour vision and support vector machines. Journal of Food Engineering, 66(2), 137–145.
[14] Sun, D.-W. (1997). Thermodynamic design data and optimum design maps for absorption refrigeration systems. Applied Thermal Engineering, 17(3), 211–221.
[15] Trinderup, Camilla H., and Yuan H. Brad Kim. "Fresh meat color evaluation using a structured light imaging system." Food Research International 71 (2015): 100-107.
[16] Sadgrove, Edmund J., et al. "Fast object detection in pastoral landscapes using a Colour Feature Extreme Learning Machine." Computers and Electronics in Agriculture 139 (2017): 204-212.
[17] Chernov, Vladimir, Jarmo Alander, and Vladimir Bochko. "Integer-based accurate conversion between RGB and HSV color spaces." Computers & Electrical Engineering 46 (2015): 328-337.
[18] Sun, Xin, et al. "Prediction of pork color attributes using computer vision system." Meat science 113 (2016): 62-64.
[19] Bhosale, Dipali, and Roshani Ade. "Feature Selection based Classification using Naive Bayes, J48 and Support Vector Machine." International Journal of Computer Applications (0975− 8887) Volume 99 (2014).
[20] Harrington, Peter. Machine learning in action. Vol. 5. Greenwich, CT: Manning, 2012.
[21] Ebrahimi, M. A., et al. "Vision-based pest detection based on SVM classification method." Computers and Electronics in Agriculture 137 (2017): 52-58