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Research paper

Maize Plant Desease Identification (Zea Mays L. Saccharata) Using Image Processing And K-Nearest Neighbor (K-Nn)

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Abstract

Plant pests of maize are known to attack in all phases of corn plant growth (Zea mays L. saccharata), both vegetative and generative. Common pests found in maize are seed flies (Atherigona sp.), Stem borers (Ostrinia furnacalis), Boricoverpa armigera, leaf-eaters (Spodoptera litura). The process of identification of maize plant disease is done through laboratory analysis and direct observation. The time required to obtain the identification result is 4 (four) months. Plant pests will attack some parts of the plant, including leaves, stems and fruit. Early detection is usually done through leaves. Plant pests will attack the plant leaf area with certain characteristics. Digital image processing is the use of computer algorithms to perform image processing on digital images. Identification of maize plant disease can apply image processing techniques through the characteristics or symptoms of disease raised on the leaves. Characteristic of attacks by pests in maize plants can be detected through the colors and patterns that appear on the leaves. This research performs implementation of digital image processing method to identify disease in maize plant caused by pest. The disease is Hawar Leaf, Bulai (Downy Midew), Hama Grasshopper, Leaf Spot (Sourthern Leaf Blight). Through color and edge detection, the accuracy obtained is 91.7%.

Keyword : *Maize, K-Nearest Neighbor, color extraction, Canny*

1. Introduction

Pests in the broadest sense are all forms of disorder both in humans, cattle and plants. The definition of pests in the narrow sense associated with the cultivation of plants is all animals that damage the plants or the results of which this life activity can cause economic losses. The existence of an animal in one plant before causing economic losses then in this sense does not include pests [7].

There are types of pests and diseases that potentially decrease corp productivity. The pests are dominated by O. furnacalis and H. armigera whereas the disease is dominated by the brownish disease (Peronosclerospora maydis), rust (Puccinia sorghi), and leaf blight (Helminthosporium turcicum). The existence of pests on the field of research by farmers is considered not to affect the production of crops. Meanwhile, the diseases that play a role in the decline in production is a disease that can decrease the downy harvest to 90% more. The cultivation of sweet corn with intercropping pattern is more advantageous compared to monoculture pattern (Fitriani, 2009).

Corn pests are known to attack in all phases of corn plant growth, both vegetative and generative. Common pests found in corn are seed flies (Atherigona sp.), Stem borers (Ostrinia furnacalis), Boricoverpa armigera, leaf-eaters (Spodoptera litura).

In the detection of plant diseases the farmers will see firsthand the symptoms that appear on the parts of the plant. Based on the experience of the farmers can conclude the disease and handling it. If the farmer can not conclude, then the sample of infected plant part will be analyzed by the researchers. This takes a relatively long time. Detection and handling need time as early as possible so as not to adversely affect the growth of the next crop.

Corn plants infected with pests will give symptoms on the plant parts such as leaves, stems, and fruit. Symptoms that occur usually occur changes in color, shape and there are spots or stains on the plant. Direct observations made by farmers may provide improper information depending on the experience of the farmer and the attacking pest. Not infrequently different diseases will give the same symptoms. This is because the human eye still has not distinguished some similar things when giving different conclusions. Implementation of digital image processing techniques can help humans to draw conclusions based on the symptoms that appear on the plant.

Image Processing aims to improve image quality for easy interpretation by humans or machines (in this case the computer). One of the implementation of image processing is pattern recognition. Pattern recognition is automatically grouping numeric and symbolic data (including imagery) by the machine (in this case the computer). The purpose of grouping is to recognize an object in the image.

Pattern recognition can be applied to recognize diseases based on the symptoms raised on the leaves of corn plants. The emerging symptom feature can be extracted from leaf image to be processed in detecting maize plant disease. In this study, the extracted features are color and shape through edge detection. The classification of the disease was determined using the K-Nearest Neighbor (KNN).

