DETEKSI PENYAKIT VIRUS GEMINI PADA TANAMAN CABAI MENGGUNAKAN CONVOLUTIONAL NEURAL NETWORK

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JAKARTA
2022

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Menyetujui,

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ABSTRAK

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Pembimbing TA	:	Yaya Sudarya Triana. Ph.D.
Judul	:	Deteksi Penyakit Virus Gemini pada Tanaman Cabai Menggunakan Convolutional Neural Network

Indonesia menjadi salah satu negara agraris yang memiliki 45% penduduk Indonesia memanfaatkan pertanian sebagai sumber mata pencaharian. Komoditas tanaman yang banyak ditanam di Indonesia adalah cabai. Masyarakat Indonesia yang mayoritas sangat menyukai makanan pedas menjadikan cabai cukup popular di Indonesia. Seiring dengan banyaknya masyarakat yang menyukai makanan pedas, harga cabai dipasaran selalu mengalami kenaikan yang disebabkan kelangkaan cabai. Kelangkaan cabai ini karena adanya perubahan cuaca, bahkan adanya penyakit yang menyerang tanaman cabai seperti virus gemini sehingga sering menyebabkan gagal panen. Virus gemini menyerang daun tanaman cabai yang menyebabkan tanaman cabai menguning secara perlahan. Penelitian ini bertujuan untuk mengembangkan algoritma Convolutional Neural Network (CNN) untuk mendeteksi penyakit virus gemini. Algoritma Convolutional Neural Network (CNN) merupakan algoritma yamg cocok digunakan untuk mendeteksi virus gemini pada tanaman cabai. Penelitian ini menggunakan data sebanyak 279 data citra yang terdiri dari 179 citra daun normal dan 100 daun terinfeksi Virus Gemini dengan perbandingan data latih, data uji, dan validasi data sebesar 80:10:10. Hasil pengujian yang diperoleh penelitian ini yaitu accuracy on training data sebesar 0.9731, loss on training data 0.0680, sedangkan accuracy on test data sebesar 0.9643 dan loss on test data 0.0943.

Kata kunci: Cabai, Gemini Virus, Convolucional Neural Network, Deep Learning

ABSTRACT

Name	:	Aldi Muhammad Rahim
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Counsellor	:	Yaya Sudarya Triana, Ph.D.
Title	:	Detection of Gemini Virus Disease in Chili Plants with Convolutional Neural Network

Indonesia is an agrarian country with 45% of the Indonesian population using agriculture as a source of livelihood. The most widely grown commodity in Indonesia is chili. The majority of Indonesian people really like spicy food, making chili quite popular in Indonesia. Along with the number of people who like spicy food, the price of chili in the market always increases due to the scarcity of chili. The scarcity of chili is due to changes in weather, and even diseases that attack chili plants such as the Gemini virus, which often causes crop failure. Gemini virus attacks the leaves of chili plants which causes the chili plants to turn yellow slowly. This study aims to develop a Convolutional Neural Network (CNN) algorithm to detect gemini virus disease. The Convolutional Neural Network (CNN) algorithm is an algorithm that is suitable for detecting the Gemini virus in chili plants. This study used 279 image data consisting of 179 normal leaf images and 100 leaves infected with Gemini Virus with a comparison of training data, test data, and data validation of 80:10:10. The test results obtained in this study are accuracy on training data of 0.9731, loss on training data of 0.0680, while accuracy on test data of 0.9643 and loss on test data of 0.0943.

Keywords: Chili, Gemini Virus, Convolucional Neural Network, Deep Learning

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Tugas akhir ini dibuat untuk memenuhi persyaratan untuk memperoleh gelar Sarjana Strata 1 serta Tugas akhir ini juga dibuat sebagai salah satu wujud implementasi dari ilmu yang didapatkan selama masa perkuliahan di Program Studi Teknik Informatika Fakultas Ilmu Komputer Universitas Mercu Buana. Tugas akhir ini tidak lepas dari bantuan ketersediaan data, bimbingan, masukan, dan arahan dari berbagai pihak. Oleh karena itu, pada kesempatan ini saya ingin mengucapkan terima kasih yang sebesar-besarnya kepada:

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Jakarta, 28 Juni 2022

Aldi Muhammad Rahim

DAFTAR ISI

NASKAH JURNAL

Detection of Gemini Virus Disease in Chili Plants with Convolutional Neural Network

