

Tea Leaf Pest Detection Using Support Vector Machine (SVM) METHOD IN PTPN IV Unit Bah Butong

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Abstract

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Indonesia is one of the largest tea-producing countries in the world. The Ministry of Trade recorded the value of tea exports in 2017 of 1,826.8 million US dollars. So that the quality and quality of the tea produced must be considered, starting from planting tea plants, picking tea leaves, to processing tea leaves into ready-to-eat tea. So far, farmers are only picking tea leaves based on the time they are picked from the planting block. If the time to pick the block has arrived, then the block will be picked as a whole. Weather is one of the factors that affect the uncertainty of picking times. This study identified pests on tea leaves using digital image processing. The first stage starts with image acquisition and preprocessing. From the results, the statistical characteristics of each image are taken. The data resulting from the training image are stored in a database. The training image data will be used as a reference for identifying types of pests using a Support Vector Machine.

Keywords: Pest, Teh, Support vector machine, SVM, PTPN IV

1. Introduction

Indonesia's location at the equator causes Indonesia to have a tropical climate so that Indonesia has the potential to cultivate plants, especially tea plants or by other names *Camellia Sinensis* which grows in the tropics and generally grows at an altitude of 200-2000 meters above sea level with a weather temperature of 14-25 degrees. Celsius. In addition, Indonesia is one of the ten largest tea-producing countries in the world. However, during tea cultivation there are obstacles such as pests, diseases and the assessment of each planter in identifying pests is not always the same, thus affecting the production of tea plants. Pest attacks are very detrimental to planters such as the tea plantation in Bah Butong managed by PT Perkebunan Nusantara IV.

Of the total 2.8 hectares of plantation land, almost half of them were attacked by pests. So that we need a system or program that can diagnose tea leaves affected by pests, which is where it is hoped that the system can diagnose pests on tea leaves more accurately to increase plantation yields. Image processing is a method or technique used to process an image or image to produce certain information.

Puji Lestari's previous research investigated the detection of tea leaf defects in ANN Learning Vector Quantization in 2011. The method of color analysis and the comparison of leaf length and width as a feature extraction method. Tests using 100 training data and 160 test data get an accuracy of 85.38%. Prihandana Yuda 2 and Romadhony Ade researched the detection of smallpox in tea leaves in 2013. Extraction of RGB, HSI color features, and comparison of leaf width with 60 test data and 84 training data using PNN obtained an accuracy of 93.33%. Zulfah Aprilianti studied the classification of colon cancer using the Contourlet Transform feature extraction method and SVM classification in 2013. Wijayanti Ika



Ari researched the classification of tea leaf disease using the wavelet transform method and probabilistic neural networks in 2014.

Extraction of texture, shape, and color features using a low-pass filter and a high-pass filter using 120 training data and 120 test data, obtaining an accuracy of 92.5%. This final project aims to assist plantations in identifying pests found in tea leaves using a system. The simulation is done by classifying the image on the tea leaves. In addition, the shape of tea leaves affected by pests has different contours and textures, extraction is needed to capture these features. So that image data processing with classifiers uses a support vector machine (SVM). The system requires a classification of a pattern as well as an easy and statistical-based implementation, therefore the Support Vector Machine will be used to classify the types of tea leaves affected by pests.

2. Method

Tea is a beverage that contains caffeine, an infusion made by brewing the dried leaves, shoots, or petioles of the *Camellia sinensis* plant with hot water. Teas derived from the tea plant are divided into 4 groups: black tea, oolong tea, green tea, and white tea. The term “tea” is also used for beverages made from brewed fruit, spices, or other medicinal plants, for example, teas of rosehip, chamomile, chrysanthemum, and jiaogulan. Teas that do not contain tea leaves are called herbal teas. Tea is a natural source of caffeine, theophylline, and antioxidants with levels of fat, carbohydrates, or protein close to zero percent. Tea when drunk tastes a little bitter which is the pleasure of tea.