There have been previous studies related to the detection of plant diseases using digital imagery. The first study was detection of disease in coffee plants using edge detection. One of the diseases that attack the coffee plant is the leaf spot. Edge detection on coffee leaves is one of the earliest forms of handling the disease. Edge detection on the leaves of the coffee plant is done to identify the geometric area of the leaf. One of the best method of edge detection is the Laplacian of Gaussian (LoG) method. This study

was able to distinguish the infected leaves and healthy leaf parts. From the process of edge detection to the coffee leaves obtained mean value of Mean Square Error of 237,629 pixels (Prihartini, 2015). Singh (2015) has conducted research on detection of plant diseases with image segmentation. Detection of plant diseases through color detection has also been done by Dey (2016). Other studies have been conducted by Bankar [2], Tejonidhi [4]. Penelitian identifikasi pola berdasarkan deteksi tepi telah dilakukan oleh Bowo[6]. This research use three detection method that is Roberts, Prewitt and Sobel method. Roberts and Prewitt methods achieved 75% for recognition rates of leaf identification forms, the Sobel method has 4%. In addition, in the leaf edge of experimental identification, Sobel's method achieved 90% for recognition rate, Roberts and Prewitt only achieved 84% [6].

2. Material and Methods

This research is done using stages in image processing, which consists of (1). Image acquisition (2) .Preprocessing (3). Feature extraction (4). Identification (5) .Try. In the identification of pests of disease Figure 1 briefly describes the steps undertaken. Figure 1 shows the process of identifying pests of corn crops

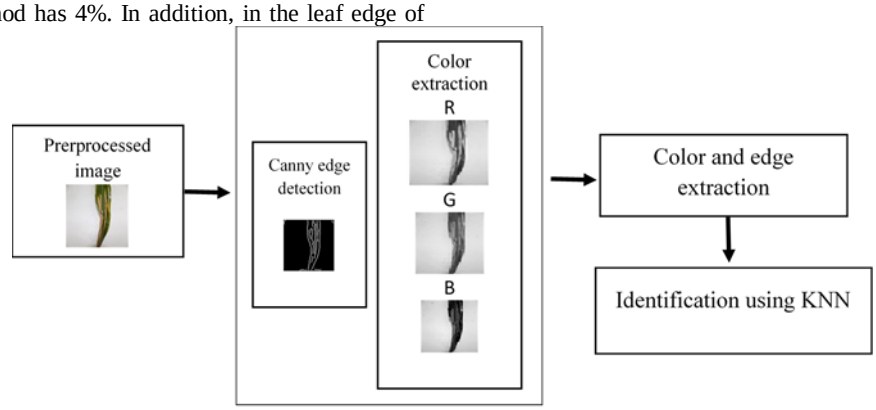

Figure 1. Steps for pest identification

2.1 Image Acquisition

Data collection in research is taken through interviews and direct observation to Indonesian Center for Agricultural Crops Research and Development. Leaf pests taken from 3 different maize plants with the total number of leaf images is 25. Image shooting is done with 20 megapixel camera and leaf image is given a white background and is done during the day. Images taken from the top, left and right sides.

2.2 Preprocessing

Image preprocessing is done by uniform image size to 100x100 pixels. Decrease in image size is done to minimize process time without eliminating image features.

2.3 Ektraksi Ciri Warna

The color value in the image is obtained by normalizing the color. The goal of normalization is to pass uniform illumination of the colors of each image. Each value of R (red), G (gree), B (blue) is determined what percentage is in the total RGB value. The equations used for normalization are as follows:

$$r=R/(R+G+B) \quad (1)$$

$$g=G/(R+G+B) \quad (2)$$

$$b=B/(R+G+B) \quad (3)$$

r,g,b = color fraction in total color

Based on equations (1), (2), (3) obtained r value = 0.34119 g = 0.33738 b = 0.32143.

