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Edge Detection Potato Leaf Damage With Laplacian of Gaussian Algorithm

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Abstract: The Potato plants are type young plant that easily attacked by pests and diseases, part of plant that often attacked by disease is leaves which can affect growth process and reduce crop yields. One way to determine if potato leaf is healthy or unhealthy is by using the edge detection method. Crop failure in potato plants can be detected through damage to leaves. The purpose of this study was to help facilitate identification type of damage to leaf margins of potato plants by applying the Laplacian of Gaussian algorithm. Based on results of testing on several research datasets sourced from the Agricultural Sector of the Karo Regency Government through an application of edge image detection on potato plant leaves through a grayscale, threshold and detection process with the Laplacian of Gaussian algorithm. It takes the longest time of 12.34 s with an error of 1.45 on the type of damage caused by aphids and at least 6.03 s with an error of 0.71 on the normal leaf edge detection results. Based on test results on 17 potato leaf images, the average test time is 8.45 s

Keywords: Potato leaf damage, Laplacian of Gaussian, edge detection

INTRODUCTION

Indonesia is an agricultural country for potato farming. In getting a good potato harvest, it is during the planting period, it should not be attacked by pests, so that it will produce a good harvest. If during the planting period, pests are attacked, then the harvest will not be good and may fail(Nazaruddin Ahmad, Iskandar, 2020). Pest and disease control in potato cultivation is very important(Dinas Pertanian, Pemerintah Kabupaten Bulelang, 2022). Pest constraints that are often encountered in potato cultivation are caterpillars (Agrotis ipsilon), leaf miner flies (Liriomyza huidobrensis), uret, and gangsir/beunceuh/cashier. Potato plants can also be attacked by late blight (Phytophtora infestans) and dry spot (Atlernaria solani)(Solusi BASF untuk tanaman Kentang, 2022). If left unchecked, it will increase the decline in food production, so it is necessary to detect diseases in plants at the right time in order to control and prevent disease(Chen, J., Chen, J., Zhang, D., Sun, Y., Nanehkaran, Y. A., 2020). The classification of leaf diseases in potato plants provides a promising step towards sustainable food security in agriculture(P. U Rakhmawati, Y. M Pranoto, dan E Setyati, 2018).

Edge detection plays an important role in object selection in image processing which will then be interpreted(Martinus HN, 2020). Edge detection is a process of searching for edge information from an image used to mark the details of image(Hotma Pangaribuan, 2019). The Laplacian of Gaussian operator captures edges from all directions and produces sharper and steeper edges(Hasanuddin Gulo, 2020; Endri Dwi Prasetyo, 2020). This is because zero-crossing defines the edge location. On the steep edge, the second derivative has zero crossing, which is the point where there is a change in the value of the second derivative, while on the gentle edge there is no zero crossing(Endri Dwi Prasetyo, 2020).

Potato plants are a type of young plant that is easily attacked by pests and diseases, the part of the plant that is often attacked by disease is the leaves which can affect the growth process and reduce crop yields. One way to determine if a potato leaf is healthy or unhealthy is by using the edge detection method. Crop failure in potato plants can be detected through damage to the leaves. The problem discussed in this study is how to identify damage to the potato leaf margins by applying the Laplacian of Gaussian algorithm. With aim to helps facilitate identification of the type of damage to the leaf margins of potato plants based on the Laplacian of Gaussian algorithm.

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Based on the results of the research, some of the benefits expected in the research are make it easier for potato farmers to find out the type of damage to the leaf edges. Quickly facilitate the solution to the damage to the leaf edges of potato plants thereby increasing potato crop yields. Reducing and avoiding crop failure in potato crops. In this study images used process to edge detection are pictures of each leaf of a potato plant affected by the disease, with the extension of JPG, PNG photos. The size of input image used is maximum of 200 x 170 pixels.

LITERATURE REVIEW

Early detection of plant diseases is very helpful increasing plant growth. The Neural Network Edge Detection Model use Laplacian of Gaussian algorithm to get best classification results with Augmentation and Fine Adjustment methods. In this case, Diseases Plants is based on simple Leaf Image Classification of normal and infected plants(Greeshma O S, 2021). Application of Artificial Neural Network using Convolutional Neural Network method with GoogleNet architecture to identify potato leaf diseases. Tests were carried out with 2152 potato leaf image samples, 1700 images as training data and 452 images as test data. Pre-processing data with resize to speed up model computation. Multiple CNN layers for feature learning and classification according to GoogleNet architecture affected by training data sharing, batchsize and dropout. Tests show that the CNN method is expected to have an average percentage of accuracy above 70%.(Dahliatul Fitriyah Ningsih, 2021).

