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Contents

Whitefly (*Bemisia tabaci*) Calculation Based on Image Processing using Triangle Method

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***Abstract*—The increasing of whitefly population and insufficient number of inspectors available, causes decreases production of vegetable crops. One solution that can be used is digital image processing. With digital image processing techniques, whitefly density can be calculated from an early age. In this study, the method used is triangle method. Triangle method is used to get the dynamic threshold value to be used in the segmentation process. The image is segmented to get the area covered by whitefly. So that whitefly densities can be calculated on the leaves. Segmentation results using triangle method has an accuracy of 75.36%. this suggests that triangle method can be used for the whitefly segmentation process in vegetable crops leaf image.**

Keywords—triangle method; whitefly; density;

I. INTRODUCTION

Vegetables is a strategic commodity in support of food security in Indonesia. This commodity has a wide diversity and is needed by the human body as a source of carbohydrates, protein, vitamins, and minerals. According to data from the Directorate General of Horticulture (2012), the value of the Gross Domestic Product (GDP) from vegetables tend to have increased from 2007 to 2010. GDP is one of the indicators in determining the contribution of commodity vegetables on state revenues. In 2010, commodity vegetables contribute to state revenue of Rp 31,244 billion. So with the increase in vegetable production in Indonesia, it will directly increase state revenues. But in fact, the production of vegetables in Indonesia in the last 10 years was not significantly increased. In fact there are some commodities, such as peppers, tomatoes, carrots, green beans, red beans, and cucumbers which decreased at year-end 2012. Based on observations, one of the factors inhibiting the production of vegetable crops are whitefly.

Whitefly are organisms that harmful to farmers. Rapid increase in whitefly population can affect the production of vegetable crops. This increase is caused by the lack of pest management and limited number of pest inspectors. The limited number of inspectors in each district can result in slow acquisition of pest information. Number of pest inspectors in the 6543 sub-district in each region in Indonesia amounted to only 3183 people, but the ideal number is one inspector for every sub-district.

One solution that is being developed at this time is to implement Integrated Pest Management (IPM). In the monitoring phase, the process is carried out is the severity of pest attack. One benchmark is the value of pest density. One method of measuring the value of pest density that is still often done is direct observation. By observation, the calculation process is done manually for each plant. However, the results are subjective and the resulting accuracy is still low. Based on this, software that can calculate whitefly density in vegetable crops accurately is needed.

Some previous researchers have done related research. Boissard et al. (2007) conducted a study for the early detection of whitefly pests on plants in the greenhouse. They use sampling techniques, two knowledge-based systems and one set of image processing algorithms. Results from these studies is that the fusion algorithm on pest density calculations may be performed to obtain optimal results. Patil and Bodhe (2011) has conducted a study to calculate the severity of brown spot disease in sugarcane leaves. In that study, they used the triangle method to determine the threshold value (threshold) used for segmentation of the diseased area. Accuracy of the results obtained was 98%. Jaware et al (2012), conducted a study to detect diseases that attack crop plants using image segmentation. Segmentation technique used is K-Means clustering. This technique is implemented well enough to perform a simple image segmentation. The research results prove that the proposed segmentation algorithm is efficient and have high accuracy. Powbunthorn et al. (2012) have developed image analysis techniques to assess the levels of brown spot disease on cassava leaves. This technique performed by transforming the RGB image into HSI. HSI image is then segmented and extraction characteristics performed to determine total leaf area and the affected area.

Based on previous research, this study aims to develop a prototype system to automatically and correctly count whitefly density using image processing technique as an alternative or supplemental to traditional direct observation method.

II. METHODOLOGY

The methodology for calculating whitefly density can be simplified as Fig. 1. This process involves several tasks, such as image acquisition, pre-processing, image segmentation, and whitefly calculation (image extraction).