2.4 Edge Detection

Steps in performing edge detection: (1) Smoothing to remove noise. At this stage Gaussian filter is used with the standard deviation σ = n. The edge should be marked on the image that has a large gradient. For that use one operator such as operator Robert, Prewit or Sobel by searching horizontally (Gx) and vertical (Gy). The results of the two operators combined to obtain the combined results of vertical and horizontal edges can be calculated using (4):

$$|G|=|G_x|+|G_y| \quad (4)$$

The edge direction is determined by equation (5)

$$\theta=\arctan(G_x/G_y) \quad (5)$$

To differentiate the line with different directions each line will be given a different color. Distribution of color is distinguished by the degree of slope of the line. Yellow for 00-25.50 and 157.50 - 1800, green for 22.50 - 67.50, red for 67.50 - 157.50. To produce a slimmer edge line the non maximum suppression method is applied. The final step in blind detection is to apply high and low tresholding to produce a binary image. Imagery before and after the edge detection process is presented in Figure 2.

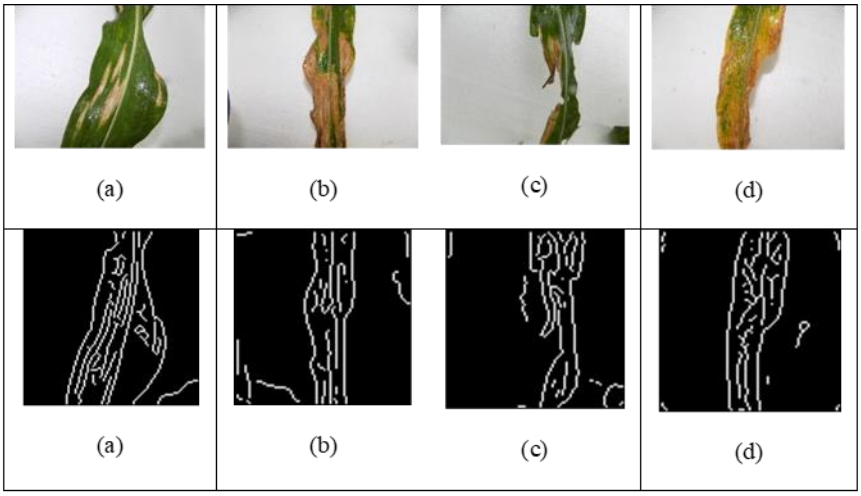

Figure 2. Preprocessed image dan result image

3. Result

This study used images of corn that are threatened by pests such as Hawar Leaf, Bulai (Downy Midew), Hama Grasshopper, Leaf Blight (Sourthern Leaf Blight). A total of 112 data were used consisting of 4 pests of maize. 100 data (25 for each type of pest) is used as training data and 12 (for each pest there are 3 data).

Preprocessing citra dilakukan untuk mengubah ukuran citra menjadi 100x100 pixel.

The image extraction stage consists of two features: color and edge. The value of K-NN color with a value of K of 20. This value is obtained based on experiments on several values of K. Figure 3 and 4 show the process of color and edge extraction

