Eggs Detection Using Otsu Thresholding Method

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***Abstract*—Egg selection process can be performed by either natural or artificial way. The latter can be done by using image processing. It is segmenting the image of an egg to obtain objects contained in the image. This study is designed to identify fertile and infertile egg by using Otsu thresholding method. The importance of this study is designing model of egg detection system using image processing to obtain information of fertile and infertile egg. The results of egg testing show that algorithm and method that was used were able to distinguish the fertile and infertile eggs of domestic fowl.**

Keywords—segmentation, otsu method, fertile, infertile, egg detection machine

I. INTRODUCTION

High demand of potentially hatched eggs offers wide business opportunity to the breeders. The rapid development of computer technology makes it possible to design a detection system of fertile and infertile eggs by using image processing.

A digital image is one of the multimedia components that plays an important role as a form of virtual information. One part of the image processing which is able to identify the object of egg image is segmentation process [1]. Segmentation is a technique to identify an object in an image by using image thresholding [2-4]. However, its segmentation process is inefficient because the thresholding value is given manually.

Therefore, in this study Otsu thresholding method plays a role in obtaining automatic thresholding values in the segmentation process. Some research on segmentation using the Otsu method [5-8].

In this study, we designed an egg detection box based on image processing where the lights and cameras were controlled by Arduino. The purpose of this study was to identify the fertile and infertile eggs of the domestic fowls using thresholding values obtained from Otsu method process.

II. RESEARCH METHOD

A. Image Segmentation

Image segmentation is a fundamental process in many images. This is often used to partition an image into a separate area. This is very important for content analysis and image understanding [9].

B. Thresholding

Thresholding is an important technique in image segmentation. The basic idea of thresholding is a selection of the optimal grayscale threshold to separate objects of interest (OOP) in the image from the background based on their grayscale distribution. Thresholding creates a binary image of the grayscale by changing all pixels, below some threshold values, to zero and all pixels in the threshold becomes one. Thresholding operation was shown in (1). The threshold value (T) while x and y are the coordinates of the threshold value point p(x,y) ,f(x,y) [10].

$$T = M\,[x, y, p\,(x, y), f\,(x, y)] \tag{1}$$

C. *Otsu* Method

Otsu method was introduced by Nobuyuki Otsu. Otsu thresholding is a simple segmentation method in segmentation technique, so it can be easier in doing the division of region of homogeneous region based on the criteria of similarity to recognize the object.

The approach performed by the Otsu method is a discriminant analysis which determines a variable that can distinguish between two or more emerging groups. Discriminant analysis is used to maximize the variable in order to be able to split the foreground and background objects. The threshold value is searched from a gray level image expressed by *k*. the value of *k* has a range of 1 to *L*, with *L* value = 255. The probability of each pixel at the i level was shown in (2), with n_i denotes the number of pixels *i* and the intensity of *N* representing the number of all pixels in the image.

$$p(i) = \frac{n_i}{N}, p(i) \geq 0, \sum_{i}^{256} p(i) = 1 \tag{2}$$

The average of the two classes is calculated based on (3) and (4).

$$m_1(t) = \sum_{i=1}^{t} i.\,p(i)/w_1(t) \tag{3}$$

$$m_2(t) = \sum_{i=1}^{t} i.p(i)/w_2(t) \quad (4)$$

Probability total number always equal to 1 that it shown in (5).

$$w_1(t) + w_2(t) = 1 \quad (5)$$

Finally, Otsu is defined as the between-class variance (BCV) that it shown in (6).

$$\sigma_b{}^2(t) = W_1.[m_1(t)\text{-}m_T]^2 + W_2.[m_2(t)\text{-}m_T]^2 \quad (6)$$

$$t^{'} = \max\{\sigma_b{}^2(t)\} \quad (7)$$

The optimal thresholding value of Otsu is the maximum value between-class variance (BCV) that it shown in (7).

III. Results and Discussion

In Fig. 1, an egg detection system is shown. This system consists of a camera used as an egg image capture, incandescent light is used as an egg shine when it will be captured by the camera where the lights and cameras were controlled by Arduino. The egg is placed between the lights and the camera. The eggs used in this study were eggs of domestic fowl.

First stage: Input stage, egg image of domestic fowls is inputted. The eggs were captured using a camera and stored in a format.jpg.

Second stage: RGB image conversion to Grayscale

Third stage: Segmentation process with Otsu method. The of Otsu thresholding is as follow:

1) Reading the original image as RGB color image (Red, Green, Blue).
2) Converting RGB image to Grayscale.
3) Reading grayscale image size.
4) Initializing histogram values = 0.
5) Calculating the histogram values.
6) Calculating p(i) value (the probability of intensity value).
7) Calculating mT value (the total average value).
8) Calculating t value (thresholding) namely

a) Initialization of the threshold value (t = 0).

b) Calculating the weighted values (w1 and w2) in both classes (object and background).

c) Calculating the mean values of classes (m1 and m2).

d) Calculating the BCV value (Between Class-Variance).