A. Image Acquisition

In this process, it is preparation process to obtain vegetable leaf images contains whitefly. The RGB colour images of vegetable leaf are captured using digital camera, with pixel resolution 3888 x 2592. The selected images was 23 images and each has different characteristics. Image acquisition is done on plants with phase imago (adult), because in this phase is easier to detect whitefly. Whitefly that attack leaf image can be seen in fig. 2. Images are stored in JPG format.

B. Pre-processing

This phase is an early stage to prepare the image before the segmentation process. Process carried out at this stage are image conversion, image scaling, and image enhancement with triangle method.

- *Image conversion*

At this stage, the initial image format, ie RGB format is converted into grayscale. the format change is using equation (1).

$$s = 0.2989 \times r + 0.5870 \times g + 0.1140 \times b \qquad (1)$$

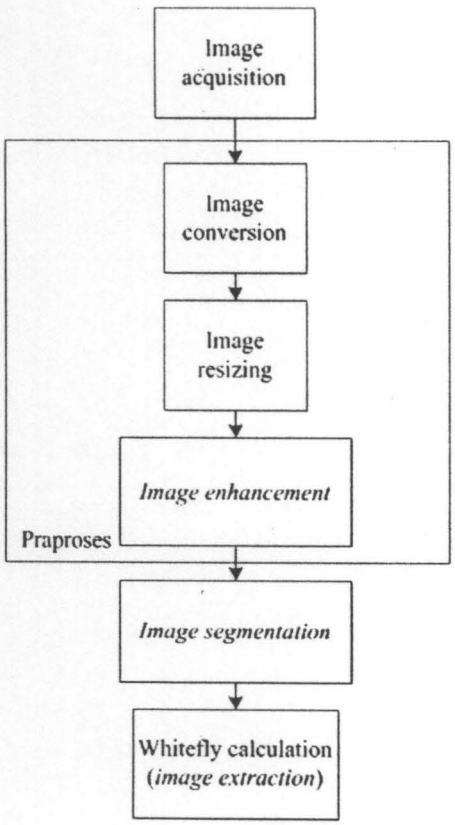

Figure 1 Methodology process

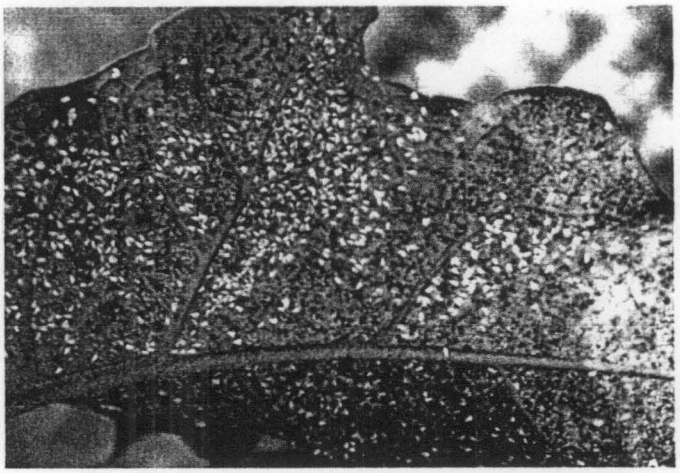

Figure 2 Leaf image attacked by whitefly

- *Image resizing*

At this stage, the initial image format, ie RGB format is converted into grayscale. the format change is using equation (1).

- *Image Enhancement*

At this stage, performed several processes including smoothing, morphological opening and contrast enhancement. Smoothing process is used for noise removal. In addition, this process is also used to eliminate texture spots on the leaves of vegetables. After going through a phase of smoothing, morphological opening is performed. Structuring element used is the form of a disk or circle with diameter 20. This process aims to eliminate parts of the image that is not a leaf. In addition, this process aims to flatten the image due to differences in lighting conditions for each image. Furthermore, the image from smoothing phase is reduced with image results of this phase.