Detection leaf potato disease with Machine Learning based classification performance comparison, using detail class dataset 552 images and 3 class labels used are potato rotten leaves which produce the highest accuracy around 91% CNN classification which has been evaluated through various performances(Ansari, 2020). Detection of potato diseases using Image Segmentation and Multiclass Support Vector Machine, presents an approach that integrates image processing and machine learning to diagnose diseases from leaf images by classifying disease (or absence of disease) in potato plants from the Plant Village database. Segmentation approach and use of supporting vector machines on a large scale shows disease classification of more than 300 images with 95% accuracy(Islam, M., Dinh, A., & Wahid, K.2017). Edge detection of meningitis image using Laplacian of Gaussian method produces sharp and thick edges. The edges meningitis are shown in the output image through white dots that are connected to each other to form a line. The stages used to detect the edges of the image using the Laplacian of Gaussian Operator are the color extraction stage, the object filling stage, the edge detection stage and the border line generation stage (Rocky Haryono. 2020)

METHOD

Type of research is qualitative, descriptive in nature and uses analysis by grouping data to find a pattern of things that are processed (though) and compare them with concepts that exist in several sources. The dataset was obtained from the results of observations and Agricultural Sector of Karo Regency Government.

Data used were sourced from the Agricultural Sector of the Karo Regency Government. The data contains data on several sample image samples of unhealthy potato plant leaves.

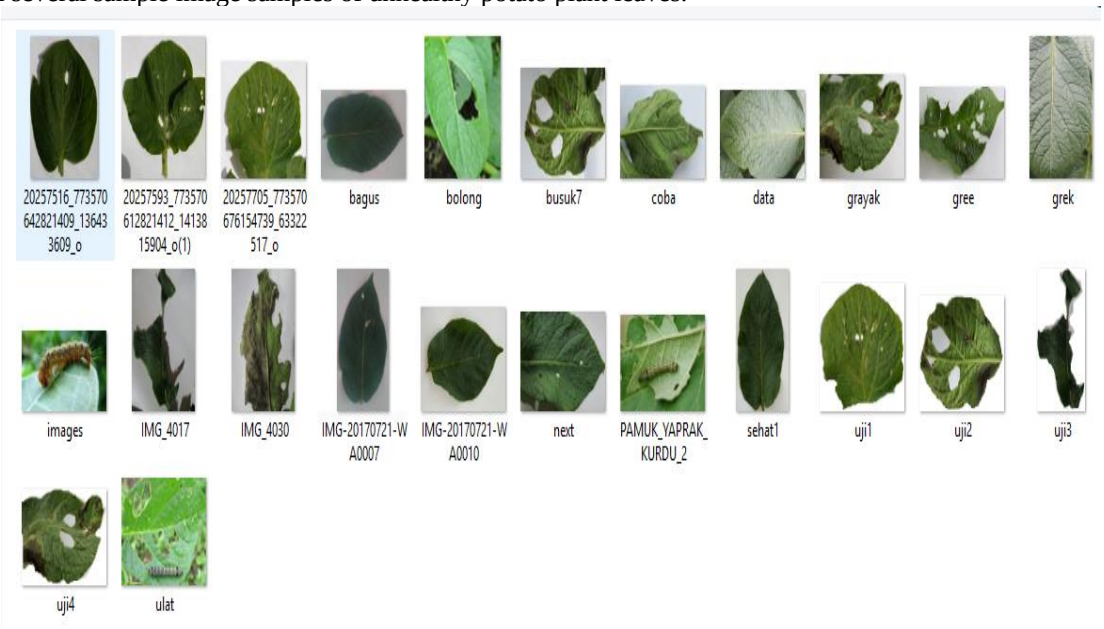

Figure 1. Potato plant leaf image dataset display

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The research was conducted to obtain information related to image identification in the dataset. The following are steps taken:

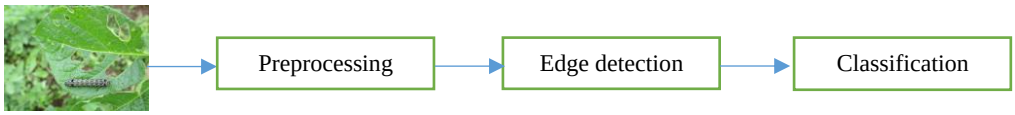

Figure 2. Diagram work

The Converter image into Grayscale to produce image quality. Next is the thresholding process to detect the edges using the Laplacian method to get the edges of the image. The following is lowchart that is used to convert image to grayscale. result of the grayscale process is an image with an intensity of 256 pixels. The lowest intensity value represents black and the highest intensity value represents white. Threshold process is carried out after the image is converted to grayscale by converting it into a black and white image to determine which areas include objects and the background of the image clearly. If the color value is greater than 128 then the pixel is changed to white, otherwise if the color is smaller than 128 then the pixel color is changed to black.