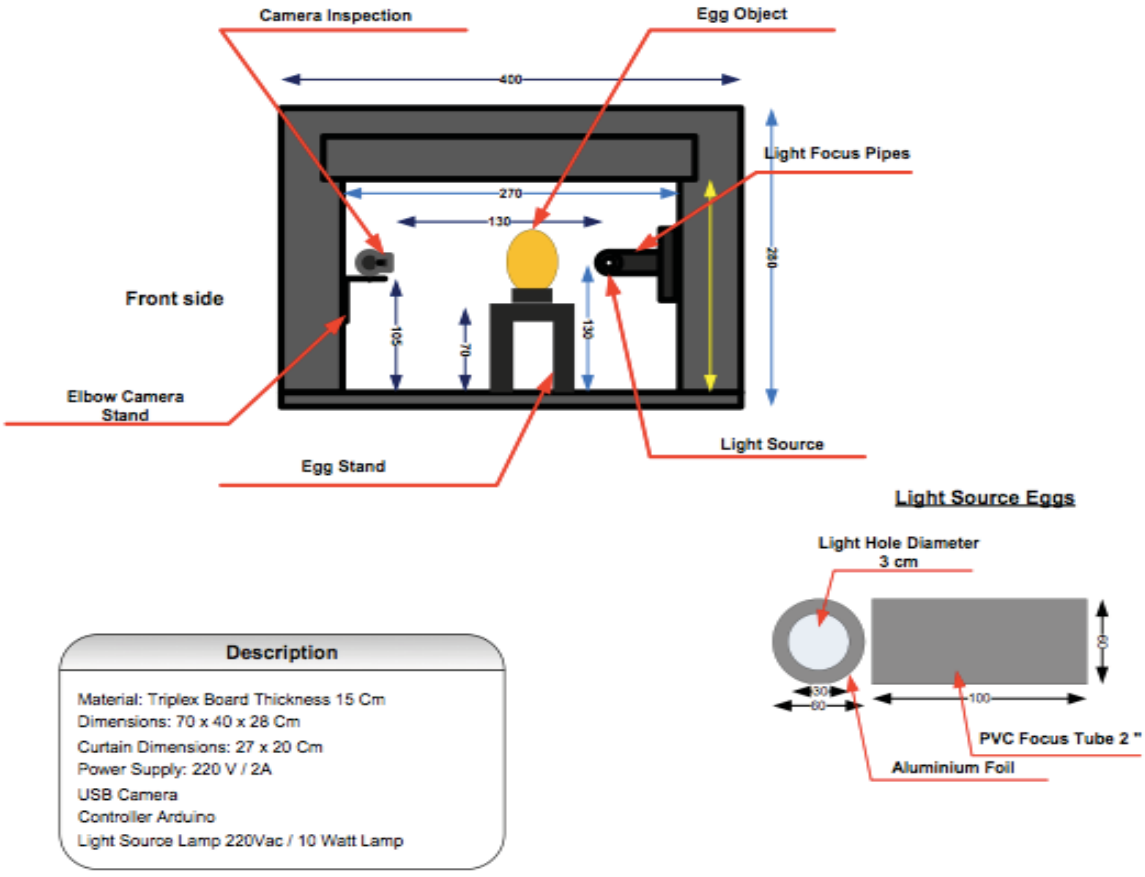
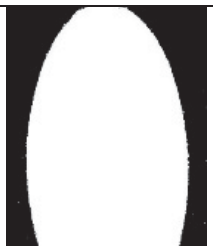


Fig. 1. Design Feature of an Egg Detection Box

Each stage in Fig. 2, described in the following sections:

TABLE I. PROCESS OF EGG SEGMENTATION USING OTSU METHOD

Image	RGB Image	Binary Image	Otsu Value	Remark
Image2.jpg			96	Infertile
Image3.jpg			54	Fertile
Image4.jpg			84	Infertile

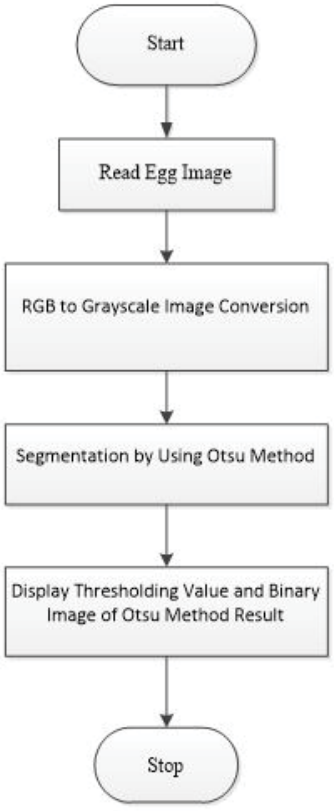


Fig. 2. Process of Egg Image Segmentation

Fourth stage: Output process, it displays thresholding value and Egg binary image.

In this study, we used MATLAB version 2016 to conduct some testing of domestic fowl's eggs aimed at distinguishing fertile and infertile eggs, shown in Table I.

Based on Table I, image2.jpg and image4.jpg conducted after the segmentation process produced infertile eggs information with Otsu thresholding value of 96 and 84, while for image3.jpg produced fertile egg information with Otsu thresholding value is 54.

The segmentation processing the egg image with image processing is shown in Fig. 2 consisting of: first was input stage of the domestic fowl's egg images. They were captured using a camera and stored in a jpg format. Second was the process stage where RGB image converted to grayscale. Third was segmentation with Otsu method and finally was the output stage in the form of thresholding value and binary image by using Otsu method.

IV. CONCLUSION

The methods and algorithms used in this study were able to separate objects and backgrounds and able to distinguish fertile and infertile eggs. Future work is the development of segmentation algorithms to distinguish bad eggs and good eggs based on their texture and we will design a conveyor as a place for eggs for detection in real time.

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