2.1. Classification of tea leaves

The tea plant is a plant that is very susceptible to disease or pests. The factor is temperature and season, if the sunlight and rain intensity are balanced then the tea leaves are good. Data collection was carried out in 8 dry seasons so that tea leaves were found that were deformed by pests. The following are characteristics of tea leaves into 2 parts, namely:

- a. Normal Tea Leaves are tea leaves that are categorized as either fresh green with no spots or colors other than world green
- b. Defective Tea Leaves are tea leaves that are deformed due to pests, viruses, or bacteria that attack the leaves, look shriveled and have color spots

2.2. Digital Image

An image is an image on a two-dimensional (two-dimensional) plane.

a. RGB Image

A color image, also known as an RGB image, is a digital image whose pixel values represent the colors red (Red), green (Green), and blue (Blue). Each color has a range of 0-255 color gradations, so the maximum number of colors that can be used is $255^3 = 16,581,375$.

b. Grayscale image

A grayscale image is an image whose pixel value represents the degree of gray on the intensity of white. Each pixel value in a grayscale image corresponds to its brightness. The pixel value of the grayscale image will be represented by bytes or words with 8-bit values, the brightness intensity varies from 0 to 255, "0" is represented as black and "255" is represented as white. The conversion calculation from RGB (Red Green Blue) to grayscale image is as follows (Slamet, et al., 2010):

$$\text{Grayscale} = ((R * 0.2989) + (G * 0.5870) + (B * 0.1140))$$

c. Binary Image

A binary image is a digital image that has two possible pixel values, namely “0” and “1”. Binary images are also referred to as B & W (Black and White) images or monochrome images. Binary images only need 1 bit to represent the value of each pixel of the image. Binary images often appear as a result of processing processes such as segmentation, development, or morphology.

2.3. Color Transformation

The color transformation is the separation of segments in an image based on the colors contained in the image. For example, an object is green because it reflects blue light with a wavelength of 450 to 490 nanometers (nm). The color of light found by 18 humans is visible light (visible spectrum) with wavelengths ranging from 400 nm (purple) to 700 nm (red).

a. RGB

RGB (Red Green Blue) is a color model that is often used in most computer applications because no transformation is needed to display information on the monitor screen. RGB (Red Green Blue) is widely used as the basic color model for most applications. The RGB (Red Green Blue) color model is a color model based on the concept of adding primary light, namely Red, Green, Blue (Sweden and Cahyanti, 2010). This color model is an additive color model, where when all three colors are combined, it will produce white.

b. CMY

Each device uses a certain color model. RGB (Red Green Blue) is used on monitor screens, televisions, and so on. However, the printer uses a different color model. The color model that is often used is CMY (Cyan Magenta Yellow). The principle of color mixing in the CMY (Cyan Magenta Yellow) model is subtractive (reducing each other) so that the more colors mixed in the CMY (Cyan Magenta Yellow) color model, the darker the result will be.

c. CIELab

The CIELab color model is a color that has the advantage of being close to the human visual system. This color model is used to distinguish one color from another. The distance between two color points in this model is calculated using the Euclidean method according to the perception of the human visual system for the two colors.

d. HSL

HSL (Hue Saturation Lightness) represents color in three components, namely Hue, Saturation, and Lightness. Hue is a color characteristic based on the light reflected by the object, in terms of color according to its size, it follows the levels 0 to 359. For example, at level 0 is red, 60 is yellow, for green 13 is at level 120, while at 180 is color cyan. For level 240 is blue, and 300 is magenta. Saturation is the level of color based on its sharpness, which serves to define the color of an object that tends to be pure or tends to be dirty (gray). Saturation follows a percentage that ranges from 0% to 100% as the color is the sharpest. Lightness is a color level based on mixing with white elements as an element that gives the impression of a light or dark color. The color correction value for Lightness ranges from 0 for the darkest and 100 for the lightest color.

e. HSV

According to several studies, HSV (Hue Saturation Value) is a color model that is better used for image processing and computer vision purposes. HSV (Hue Saturation Value) shows the color space in the form of three main components, namely Hue, Saturation, and Value. Hue is a measure of color types such as red, yellow, green, and so on. Representation in degrees with values 0–360. Saturation is the color of color. The more colorful a color means the greater the saturation value, but if the color in an image looks pale, it means that the image has low saturation. Value is the brightness value of a color. Bright colors have a high value and vice versa for dark colors a low value. When the value is very low, it is difficult to distinguish between one hue and another, meaning that the color is difficult to identify. If value = 0, any color will look black.