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ABSTRACT

Indonesia is an agrarian country with 45% of the Indonesian population using agriculture as a source of livelihood. The most widely grown commodity in Indonesia is chili. The majority of Indonesian people really like spicy food, making chili quite popular in Indonesia. Along with the number of people who like spicy food, the price of chili in the market always increases due to the scarcity of chili. The scarcity of chili is due to changes in weather, and even diseases that attack chili plants such as the Gemini virus, which often causes crop failure. Gemini virus attacks the leaves of chili plants which causes the chili plants to turn yellow slowly. This study aims to develop a Convolutional Neural Network (CNN) algorithm to detect gemini virus disease. The Convolutional Neural Network (CNN) algorithm is an algorithm that is suitable for detecting the Gemini virus in chili plants. This study used 279 image data consisting of 179 normal leaf images and 100 leaves infected with Gemini Virus with a comparison of training data, test data, and data validation of 80:10:10. The test results obtained in this study are accuracy on training data of 0.8117, loss on training data of 0.7737, while accuracy on test data of 0.9643 and loss on test data of 0.2151.

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1. INTRODUCTION

Indonesia is known as an agricultural country that has a variety of plants that have high economic value. Therefore, almost 45% of Indonesia's population

depends on agriculture as a source of livelihood[1]. One of the crop commodities that are widely grown in Indonesia is chili. Chili is one of the horticultural plants that is quite popular in Indonesia because Indonesian people really like spicy food [1]. In addition, chili also contains a lot of vitamin C which is very useful for maintaining our immunity. However, the price of chili in the market is always increasing. This is because the scarcity of chili plants in Indonesia is the main factor in the increase in chili prices in the market. The cause of this scarcity is erratic weather changes that can cause crop failure[2]. Not only that, the main cause of this scarcity is a disease that attacks chili plants. One of the diseases is caused by the Gemini Virus. This virus attacks the chili plant leaves causing the chili plant leaves to turn yellow slowly.

Several studies using the Convolutional Neural Network to detect diseases in potato plants such as in research [3] resulted in the implementation of the model running well and having good results with the distribution of the dataset of 80% and 20% and the image used was changed to 150x150. In the 10th epoch with batch_size 20 with a total of 922 images of training data and 230 images of testing data, it produces an accuracy value of 95% and for validation accuracy it produces 94%. In addition, there are several studies such as [4] resulting in image detection of leaf diseases using Convolutional Neural Network by utilizing the MobileNetV1 architecture and Feature Extraction which has excellent accuracy and needs optimization to avoid overfitting. Among the studies [5], [6]showed the Convolutional Neural Network (CNN) has advantages which are indicated by higher accuracy results than other methods used.

In this paper, we develop a convolucional neural network algorithm to detect gemini virus disease. Convolucional neural network algorithm is a deep learning algorithm that is used to classify/detect image datasets so that it is suitable for detecting Gemini virus disease in chili plants.

2. METHOD

2.1. Artificial Intelligence

Artificial Intelligence is one of the main areas of research in computer science. With rapid technological advances and wide application areas, AI is becoming very rapidly spreading due to its strong application in problems that neither humans nor traditional computing structures can solve [7]. Artificial Intelligence has several fields, one of which is machine learning and deep learning. Machine learning is part of the field of artificial intelligence (Artificial Intelligence) which is commonly used in solving classification problems by grouping homogeneous classes from similar data objects [8]. Machine learning is also often referred to as the ability of software to study data with statistical methods and make decisions [9]. Deep Learning is a subclass of machine learning [7] . Deep Learning uses a layered artificial neural network to provide high accuracy in object detection, speech recognition, language translation, and so on. With a flexible architecture, Deep Learning can learn directly from raw data and can increase accuracy if more data is provided [2].

2.2. Convolucional Neural Network

Convolucional Neural Network is one of the deep learning algorithms[10]. CNN is usually used to process image data because CNN is a type of deep neural network because of the high network depth so that it is widely applied to image

data[11]. The CNN algorithm model will usually pass through a series of so-called layers. These layers consist of convolucional layers, polling, fully connected layers, and the application of the softmax function to classify objects with probability values between zero or one [7][3][12][6][5][13].

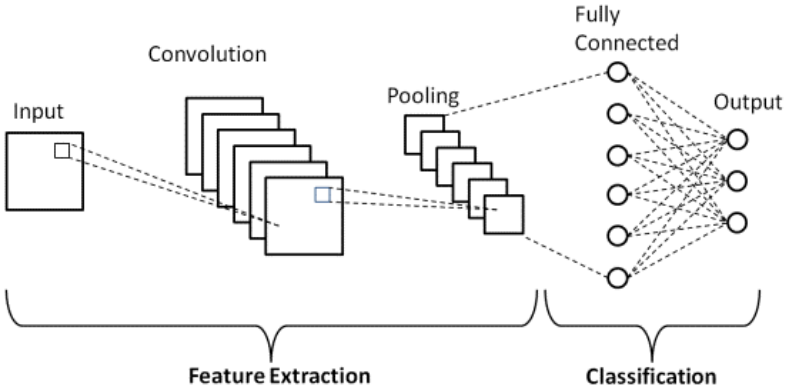


Figure 1. Basic Architecture of Convolutional Neural Network Algorithm

2.3. Data Preparation

At this stage, researchers prepare data starting from data collection to data sharing. Data collection is carried out for 2 months from November 2021 to December 2021. After the data is collected, image data filtering is carried out first which data can be used to carry out the data training process. The dataset in this study contained 279 image data consisting of 179 images of normal leaves and 100 leaves infected with Gemini Virus. Then the data is used as a dataframe for convenience in dividing the dataset into train, test, and validation data.

