P-ISSN: 2715-2448 | E-ISSN: 2715-7199
Vol.5 No.1 Januari 2024
Buana Information Technology and Computer Sciences (BIT and CS)

Detection of Diseases and Pests on The Leaves of Sweet Potato Plants sing Yolov4

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Abstract
Sweet potato (Ipomea batats) is a root plant that can live in all weather, in mountainous areas and on the coast. This plant is one of the important food crops in Indonesia, and makes Indonesia the second largest sweet potato producer after China. However, according to data from the Central Statistics Agency (BPS), sweet potato production in Indonesia in 2018 decreased by 5.63% when compared to production in 2017 which reached 1,914,244 tons [2]. Based on these data, it is important to conduct research on pest and disease detection in plants. Therefore, the author conducted a study related to this problem entitled Detection of Diseases and Pests on the Leaves of Sweet Potato Plants using Yolov4 with the aim of helping educate farmers in recognizing diseases on the leaves of sweet potato plants and how to overcome them. In this study the dataset was sweet potato leaves with a total of 1500 data divided into three classes, namely aspidomorpha, yellow spot and normal leaves with 4000 iterations. The best training results on 1500 data with 75% accuracy. The Yolov4 algorithm produces high accuracy in detecting diseases in the leaves of sweet potato plants.

Keywords: *Yolov4, Detection, Sweet Potato, Plants*

I. Introduction

Sweet potatoes are vines that live in all weather conditions, mountainous areas and coastal areas. Sweet potatoes are a very nutritious food with quite a lot of carbohydrates and calories. Therefore, sweet potatoes are also used as a staple food in about 4,444 regions. Sweet potatoes are also a good source of vitamins and minerals [4]. Sweet potato (Ipomoea batatas) is one of the important food crops in Indonesia and makes Indonesia the second largest sweet potato producer in the world after China. Indonesia's sweet potato production in 2018 was 1,806,389 tons of tubers.

Sweet potato production decreased by 5.63% compared to 2017 production of 1,914,244 tons. In addition to the decline in sweet potato production, the harvest area has also decreased. The sweet potato harvest area in Indonesia in 2018 was 90,707 ha, a decrease of 14.61% compared to the 2017 harvest area of 106,266 ha (Ministry of Agriculture of the Republic of Indonesia, 2019).

Previous research on leaf disease in plants, namely potatoes. In addition to agriculture, much has been done in the field of technology in overcoming the problem of potato leaf disease, one of which is the use of information technology in detecting potato plant diseases through image processing or commonly called digital image handling [10].

You Only Look Once (YOLO) is an algorithm developed for real-time object detection. The detection system used must use a recycling classifier or locator for its detection. The model is applied to images at various locations and scales. Observation is considered the area where the image scores highest [5]. YOLO uses a very different approach, applying a single neural network to the entire image. This network divides the image into several regions, then predicts the bounding box and its probability, for each box in the boundary region, there is a possibility to classify it as an object or not [9].

This research in its application is detecting diseases in sweet potato leaves using the primary dataset obtained by itself from CV. Raj Organic, with categories in one dau getting one image divided into three classes, namely: 1. Aspidomorpha, 2. Yellow spot, 3.and normal. The purpose of this study is to educate farmers in recognizing and understanding diseases and pests on plant leaves and testing the accuracy of the YOLOv4 method in detecting.

Leaf diseases in this study include:

1. Yellow spot

Yellow spots on plant leaves can be a sign of a variety of problems, including disease, nutrient deficiencies, or environmental stress. To identify the exact cause of yellow spoton plant leaves, it is necessary to examine in more detail and consider factors such as plant type, growth environment, and other symptoms that may be associated. Here are some possible causes of yellow spoton plant leaves: such as nutritional deficiencies especially nitrogen [8]. Nitrogen-deficient plants will experience yellow leaves, especially on the underside of the plant but many also occur on the surface of the leaves themselves.

