Silkworm Egg Counting System Using Image Processing Algorithm - A Review

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Abstract - *India is 5 th largest producer of silk in the world so production of silkworm from silkworm egg rapidly increasing. Success of sericulture as a cash crop depends on the vitality and disease freeness of the silkworm seed applied to farmer. Production of silkworm seed is not only free from diseases but having high heterosis. It is necessary to count silkworm egg accurately to avoid loss to silkworm egg production industry and farmers or grainges. Convential method of egg counting is using calculator and manually. Calculator counting is harmful for egg due to its counting needle and manual method is waste of time and investment of man power. This paper has developed a new method for counting silkworm egg using image processing algorithm.*

***Key Words*: Image acquisition, Image enhancement, Image segmentation, Object counting, etc**

1. INTRODUCTION

Sericulture industry is measured by quantity of silkworm seed produced. Grainges are the centers for production of large quantities of silkworm egg. In seed areas they concentrate on production of disease free silkworm eggs of pure races. Grainage which had direct link with commercial cocoon producers and naturally more popular with farmers than basic seed farms. The farmers look to the grainage for supply disease free laying (DFL) seed which produce cocoons with rich silk content and high yields. Farmers expectations of good quality seed supply and accurate counting of eggs from grainage is high. The conventional method for object counting is manual, time consuming and in non-automatic form. Continuous counting leads to eye fatigue and affects the accuracy of results. However, the process of counting objects is not always straightforward or trivial, even performed manually. Most counting methods have peculiarities that make them tricky to tackle. For example, the objects may occur in large number and overlapped making counting tricky and tedious that in turn leads to error. Manual method must be replaced by computer vision as the results of this method are erroneous and time consuming. Automatic counting of objects is a subject that has received significant attention in last few years with objects as varied as cells , RBCs , fish , eggs etc. Traditionally, silkworm egg counting is done manually using ink/sketch pen which cause more errors, required man power and waste of time. Karnataka State Sericulture Research and Development Institute, Banglore (India) has used a calculator for eggs counting this method use only marking system on eggs no need to remember count but this method is also erroneous and waste of time so to Reduce the time and man power and to increase the accuracy, Silkworm eggs counting system using image processing algorithm is used.

2. METHODS

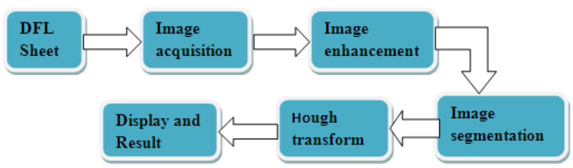

Fig -1: Block diagram of silkworm counting system

2.1 **Image Acquisition**: Image acquisition consists of capture image through camera. The quality of image depends on camera parameters, camera resolution, lighting conditions, environmental condition, size of objects and distance from which image is taken. For better results, cameras with higher resolution are preferred.

2.2 **Image Enhancement:** Image enhancement is process to modify image so that resulting image is more suitable and noise and blur of images removed so that resulting image is more suitable than original image for specific application. These include basic gray level transformations, histogram modification, average and median filtering, Top hat filtering etc.

2.3 **Image Segmentation**: The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. The result of segmentation is set of contours extracted from image. It can be region based segmentation or data clustering or edge based segmentation.

2.4 **Object Counting**: Object counting is done get number of segmented areas. Methods of object counting are Hough transform, connected components analysis, statistical area measurements etc.

3. LITERATURE REVIEW

Carlos A. B. Mello et al. in [1] presented two methods for mosquito eggs counting. In the first method, RGB image is converted into HSL color model (Hue, saturation, Lightness). From these three components, the hue image is extracted as it contains information Huang's and Li-Lee's algorithms have better result as compared to other thresholding so hue image is binarized using Huang thresholding algorithm. To label the connected regions of the image, A connected components algorithm is used. Using morphological opening operation with structuring element defined in the form of egg Filtering is done .For calculating the number of eggs total number of white pixel dividing by average area. The second method used for counting mosquito egg is based on converting RGB sub-images to YIQ ones and, segmenting band I and counting mosquitoes eggs using following two methods

a) Standard labeling algorithm using limiarization with a fixed threshold of 200 [1].
b) Binarization using k-means clustering method. For counting mosquito eggs considered average-sized mosquito egg of 220 pixels[1].

Hemant Tulsani et al. in [2] presented method for counting RBC, WBC and platelates from blood cell .First RGB image converted into two formats YcbCr and grayscale. YcbCr is used to overcome the illumination issue which occurs in blood cell image and the Cb component generally shows the clear appearance of the WBC nucleus and platelets. To obtaining RBC mask, the grayscale image is used. On the grayscale image Opening by reconstruction followed by closing by reconstruction operations are performed. For removing overlapping of cells watershed segmentation is used. To separate overlapping cells and for accurate count Regional maxima transform of the distance transformed image is computed.

G. Gusmao et al. in [3] presented algorithm for Counting Aedes aegypti Eggs in Ovitraps. In this paper images are captured in RGB color system and then RGB is converted into L*a*b color system. a* and b* are used using k-means map clustering. To minimize the sum of Euclidean distances from each object to the cluster mean vector there were two measurements are used, first is maximum of iterations of 100 and second is the cohesion estimative. After clustering, need to define which cluster contains eggs. For that original RGB image is converted into HSV. An analysis of the hue component can give information of the objects. When hue value is higher than 0.5, the respective cluster is set an area with eggs .Otherwise it is ignored. To label its connected regions connected component algorithm is used. Thus, the total amount of white pixels divided by average area is nothing but the number of eggs counts.