After going through the morphological opening, the image contrast enhancement process is applied. The technique used in this process is intensity adjustment. Intensity adjustment is a technique to map the range of pixel intensities in the image histogram to a new range of pixel intensity in order to produce a better image contrast. The parameters used in this process, such as low, high, bottom, and top. Low parameter value is used as the lower limit of the image pixels to be transformed. High parameter is used as the upper limit value of the image pixels to be transformed. Bottom is used as a parameter value below the pixel mapping. Top parameter is used as the value of the pixel mapping. If you notice, the lighting conditions in each of the different image acquisition process. Therefore, we need a dynamic adjustment techniques, so that these four parameters are selected that best suits the image conditions.

Classes of light intensity conditions is selected so that adjustment techniques that can be applied optimally. The leaves condition is divided into there, such as high

brightness, medium brightness and low brightness. To classify the image into that conditions, the parameters used are the number of pixels above the threshold value. To select the threshold value, triangle is constructed by drawing a line between the maximum of the histogram at brightness bmax and the lowest value bmin in the image. The distance'd' between the line and the histogram h[b] is computed for all values of 'b' from b=bmin to bmax. The brightness value 'bo' where the distance between h [bo] and the line is maximum is the threshold value as shown in fig.3. After that, the image intensity adjustment process is applied with the parameters that have been determined for each condition.

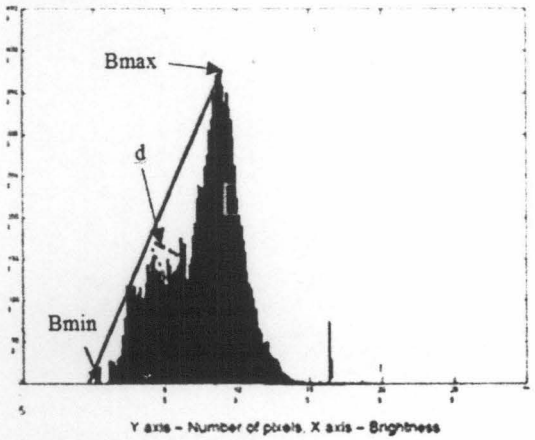

Figure 3 Illustration of triangle method

C. Image Segmentation

At this stage, to process to separate whitefly area and non-whitefly area is applied. This process uses a histogram of image that has been through the process of image enhancement. Image histogram obtained split into two areas using a threshold value. This value is obtained dynamically using the triangle method. Figure 4 shows the image after the segmentation stage.

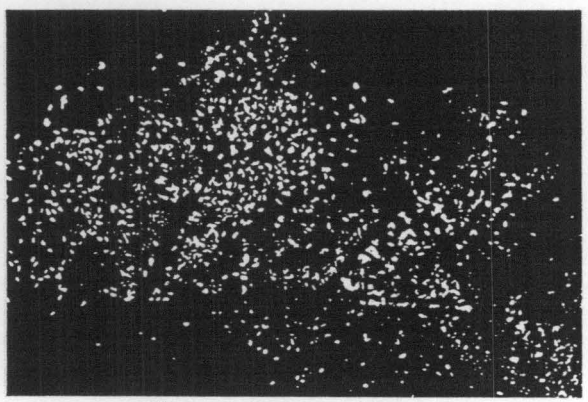

Figure 4 Segmented Image

D. Whitefly Calculation (Image Extraction)

At this stage, the whitefly calculation will be performed on segmented image. Because of segmented image is binary image, calculation is done automatically based on the contours of white pixels.

III. Result and Analysis

There are two applied methods to determine the threshold value: triangle method and without triangle method, in pre-processing and segmentation phase. These methods are used in this study for comparison which one got the optimal result. In without triangle method, threshold value used in image enhancement is 50 and threshold value used in image segmentation is 20.

Twenty-three image samples have been tested using these threshold methods and compared. This comparison uses point determined by the difference in the number of pests on the original image and segmented image as shown in Table 1. Parameters used in this comparison is the difference of the number of whitefly on the image segmentation result and the original image (x).