Figure 3. Color extraction

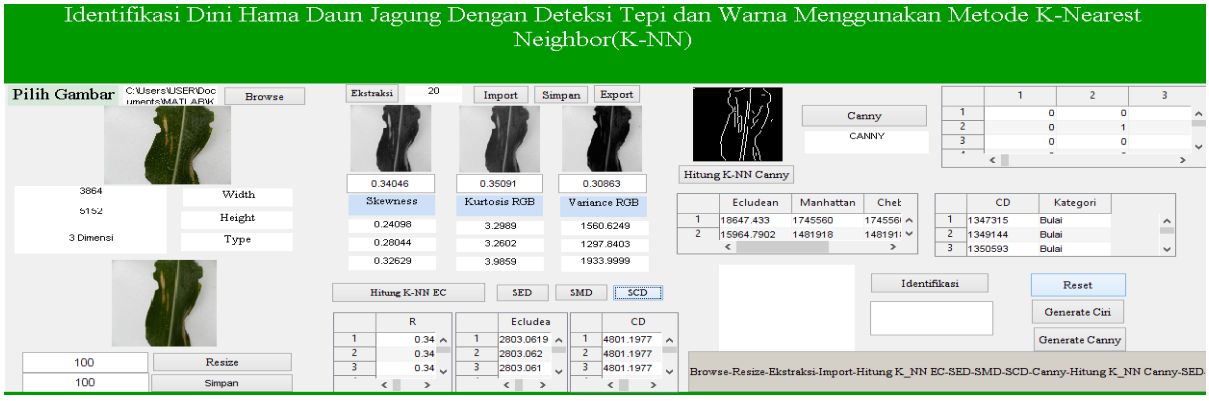

Figure 4. Canny Edge Detection

4. Discussion

The identification process is done by comparing the KNN value of the color and the edge of the image with the closest distance between the KNN color and the edge KNN. This comparison will be a comparison parameter between pests with each other (Figure 5).

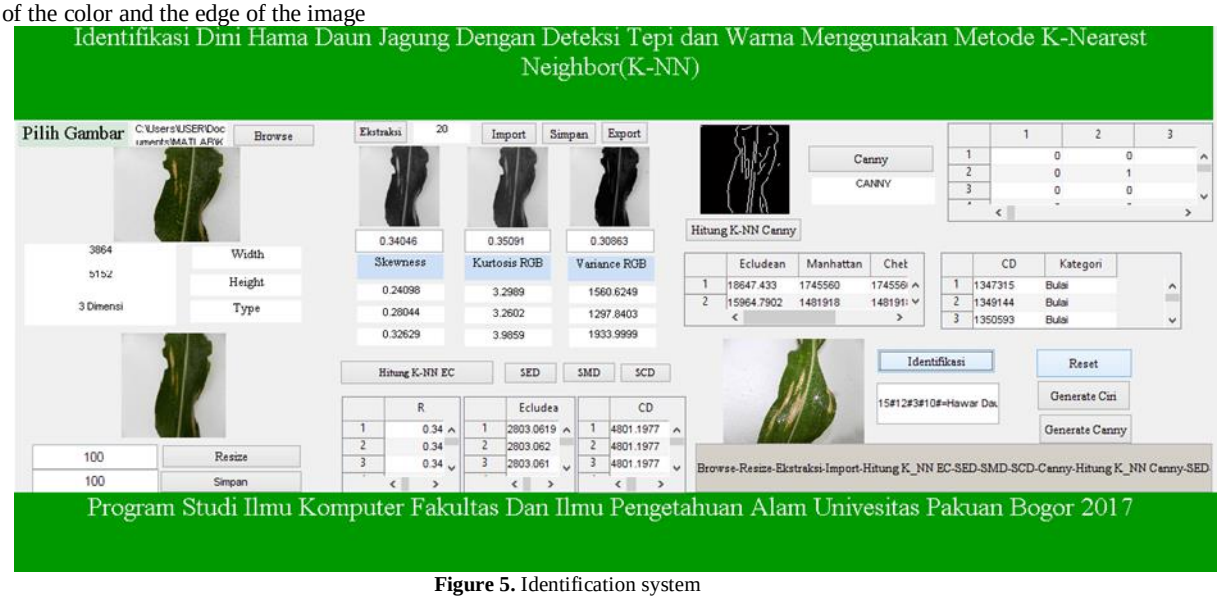

Figure 5. Identification system

The maize plants identified were corn maize which was 3 months old in the process of taking the test data.Warna dan deteksi tepi Canny digunakan sebagai metode ekstraksi ciri dan metode K-NN digunakan sebagai identifikasi. Based on the experiments on 3 data of the Hawar Leaf test, 3 test data of Grasshopper, 3 Leaf Spot test data and 3 test data of Gulai, it was found that the Leaf had 1 valid data and 1 invalid test data because the result of color extraction and edge extract on the data the leaf blight test yields a value similar to that of the Bulai pest, whereas the Grasshopper Pest has 3 valid data, the Leaf Pest type has 3 valid data and the Pulai Bulai type has 3 valid data. So with the experimental data test is drawn the conclusion that the data has 11 valid data and 1 data that is not valid. The result of validation test using extraction of combined characteristic between color and edge for pest of maize leaf yielded 91,7% accuracy value.

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