Jayme Garcia et al. in [4] presented method for Counting Microorganisms and Colonies in Microscopic Images. First original image is converted into grayscale image. Two-dimension median filter is applied, to eliminate noise present in the image. For applying filter determining of the ideal size of neighborhood pixel of image should required. There are two methods for determining of the ideal size of neighborhood

1. User enters a rough estimate for the diameter (in pixels) of the objects and artifacts [4].
2. Estimation using multiple counts [4].

Then, the contrast is adjusted in such a way that the brightest pixel should be full-scale value (255) and the darkest pixel is equal to zero. such an operation can be performed by following formula

$$p(i,j) = \frac{[p(i,j) - \min(p)].255}{\max(p)} \quad (1)$$

where P is the new pixel value, p is the original pixel value, and i and j are the indices of the pixels[4]. After contrast adjustment top hat filtering is applied on image due to that illuminate differences within images that have dark background, and consists in the subtraction, from the original image, of the same image morphologically opened. After that Eq. 1 is applied again and image is binarized with threshold in 128. From binarized image it is possible to extract information like area of object, eccentricity of object , mean diameter of object and from that it is easy to counting objects.

Venkatalakshmi.B et al. in [5] presented method for automatic red blood cell counting using Hough transform. First step of this method is image acquisition , 2nd is preprocessing in which input image is converted into HSV from that analyzed saturation component S, S image shows clearly bright objects such as WBC and platelets so that there is easy to distinguish red blood cells. Third step is segmentation, Segmentation is based on histogram thresholding and morphological operation. Mathematical morphological is useful for describe region shape i.e skeleton, boundaries and texture. For segmentation wants to calculate lower and upper threshold value from histogram. Based on threshold value image is divided into two region i.e object point and background point. After that Morphological operation is performed on two regions which fills small holes present in the binary images. Fourth step is feature extraction using hough transform ,Hogh transform is used for detection of parametric curves designed to find a circle characterized by a center point x0,yo and radius r by equation

$$(x\text{-}x0)^2+(y\text{-}yo)^2=r^2$$

Last step is detection and counting of RBC ,accumulator space red blood cell can be detected and using hough transform it easily count red blood cell.

Marjan Ramin et al. in [6] presented method for counting the number of cells in immunocytochemical images using genetic algorithm. first step is pre-processing step in this by using smoothing spatial filter noises are reduced from captured image. Second step is classification in which nucleus can be separated from antigens. Third step is Separating bound nucleus in which segmentation process is applied for segmentation local thresholding is used. And from segmentation antibodies and nucleus are separated. Fourth step is cell counting in this boundaries of image traced for counting objects from binary image of cell.

Xiaomin Guo et al. in [7] presented a method of automatic cell counting based on microscopic images. In this method Histogram dual threshold is used to separate of cell and background. Next step is segmentation of the cell image in which Floodfill method is seed filling method used for region filling. It is used to mark or separate regions in an image. After that segmentation process is done in which dual threshold segmentation is used. Segmentation and filling is used for accurate identification of cells. Next step is cell detection in which Blob analysis is used to detect blobs in an original image and make selected measurements of those blobs. Blob analysis consists of a analysis functions and series of processing operations which used to produce information about any 2D shape image. Blob obtains the total number of cells in whole image by calculating the number of cells contained in each blob.

Chomtip Pornpanomchai et al. in [8] presented method for Object detection and counting system. There are five methods used in this first is image acquisition, from video camera video stream is given as input which is in frame level. Second step is image en Image enhancement in which level difference between two images is set. Third step is image segmentation in which approximate size of the object can be calculated. Fourth step is image analysis in that by using pattern matching technique ,there is finding the number of objects that are moving in the detection area. Fifth step is object counting in which number of objects in scene can be count.

Amruta Pandit et al. in [9] presents the development of automatic method for counting of silkworm eggs. The algorithm is implemented in LabVIEW graphical programming environment that shortens the development cycle. The algorithm realizes high precision and accuracy of counting. In this method image acquisition is developed by using IMAQ vision for LabVIEW. After image acquisition, RGB image is converted into grayscale. Contrast of grayscale image is increased by using histogram equiliztion and for removing non-uniform lighting, top hat filtering is used. Segmentation is performed after top hat filtering in which image is divided into two regions by using thresholding. For filtrate and removing small particles IMAQ gray morphology function is used which is dual combination of opening and closing. Unwanted particles is removed by using erosion function. IMAQ count object is used for counting eggs. The proposed method is robust yet effective for automatic counting of silkworm eggs. Function blocks of LabVIEW reduce the development time of the algorithm. Accuracy of results depends upon the size of objects, lighting conditions of background and number of erosions to separate connected objects.

4. APPLICATION

Silkworm eggs counting system using image processing algorithm will be useful for counting eggs accurately, reduces the time of manual counting and will increase benefits to the sericulture production and increasing the production of silk in India by automation in counting of silkworm eggs. By using this system, sericulturists can be guided for production of mulberry plantation before rearing process. It is also useful to count objects which are in very small size.

5. CONCLUSIONS

In this paper we have discussed different method for counting very small size of objects. Counting method is not only useful in sericulture or industries but in agricultural field and in medical field also it useful to count small bacteria and blood cells. Project can be extended in future by using hardware implementation for real time object counting system.

ACKNOWLEDGEMENT

I take this opportunity to express deep sense of gratitude and sincere thanks for valuable assistance that I have received from my guide Prof. Avinash D. Harale, I also express thanks to all who guided me, supported me during this work.

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