Implementation of Connected Component Labelling for Calculation Amount of Eggs on the Laying Pullet Cage

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Abstract. Chicken eggs are one of the commodities that become easily available foodstuffs. The level of egg production in good condition is directly proportional to the capacity of the cage. The process of calculating the amount of egg production becomes a problem for farmers when they want to calculate the amount of egg production in the condition of a chicken coop on a large scale. Smart systems are one form of technological development with the primary goal of producing effective and efficient systems. One area that plays a role in technological development is image processing, eggs are objects with certain color characteristics and pixel scales. In this study, the process of calculating the number of eggs based on color segmentation and selection of pixel scales on eggs and the process of calculating objects using the Connected Component Labeling algorithm of images that have gone through gray-scale and threshold processes and implemented using MATLAB. The trial results show that the object image of an egg is strongly influenced by the size of the image, the intensity of the light, and distance of capturing images. The number of eggs that can be detected in this study depends on the process of segmentation and measurement of the object's egg scale, in this study it was found that colors other than egg colors and objects that are outside the egg scale will be considered as noise and will not be detected.

1. Introduction

According to [1], eggs contain high protein and complete composition of protein substances, fat content in eggs is also high. The development of laying hens business provides nutritional fulfillment in addition to stabilizing and stabilizing the egg production business, breeders must make improvements from various aspects such as production, management, biosecurity and marketing strategies [2]. Smart system or what is called Smart System is a system that provides several technologies that provide services with several, the purpose of these services so that the system can run effectively, efficiently, safely and comfortably. Smart systems also implement the Internet of Things (IoT) so that the system can be run anywhere and anytime with an internet network connection [3]. The concept of IoT is widely implemented in various smart systems such as smart buildings, smart homes, smart classes, and so on. IoT elements are detection, communication, computing, services, and resources [4].

The problem that the writer found was the difficulty of egg farmers in calculating the amount of chicken egg production and calculating the production statistics in large capacity cages detecting objects in images has long been a staple in image processing. This research is to find the egg object in the image. Each egg object is represented by a certain set of pixels and colors which are then segmented to determine only egg objects. To get the egg object, the labeling algorithm of the connected components is used.
2. Literature Review

2.1. Grayscale

The process of converting an image into grayscale is done by taking all the pixels in the image, then taking the basic color data that is RGB through the pixel of each color and then the results are divided into three which will then produce an average value. Grayscale will be obtained from the average value used to obtain the value used to obtain the pixel value of the image [5]. The following is the equation from grayscale

\[ Y_{(x,y)} = (0.299 \times R) + (0.587 \times G) + (0.114 \times B) \]  

where:
- \( Y \) = degree of gray
- \( R \) = Pixel channel Red
- \( G \) = Pixel channel Green
- \( B \) = Pixel channel Blue

2.2. Gaussian Blur

Filter Gaussian is a very good method in removing noise in the image because it has the nature of the normal distribution which is found when the results of the digitization process using a camera [6]. Blur filter in the Gaussian blur method can make color changes that are quite visible in the image, then the mid color image is used as a soft effect on all sides of the image. The equation of the following filter is the gaussian kernel matrix and the formula as below.

\[
G = \begin{bmatrix}
1 & 2 & 1 \\
2 & 3 & 2 \\
1 & 2 & 1 \\
\end{bmatrix}
\]

\[
 Pixel B(i, j) = \frac{1}{k} \sum_{p=0}^{N-1} \left( \sum_{q=0}^{M-1} G(p, q) \cdot Pixel A \left(i + p - \frac{(N-1)}{2}, j + q - \frac{(M-1)}{2} \right) \right)
\]

where:
- Pixel A : Original image
- Pixel B : Weight of the product
- N : Number of kernel matrix columns
- K : The sum of all values in G
- G : Gaussian kernel value.

2.3. Thresholding

Thresholding is a basic method in image segmentation systems. The threshold is divided into three methods, namely binary, truncate, and zero threshold. Sophisticated techniques of thresholding are band and multispacial thresholding. This method is usually applied to images that use grayscale. When the image cannot be extracted into grayscale, then it is multispectral [7].

