Support vector machine for omega 3 classification based on histogram equalization

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Abstract. Eggs are one of the animal food ingredients consumed in addition to meat, fish, and milk. But now the engineered eggs have emerged that have a higher nutritional value, namely eggs that contain omega-3. The distinguishing part is omega-3 egg yolks rather yellow while ordinary egg yolks are more reddish. The purpose of this research was to classify eggs based on texture using the support vector machine method. To find out the value of egg texture using extraction of first-order statistical features. Based on the results of the testing of this research obtained an accuracy rate of 88.75% based on 120 training data and 80 test data.

1. Introduction
Eggs are a food ingredient that is often used in everyday life. Eggs have high protein content and have a complete protein composition, but the fat contained therein is also high [1]. One type of egg that has high nutritional advantages is Omega-3 eggs. Omega-3 eggs contain docosahexaenoic acid or DHA, which is a fatty acid that is needed by the body, including to improve children's brain intelligence, prevent coronary heart disease and increase endurance [2].

Based on previous research from Arivazhaga conducted research on egg identification by converting color images into gray images, then an image enhancement process was carried out to improve the image quality of eggs [3]. In 2014 Mehdizadeh conducted research on the classification of eggs based on infrared imagery, the classification process using NN [4]. Guan in 2017 explored the value of diffusion in the apparent diffusion coefficient (ADC), there is a first order in the clinical introduction of cervical cancer [5].

Visually, ordinary chicken eggs with omega-3 chicken eggs look the same because it is the same result from the race of laying hens, only different feed from the parent. If the egg yolks are broken, they contain reddish omega-3 color while the egg yolks in ordinary eggs are yellow. Based on these conditions, this research was carried out by utilizing digital image processing to find out omega-3 eggs or ordinary eggs.

Equalization Standard histograms usually result in excessive contrast enhancement due to lack of control at the level of increase [6]. This is intended so that the gray level distribution is more evenly distributed compared to the original image. Histogram equalization used to increase image color contrast. Wang improvement techniques based on the local histogram to performed by segmenting the image into several sub-blocks using gradient values, this algorithm successfully increases local contrast without adding noise to the image [7].

Previous research, the support vector machine method was used for classification of mango plants based on leaf bone structure [8]. In this study first-order is used to find out the omega-3 content. The first order is a feature taking method based on the characteristics of the image histogram. The mean and standard deviation of first-order statistical extraction used to base the classification of omega-3 eggs. The classification process uses the support vector machine method.

2. Methods
In image processing, feature extraction stages are needed for image interpretation so as to facilitate image analysis in the classification process. The texture analysis generally requires feature extraction at an early stage. One feature extraction can be done by first-order feature extraction.

In this research several stages will be carried out including image input, changing the RGB to grayscale, histogram equalization, gaussian filter, first-order statistics, and system analysis.

![Figure 1. Stage of the research](image-url)
2.1. RGB image to Grayscale
Changing the RGB image into a gray image using the luminosity method. This method calculates the value of each color element from the image, namely red, green, and blue. This calculation by adding weight according to human visual perception. The luminosity method is performed by calculating the value of each color element R, G, and B by adding weights according to human visual perception. Changing RGB image to gray image using Equation 1.

\[
\text{Luminosity} = \frac{R \times 299 + G \times 587 + B \times 114}{1000}
\] (1)

2.2. Histogram Equalization
This stage is a stage to improve the image quality that will be processed using a histogram equalization[9]. By using a histogram can be known information on the frequency of use of gray levels.. Equalization histogram is a method to improve quality by changing the distribution of gray levels. This is intended so that the gray level distribution is more evenly distributed compared to the original image.

Histogram alignment is obtained by changing the gray level of a pixel with a transformation function [10]. The equation used to calculate histogram equalization in equation 2.

\[
h_i = \frac{n_i}{n}, \quad i = 0,1,2,3 ...\] (2)

After the process, the image of chicken eggs is filtered with a Gaussian Filter. The Gaussian filter is an H filter in the form of an \(m \times n\) sized matrix, and the value is the same for each element, and because it is LPF the total number of elements is one [10].

2.3. Extraction of first-order
Feature extraction is the process of taking the characteristics contained in the objects in the image to recognize the object. Feature extraction is the first step in the classification and interpretation of images[11]. This process is related to the quantization of image characteristics into a group of corresponding feature values.

Mean is a measure of image dispersion regarding the color distribution of an image.

\[
\mu = \frac{1}{MN} \sum_{i,j=1}^{M,N} P_{ij}
\] (3)

Calculation of standard deviation values is shown in Equation 4.

\[
\sigma = \sqrt{\frac{1}{MN} \sum_{i,j=1}^{M,N} (P_{ij} - \mu)^2}
\] (4)

2.4. Support Vector Machine
This is a learning system that uses hypothesis space in the form of linear functions in a high-dimensional feature space, trained with learning algorithms [12]. From the test results after this feature is omitted it can be known as an important feature or not from the difference in efficiency and effectiveness. The steps taken in the classification process are shown in Figure 2.
3. Results and Discussion

The testing process of the classification of eggs. Test scenarios using 200 egg data, consisting of 100 images of omega-3 and 100 images of ordinary eggs. The data is then divided into 120 training data and 80 test data.

3.1. Histogram Equalization

In the initial stage, preprocessing is grayscale which aims to change the RGB image into a gray image. Preprocessing results as shown in Figure 4.

The next step is an image equalization process and a Gaussian filter. Gaussian filters are used to reduce noise generated during the equalization process. Figure 5 is a Gaussian image produced.
3.2. Extraction features
In extraction stage, the mean and standard deviation are calculated. The process of calculating for 120 training data that have been prepared. The results of the calculation to determine the classification of an image of chicken eggs shown in Table 1.

| Mean       | Standard deviation | Mean       | Standard deviation |
|------------|--------------------|------------|--------------------|
| 159.0849609375 | 4.561617358004262 | 163.5498046875 | 4.55727677476295  |
| 158.4521484375 | 4.5621798142668295| 164.431640625 | 4.5563403865160375 |
| 158.8447265625 | 4.561832395479497 | 162.4365234375 | 4.55842113012096  |
| 158.8271484375 | 4.561848057146354 | 163.658203125 | 4.557163105851699 |
| 157.4091796875 | 4.563078953279427 | 163.3388671875 | 4.557496820944728 |
| 160.4501953125 | 4.560359884249256 | 163.25390625 | 4.55758502322921  |
| 160.0166015625 | 4.560765814616692 | 164.9267578125 | 4.555802899681618 |

3.3. Classification
Determination of the range of values Table 1 is used as the basis for the classification. The support vector machine method used to determine the Omega-3 egg classification. The test results of 80 test data obtained 71 perfectly identified images and 9 images with reading errors. Based on the test, the image accuracy is 71/80 = 88.75%.

4. Conclusion
Based on the results of testing the conclusions were obtained

- The use of Gaussian filters in the equalization process can repair the image.
- The first-order statistical characteristics can be used as a reference to distinguish between omega-3 and ordinary eggs.
- The results of the classification testing using support vector machine obtained an accuracy value of 88.75%.
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