Table 1. Total chili plant image data

Name	Total
Normal	179
Gemini Virus	100
Total	**279**

After that, the dataframe is divided into data train, test data, and data validation with a comparison of train data, test data, and data validation of 80:10:10 so that the results of the division are as shown in Figure 2.

```
set         tag
test        gemini_virus      6
            normal           22
train       gemini_virus     84
            normal          139
validation  gemini_virus     10
            normal           18
```

Figure 2. Data Training, Data Testing, and Data Validation

2.4. Training Model

At this stage, the researcher uses the Convolucional Neural Network algorithm with the addition of MobileNetV2 and EfficientNet in making the training data model. Before the data is entered into the model, the data is pre-processed first to facilitate the data in carrying out the model training process so

as to get maximum results. During pre-processing, the image data that has been divided into train data, test data, and validataion data is generated into an array so that it can be read by tensorflow using the ImageDataGenerator library. Then, transform the train_generator and other variables into tf data, why use tf.data because tf.data is a type of generator variable that matches tf. Keras so that it is optimal in reading data carried out in the training process compared to only using the generator from Keras itself. After training the data, the next step is to evaluate the model. This aims to find out whether the algorithm model that we train has met what we expected or not.

2.5. Predict Data

After the model has been successfully created, the next step is data prediction. This stage detects whether an image is included in the normal label or the Gemini Virus label. Before the image data is predicted, the image data is pre-processed for the purpose of facilitating the model in reading image data so that it can produce good data accuracy.

3. RESULTS AND DISCUSSION (10 PT)

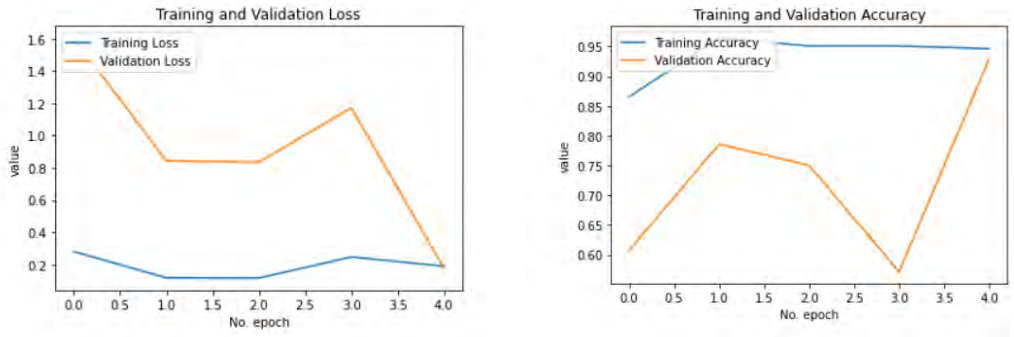
3.1. Model Training Results

Training data using Convolucional Neural Network algorithm. In making this model, the authors add MobileNetV2 and EfficientNet to the CNN architecture layer to help overcome the need for excessive computing resources during data training so as to produce good data accuracy. The following is a summary model of the CNN architecture that has been created.

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 160, 160, 128)     3584

 activation (Activation)     (None, 160, 160, 128)     0

 conv2d_1 (Conv2D)           (None, 158, 158, 32)      36896

 activation_1 (Activation)   (None, 158, 158, 32)      0

 max_pooling2d (MaxPooling2D  (None, 79, 79, 32)       0
 )

 dropout (Dropout)           (None, 79, 79, 32)        0

 conv2d_2 (Conv2D)           (None, 79, 79, 64)        18496

 activation_2 (Activation)   (None, 79, 79, 64)        0

 conv2d_3 (Conv2D)           (None, 77, 77, 64)        36928

 activation_3 (Activation)   (None, 77, 77, 64)        0

 max_pooling2d_1 (MaxPooling  (None, 38, 38, 64)       0
 2D)