2. Aspidomorpha

Aspidomorpha is a genus of a group of insects known as leaf beetles. These insects are often found on various types of plants, including sweet potato plants. They are insects that feed on leaves and can become pests for plants if their population is too large. This if allowed to eat can cause bare leaves and affect the quality of sweet potatoes produced [4].

II. Methods

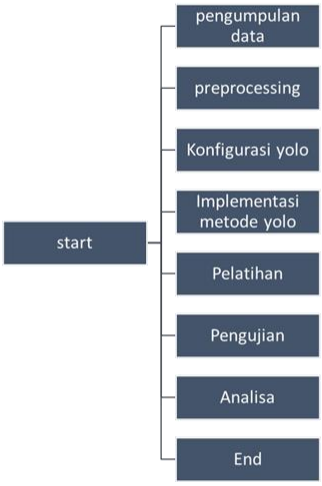

Figure 1. Flowchart Stages of research
(Source: Personal Preparation)

1. Data Collection

The image used in this study is the image of sweet potato leaves. With the number of 1500 dataset images with jpg format, which are divided into several classes, namely normal leaves 500, yellow spot 500 and aspidomorpha 500 data. The data collection technique is to use primary data obtained directly from the subjects of the first perpetrators of a study. Taken using a samsung galaxy A10s cellphone.

2. Data Preprocessing

The things done in research related to object detection include literature studies where the author looks for references and problems that will be researched. Then conducted interviews in the field in this study located at RAJ Organic, Sukun Malang interviewed directly the founder of CV RAJ Organik regarding the problem to be researched. This technique is more efficient in obtaining information about the leaf disease of sweet potato plants. Furthermore, the collection of image data taken using a cellphone camera with the total amount of data is 1500 which is further divided into 3 classes according to the type of plant disease. Next is the process of melting and changing the size of the image. Overview is the initial term in which a dataset is labeled for the purpose of storing picture information. This process is done by giving a bounding box with a class name to each image object. Then changes the image size is carried out to enhance the performance of the YOLO example in object recognition [3].

3. Yolo configuration

Network configuration is required as a model network to load the data to be trained. The configuration of parameters used for the formation of the YOLOv4 model is adjusted to the number of object classes to be detected and the ability of the graphics card to handle computational processes owned by the researcher [6]. The parameters involved are batch with value 64 and subdivision with value 16. This parameter means that in one process the step is able to computate 64 data with the division of 16 data.

4. Testing

Testing is done by selecting the model that provides the best accuracy at the end of the training process. After obtaining a model that has good and stable performance will be loaded again in the testing process. Next, the model will be given input images to start its testing process. Tests carried out on the YOLOv4 algorithm will provide detection results in the image in the form of marker boxes and object labels based on their class. When the training process runs it will produce the best weight where this best weight will be used to detect objects captured by the camera. After that, the display will display information and information from the object where the information obtained is in the form of confidence values [3].

5. Analysis

At this stage, the process of calculating the performance of the testing stages on each algorithm is also carried out. Researchers analyzed the mean average precision or mAP. The analysis method was chosen to compare the actual number of objects and the number of correct objects detected.

III. Results and Discussions

The test was conducted with 4 different epoch stages. The number of datasets is 1500 data with epochs of 1000,2000,3000 and 4000. In a detection system, the ground station (laptop) must be able to detect leaf imagery using YOLOv4. The stage carried out is to collect datasets in the form of images with a total of 15000 images of various types of sweet potato leaf diseases, then labeling.

1. Establishment of Detection Model

Modeling is a step after the training process is carried out to form a model or weight recognition system using YOLOv4 recognition objects [12]. After each image is labeled which is training data, the next step is training. In this study, we used YOLOv4 or a higher-weighted version. The training process creates a weight expansion file that is used to detect sweet potato leaf objects.