2.4. Connected Component Labelling

Connected component labeling algorithm is an algorithm that calculates objects in an image with the condition that the image is a binary image. Labeling objects is done in sequence. This method is divided into two main categories, namely recursive connected components and sequential labeling based on neighborhood (4-connectivity, 6-connectivity, 8-connectivity).
The connected component labeling algorithm carries out the scanning process in a row starting from the top left to the bottom right. The scanning process is repeated until there are no more changes to the label naming then the algorithm has been completed [8]. Thus the pixels that are said to be connected basically have the nature of neighborhood.

3. Research Method
This research uses experimental research with the following stages:

3.1. Image
The first stage taken was image capture by the camera. Image can be process to the next stage.

3.2. Preprocessing
At this stage, the RGB image which is an image with a composition of three basic colors (Red, Green, Blue) is converted into grayscale and then carried out a filtering process to eliminate noise with the Gaussian blur method.

3.3. Thresholding
In the next stage, a thresholding process is carried out, namely the conversion of grayscale images into binary images of 0 (black) and 1 (white) values.

3.4. Connected Component Labeling
Furthermore, the connected component labeling algorithm will count objects with a value of 1 with the 4-connection concept, this algorithm will scan pixel images from top left to bottom right. When finding an object, the concept of neighborhood will be carried out to look for pixels that are part of the object found. After completing the labeling and reviewing the scanning process again until no objects are found then the CCL algorithm is complete.

3.5. Object Counting Results
The results obtained in the form of the number of detected egg objects.

4. Results and Discussion
4.1. Results
The results obtained are the number of eggs detected and calculated by the connected component labeling algorithm. Figure 2 shows the image of the egg on the prototype.
Then take a sample of the color point on the egg to determine the color range of the egg, so that the minimum and maximum RGB values are obtained as follows.

- Minimum RGB is \((R = 197, \ G = 104, \ B = 78)\)
- Maximum RGB is \((R = 255, \ G = 190, \ B = 175)\)

4.2. Image Processing

Figure 2. Image of an RGB egg on a prototype

Figure 3. Image of an egg with grayscale and gaussian blur

Figure 4. Image of eggs with a threshold
To reduce noise in the image is also done to determine the scale, the egg scale in this study is 300 to 28000 pixels so that objects outside of the scale will not be read as objects.

4.3. Calculation Accuracy

The accuracy of egg calculation by implementing connected component labeling algorithm using segmentation and egg scale obtained an accuracy value of 63%. In this study, the weaknesses are the process of segmenting the egg object before the thresholding stage, the color segmentation is not yet maximum and there is noise entering the egg scale so that it reduces the accuracy of the calculation.

5. Conclusions and Suggestions

5.1. Conclusions

Based on the results of research on the implementation of connected component labeling on the calculation of the number of eggs in laying hens, it is concluded that the Minimum and Maximum Values for the scale range of egg pixels are 300 to 28000 pixels, the minimum and maximum egg RGB values, namely the Minimum RGB is \((R = 197, \ G = 104, \ B = 78)\) and Maximum RGB is \((R = 255, \ G = 190, \ B = 175)\). The accuracy obtained is 63%.

5.2. Suggestions

For further research, object segmentation, morphology, and background substraction techniques need to be improved.

Reference

[1] Sudaryani, "Kualitas Telur," Penebar Swadaya, p. jakarta, 2003.
[2] S. P, "Prospek Usaha Ayam Petelur di Indonesia," Poulrty Indonesia, 2009.
[3] V. L. a. E. N. C.Zhu, "Green Internet of Things for Smart World," IEEE, pp. 2151-2162, 2015.
[4] B. N. S. K. H. M. Khan, "Internet of Things based Energy Aware Smart Home Control System,” IEEE, 2016.
[5] R. F. Shaumi, "Rancang Bangun Alat Penyortir Buah Tomat Berdasarkan Ukuran Berbasis Raspberry Pi 3,” Universitas Lampung, 2018.
[6] M. Y. d. F. G. F. Boskurt, "Effective Gaussian Blurring Process on Graphics Processing Unit with CUDA,” International Journal of Machine Learning and Computing, pp. 57-61, 2015.
[7] M. Rinaldi, "Pengolahan Citra Digital dengan Pendekatan Algoritrik," Informatika, 2004.
[8] Binus, “eThesisdoc” 2017. [Online]. Available: http://library.binus.ac.id/eColls/eThesisdoc/Bab2/TSA-2017-0136Bab%202.pdf.