Laplacian process is carried out after image is converted into binary by thresholding to convert it into outlines. If color value is greater than 255 then the pixels are changed to white otherwise the pixel color is changed to black. The step of Laplacian algorithm are: (1) An image converted into a matrix form and performs the preprocessing process with grayscale; (2) Multiply by 3 x 3 . Laplacian kernel; (3) Select f(x,y) size 3x3, starting from the top left corner. Then calculate the convolution with the filter g(x,y); (4) Result of convolution is Replaced according to the result of the convolution, which is 3, place it in the new matrix; (5) Move f(x,y) size 3 x 3 one pixel to the right, then calculate the convolution then move f(x,y) size 3 x 3 one pixel to the right, then calculate the convolution. And so on for the 4th to 9th pixels. Then select f (x,y) size 3 x 3, 1 pixel below the top left corner. Then calculate the convolution with the g (x, y) filter. The calculation process is then carried out continuously until f(x,y) size 3 x 3 reaches the bottom right corner; (6) If the convolution result is negative, then the value is set to 0 (clipping).

The edge pixels are same as pixel values in original image, the edge pixels are ignored or not convoluted. It is assumed that the eye cannot see the edge elements because the edge pixels are very small. If convolution result produces a negative pixel value, then the value is made 0, otherwise if the convolution result produces a pixel value greater than the maximum gray value, then the value is used as the maximum gray value. And the empty pixels can be filled with the number of pixels of the initial image.

RESULT

Some of the steps carried out with the buttons on the application on each image are shown in the following images:

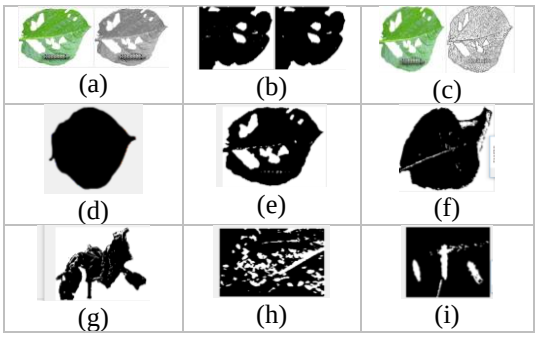

Figure 3. (a) change image color to grayscale(gray); (b) threshold results and noise fix; (c) edge detection results with Laplacian; (d) result healthy/normal leaf pixel calculation; (e) results calculation of damaged leaf pixels armyworms; (f) result calculation of sick leaf pixels/rotten leaves; (g) result calculation of sick leaf pixels/bacterial wilt; (h) result calculation of sick leaf pixels/aphids; (i) result sick leaf pixel calculation/Thrips Tabachi

Test results on several potato leaf images are presented in table 1 below:

Table 1. Test results of leaf image

Leaf Potato	Edge detection	Threshold	Time/s	Error	Description
			**06.03 s**	**0.71**	**Normal**

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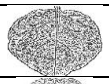
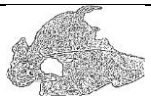
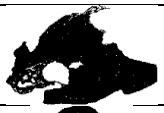
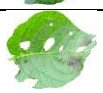
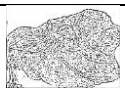
			**08.20 s**	**0.96**	**Normal**
			**12.34 s**	**1.45**	**Ulat Grayak**
			**10.58 s**	**1.27**	**Busuk Daun**
			**08.13 s**	**0.96**	**Tabachi**
			**09.85 s**	**1.16**	**Ulat Grayak**
			**08.11 s**	**0.96**	**Layu Bakteri**
			**08.59 s**	**1.01**	**Ulat Grayak**
			**7.04 s**	**0.83**	**Ulat Grayak**
			**09.10 s**	**1.07**	**Tabachi**
			**08.50 s**	**1**	**Ulat Grayak**
			**11.44 s**	**1.35**	**rayak**
			**06.91 s**	**0.81**	**Ulat Grayak**
			**08.04 s**	**0.95**	**Busuk Daun**
			**09.47 s**	**1.12**	**Kutu Daun**
			11.37 s	**1,34**	**Bercak Daun**
			4.25 s	**0.07**	**Kutu Daun**

From Table 1 above, it can be seen from edge detection results that healthy and unhealthy leaves are distinguished from the shape of the leaves. Where if healthy leaf has clear leaf bone line, while the unhealthy leaf consists of several categories, namely, the leaf bone line is not visible, and is cut off due to the presence of a hollow leaf. The following is graphic description results of table test. The process of leaf fly edge detection takes a longer time of 12.34 s with an error of 1.45 for the type of damage caused by aphids and at least 6.03 s with an error of 0.71 on the normal leaf edge detection results. Based on the test results on 17 potato leaf images, the average test time is 8.45 s.

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CONCLUSION

Based on the results of the tests carried out, some information can be obtained, namely: The application is used to segment the potato leaf image. The sample dataset used is the image of potato leaves affected by armyworm disease. Image segmentation results are stored in the computer Directory with PNG and JPEG extensions. Table 4.1 shows the comparison of image results before the segmentation process and after the segmentation process is carried out.

Based on the needs and the results of the application analysis, the following functions can be used: implementing the Laplacian method on the application. Recognizing the difference between normal images and those affected by armyworm disease through the threshold process and edge detection using the Laplacian method. Produce a conclusion about armyworm disease in the input potato leaf image, and find out the weaknesses of the Laplacian method.

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