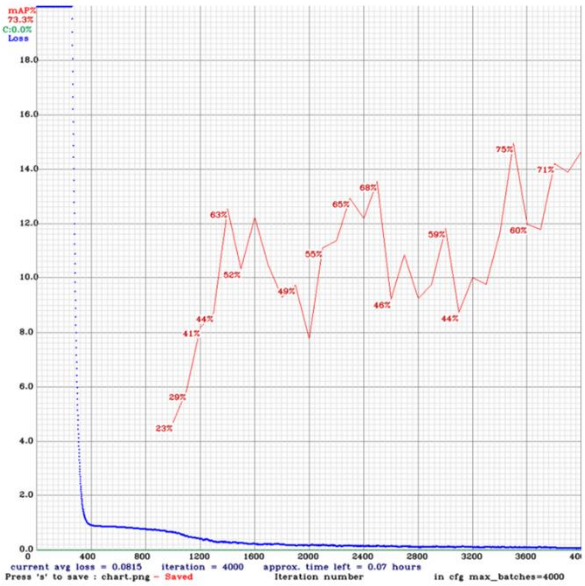

Figure 2. Training Dataset Result
Source: (personal preparation)

Based on the results of the training conducted to create the weight file took 86 hours with 4000 iterations of epochs. In Figure 5, the highest accuracy is 75%.

2. Test Results

The training result data is in the form of weights, CFGs, and file names used by the jalar ui leaf detection system. The system that has been created can be run in real time using a web camera. Its detection uses programs built with the Python language YOLOv4. Tests conducted as shown in Figures 5 and 6 show that the system is able to detect sweet potato leaves according to the class in real time by providing a bounding box when clearly identified [7].

3. Confusion Matrix Evaluation

Table 1. Confusion Matrix Results Details, Precision, Recall, F-score.
(Source: Personal Preparation)

Iterasi	TP	FP	FN	Presisi	Recall	F-Score
1000	12	5	0	0.70%	1.00%	0.82%
2000	12	4	1	0.75%	0.92%	0.82%
3000	51	372	97	0.12%	0.34%	0.18%
4000	36	162	84	0.18%	0.30%	0.23%

Precision and recall are two calculations commonly used to measure system performance. In this study, precision is calculated to determine the degree of precision between the requested information and the system's response, recall is the extent to which the system has succeeded in finding information, precision is the predicted value and the actual value [1].

Based on the table above, the 2000 iteration has a high precision of 0.75% and the lowest precision of 0.12%. It can also be seen in the recall graph that the high value is at 1000 iterations with a percentage of 1.00% and the lowest recall is 0.30%. The F-score contrasts with the weighted average of precision and memory. According to the aforementioned findings, the system does not work well in categorizing positive responses of each type, as shown by poor precision and recall results, which also indicate a low True Positive (TP) score. Higher precision and recall values because they have higher True Positive (TP) values [11]. However, because the number of False Positives (FP) is also high, causing the f-score value to be less than optimal. Here is the F-score chart.

4. System Testing

System testing is performed to demonstrate system performance. System tests are also run to check whether the system recognizes objects correctly. When testing, the system displays a bounding box that contains confidence values. The value obtained can change due to lack of lighting on the object or taking a picture that is less clear so that the object is blurred. Below are the results of testing the object system by its class.

Table 2. Confidence Values (Source: Personal Preparation)

Object	Confidence Value	Information
	0.52	Normal leaves
	0.30	AspidomorphaUse the "Insert Citation" button to add citations to this document.
	0.37	Yellow spots
	0.87	Normal leaves

Based on the test results above, fish objects can be recognized well and the system can display information including confidence values. The confidence value changes due to changes in the contrast of light on the object, but according to the test results, the confidence value is higher when the distance between the leaf object and the adjacent camera and the leaf object is photographed according to its class hasl bounding also affects the value of confidance (Widjaja &; Leonesta, 2022.

IV. Conclusions

According to research findings, system testing requires a reliable internet connection and less signal interference. Based on the results of testing and image processing with YOLOv4, the system can detect fires in real time with 4000 training epochs, thus achieving the highest accuracy of 75%. . The Yolov4 test also obtained an mAP accuracy of 73.3%, with the best precision of 0.75%, recall of 1.00%, f-Score of 0.82%. This study showed good performance in its tests.

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