2.4. SVM

VM (Support Vector Machine) is a learning system that uses a hypothetical space in the form of linear functions in a high-dimensional feature space, trained with a learning algorithm based on optimization theory by implementing a learning bias derived from statistical learning theory (Nello & Taylor, 2000). The theory underlying SVM (Support Vector Machine) itself has been developing since the 1960s but was only introduced by Vapnik, Boser, and Guyon in 1992 and since then SVM (Support Vector Machine) has grown rapidly. SVM (Support Vector Machine) is a relatively new technique compared to other techniques, but it has better performance in various application fields.

3. Results and Discussion

3.1 Main page view

When the application is run, on this page, there are 3 (three) buttons and 1 (one) Combobox

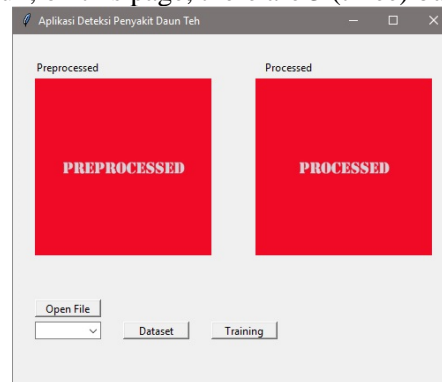


Figure 1. Main Page Display

3.2. Results page

This page is the result page when the leaf image has been entered, on this page there are 3 (three) buttons, 1 (one) combobox and 1 (one) Label

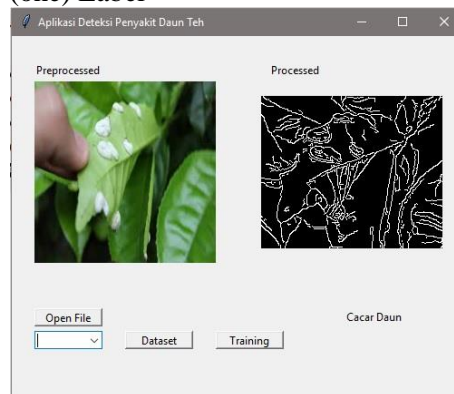


Figure 2. Results Page Display

3.3. System Test

System testing is a step taken to find out whether the system is feasible or not to be implemented. The purpose of testing this system is:

- Knowing the output generated from this system is in accordance with the predictions of the actual output.



- b. Knowing the parameters that affect the system and the resulting output in order to know the advantages and disadvantages of the system

3.4 System Testing Stage

In testing this research, there is an input image in the form of a tea leaf image which has an image format that is *.jpg. The image of tea leaves consists of images of tea leaves affected by 5 types of pests, namely Helopeltis, Empoasca, Redmite, Thrips and caterpillars. The following is a test based on the objectives described below:

- a. Image Acquisition Stage

In the first stage, the image is acquired using the Xiaomi Note 5 Pro Camera. The acquired image that will be tested is the image of tea leaves affected by 5 types of pests. The acquisition of tea leaf images was taken at PTPN IV Bah Butong Plantation with a total of 125 images taken. The images taken were affected by each pest totaling 25 images.

- b. Preprocessing Stage

In this second stage, the acquired image that has been obtained will be preprocessed. In this process the eye image will be resized and segmented, grayscale, median filter, histogram equalization. At the preprocessing stage, analysis of system performance is carried out. Performance analysis was carried out by changing the size parameters of the resize, as well as the window on the median filter that could affect the accuracy and computational time of the system.