TABLE I Quality Point

No	Point description	Point	Difference
1	Good	3	$x < 25\%$
2	Moderate	2	$25\% < x < 50\%$
3	Bad	1	$X > 50\%$

Furthermore, the quality points are summed for all the images to get accuracy. Accuracy is obtained by using equation (2). The resulting accuracy is shown in Table 2.

$$\text{Accuracy} = (\textit{total points} / (3 \times 23)) \times 100\% \quad (2)$$

TABLE 2 Resulting Accuracy

No	Treatment	Accuracy rate (%)
1	Without triangle method	65.22%
2	Triangle method	75.36%

Judging from the results of these calculations, segmentation by using the triangle method get more accuracy than wihout triangle method. Judging from the shape function, triangle method is good to use for the image that has various pixel values conditions. One advantage of using this method lies in the use of the image histogram. If the image histogram has a spread of pixel values are closer to a value, this method is suitable for the segmentation process, especially the determination of threshold.

References

[1] [BPS]. Badan Pusat Statistika (ID). Produksi sayuran di Indonesia [internet]. [diacu 2013 Juli 10]. Tersedia pada: http://www.bps.go.id/tab_sub/view.php?kat=3&tabel=1&daftar=1&id_subyek=55&notab=70.

[2] [2] [Deptan DJTP] Kementrian Pertanian, Direktorat Jenderal Tanaman Pangan. 2010. *Pedoman Pelaksanaan Perlindungan Tanaman Pangan*

Tahun 2010. Jakarta http://tanamanpangan.deptan.go.id/doc_upload/PEDOMAN%2520PELAKSANAAN%2520PROGRAM.pdf [22 Nov 2012]

[3] [3] [Ditjen Hortikultura]. Direktorat Jenderal Hortikultura (ID). Nilai ekspor impor sayuran segar tahun 2011 [internet]. [diacu 2012 Des 12]. Tersedia pada: http://hortikultura.deptan.go.id/?q=node/394.

[4] [4] [Ditjen Hortikultura]. Direktorat Jenderal Hortikultura (ID). Kutu Kebul (*Bemisia tabaci* Genn.) [internet]. [diacu 2012 Agustus 20]. Tersedia pada: http://ditlin.hortikultura.deptan.go.id/index.php?option=com_content&view=article&id=100&Itemid=228

[5] [5] MathWorks. 2013. *Adjusting Pixel Intensity Values*. Dokumen Teknis. [Internet]. [diacu 12 Agustus 2013] Tersedia pada: http://www.mathworks.com/help/images/adjusting-pixel-intensity-values.html.

[6] [6] Boissard P, Martin V, Moisan S. 2007. A Cognitive Vision Approach to Early Pest Detection in Greenhouse Crops. Computers and Electronics in Agriculture 62. 2008: 81-93.

[7] [7] Department of Education. 2005. *Resource Manual on Integratred Production and Pest Management (IPPM) in Rice*. Laguna (Philippines): World Education (INGO) Philippines, Inc.

[8] [8] Flint, M.L., Daar, S., dan Molinar, R. 2003. Establishing Integrated Pest Management Policies and Programs: A Guide for Public Agencies. ANR Publication 8093. University of California.

[9] [9] Gonzalez, R.C., dan Woods, R.E. 2003. *Digital Image Processing*. 2nd Edition. (Singapura): Pearson Education Pte. Ltd.

[10] [10] Jaware, T.H., Badgujar, R.D., dan Patil, P.G. 2012. Crop Disease Detection Using Image Segmentation. World Journal of Scinece dan Technology. 2(4):190-194.

[11] [11] Patil SB, Bodhe SK. 2011. Leaf Disease Severity Measurement Using Image Processing. International Journal of Engineering and Technology. 01: 297-301.

[12] [12] Powbunthorn, K., Abdullakasim, W., dan Unartngam, J. 2012. The International Conference of the Thai Society of Agricultural Engineering.