- c. Classification and Data Amount Stage

In this third stage there is an addition, namely the classification process of image characteristics obtained from the database and the number of comparisons between test data and training data. Training image to determine the characteristics of the image used to determine the image is affected by pests. After classifying the image, then the system performance analysis is carried out. Parameters such as kernel type that affect the system in terms of accuracy and computation time.

3.5 System testing and analysis

The testing of this system is carried out by training to produce a maximum accuracy of 100%. The initial stage is using 100 images of leaves affected by pests, then done by changing the parameters. Parameters related to preprocessing are the size of the resize used, the effect of statistical characteristics, the type of kernel used for classification, and the effect of the number of leaf images. Changed parameters observed changes to the level of accuracy and computation time.

3.5.1 effect of resizing on system performance

This scenario is a test of the system by changing the size of the computation time and accuracy. Changes in the size of the resize from 128 to 1024. The results will be analyzed for the effect of changing the size of the resize on the calculation of computational time and accuracy. Other parameters used are 100 51 images of 1 statistical feature, namely kurtosis, gaussian SVM kernel, median filter with 2x2 window. The results of testing the effect of resizing on computational time and accuracy are shown in Table 3.1 below.

Resize	Accuracy	Computing Time
128x128	49%	170 s
256x256	30%	176 s
512x512	31%	190 s
1024x1024	40%	252 s

The results obtained indicate that the system testing with acquisition testing using parameter 1 statistical feature, Gaussian kernel, and median filter 2×2 produces the best accuracy at 128×128 size, which is 49% with a computation time of 170 seconds. This is because with a resize size of 128×128 the information contained in the image is better. Table 4.1 shows that the larger the size does not affect the accuracy which will increase, but it does affect the longer computation time.

3.5.2 Effect of SVM kernel on System Performance

In this test, the system will be tested for the type of kernel used in the classification stage. The data used is the best in the previous test, which uses 100 images, the statistical feature is the size of the resize 128×128 . The results of the SVM kernel type test can be seen in Table 3.2.

Kernel Type	Computing	Time Accuracy
Polynomial	100%	181 s
Gaussian	90%	174 s
Linear	60%	168 s

The results prove that the system test with 100 images, statistical features, size resize 128×128 has the best accuracy of 100% with a computation time of 181 seconds. The selection of the type of classification kernel affects the accuracy and computation time. The best accuracy is obtained in the polynomial kernel. Kernel selection depends on the type of data entered, the training data used is non-linear, or any problem where the dissolution variable cannot be written as a linear sum of independent components. so it is better to use a polynomial kernel to classify.

3.5.3 Effect of Total Data on System Performance

In this test, the system will be tested with the influence of the amount of training data and test data. The data used is the best. The results of the specifications of the system that have been obtained in the previous test are size resize 128×128 , using a polynomial kernel. The results of the effect of the amount of data on system performance can be seen in Table 3.3

Amount of Data	Practice Accuracy	Test Accuracy
100 practice 25 test 100% 74%	100 %	74%
90 practice 35 test 100% 70%	100%	70%
80 practice 45 test 100% 63%	100%	63%

The results show that the amount of training data and test data can affect system performance. The less the amount of training data, the smaller the accuracy obtained. In Table 3.3 the number of training data is 100 with test data of 25 having the best performance. The results obtained are 74% for test data.

4. Conclusions

Based on the results of the analysis of the test scenarios that have been carried out on the pest identification system on tea leaves with the Support Vector Machine classification method, it can be concluded that the Support Vector Machine classification can already be used to identify pests on tea leaves. 74% accuracy that can be used by the following parameters.

- In the preprocessing stage, the highest accuracy is obtained at a resize of 128×128 pixels and uses a 2×2 Median Filter.
- At the testing stage, the highest accuracy classification is obtained using the Polynomial kernel.
- The amount of data is 100 training images and 25 test images to get the best accuracy and computation time in the system.

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