 dropout_1 (Dropout)         (None, 38, 38, 64)        0

 flatten (Flatten)           (None, 92416)             0

 dense (Dense)               (None, 512)               47317504

 activation_4 (Activation)   (None, 512)               0

 dropout_2 (Dropout)         (None, 512)               0

 dense_1 (Dense)             (None, 2)                 1026

 activation_5 (Activation)   (None, 2)                 0

=================================================================
Total params: 47,414,434
Trainable params: 47,414,434
Non-trainable params: 0
_________________________________________________________________
```

Figure 3. Summary of CNN model Structure

Then, the model is used to conduct training on data train and data validation which have been previously separated with epochs of 5. The results of the training model are as follows.



(a) (b)

Figure 4. Training Result (a) Loss training and validation graph and (b) Accuracy training and validation graph

In the Fig. above, the results of the CNN training model that have been created show the loss training value moving from 0.28 and ending at 0.18, while the validation moves from 1.6 and ends at 0.17. for the value of the training accuracy moves from 0.86 and ends at .094 while the validation moves from 0.60 and ends at 0.92. This shows that the results of the training model that has been made get good results so that it can be used to make image predictions. At the time of data evaluation, The test using the Convolutional Neural Network (CNN) resulted in accuracy on training data of 0.8117, loss on training data of 0.7737, while accuracy on test data of 0.9643 and loss on test data of 0.2151.

3.2. Image Prediction Results

After getting the results of a good data training model. The model is saved into a file which will later be used to make an image prediction whether the image of chili plant leaves includes normal leaves or leaves infected with Gemini Virus. In this study, the authors used 5 images of chili plant leaves as follows.

Table 2. Image test data

Name	Label
20211212_094649.jpg	Normal
20211212_100301.jpg	Normal
Gemini Virus 1.jpg	Gemini Virus
Gemini Virus 2.jpg	Gemini Virus
Gemini Virus 3.jpg	Gemini Virus

The five leaf images are predicted using the previously stored CNN model and then get the following prediction results.

Table 3. Model testing results

Name	Label	Result
20211212_094649.jpg	Normal	Normal (95%)
20211212_100301.jpg	Normal	Normal (80%)
Gemini Virus 1.jpg	Gemini Virus	Gemini Virus (98%)
Gemini Virus 2.jpg	Gemini Virus	Gemini Virus (99%)

Gemini Virus 3.jpg	Gemini Virus	Gemini Virus (99%)

Based on the data in the table 3, it can be concluded that the CNN model that has been made can predict the image of chili plant leaves well. However, there will be cases where the model incorrectly predicts the image in the future. This is due to several factors, including:

a. Light, Light can affect the prediction results of an image. In this case, if the light in the image has a very high contrast, the model can predict that the image is a leaf infected with Gemini Virus due to the similarity of color to the light and the leaves of the chili plant.
b. The lack of data when training the model can cause incorrect predictions of an image. Therefore, it is recommended to continue to add training data to get maximum accuracy results

4. CONCLUSION

Based on the results of research that has been carried out on the detection of gemini virus disease in chili plants using the Convolutional Neural Network (CNN) by adding MobileNetV2 and EfficientNet to the Convolutional Neural Network (CNN) architectural layer. The data used were 279 image data consisting of 179 normal leaf images and 100 leaves infected with Gemini Virus with a comparison of training data, test data, and data validation of 80:10:10. The test results in this study are strongly influenced by the intensity of light in the image used, light can affect the prediction results of an image. because the light in the image has a very high contrast, the model can predict that the image is a leaf infected with the Gemini Virus because of the similarity in color to the light and leaves of the chili plant. The test using the Convolutional Neural Network (CNN) resulted in accuracy on training data of 0.8117, loss on training data of 0.7737, while accuracy on test data of 0.9643 and loss on test data of 0.2151. This research still has many shortcomings and requires improvement efforts regarding the data to be able to add more training data to get maximum accuracy results.

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KERTAS KERJA

Ringkasan

Kertas kerja ini merupakan material kelengkapan artikel jurnal dengan judul "Deteksi Penyakit Virus Gemini pada Tanaman Cabai dengan Convolutional Neural Network". Kertas kerja ini berisi semua material hasil penelitan Tugas Akhir. Di dalam kertas kerja ini disajikan beberapa bagian yang terdiri dari literature review, source code, dataset yang digunakan, tahapan eksperimen, dan hasil eksperimen secara keseluruhan.

Bagian I membahas mengenai literature review yang berisi artikel jurnal yang menjadi dasar atau landasan dalam penelitian ini. Bagian II menjelaskan mengenai source code yang digunakan pada penelitian ini. Bagian III menjelaskan mengenai dataset yang digunakan, meliputi penjelasan dan sumber data. Bagian IV memuat tahapan eksperimen yang disajikan dalam gambar dengan penjelasan dari setiap tahapan. Bagian V merupakan bagian terakhir dari kertas kerja ini yang menjelaskan hasil keseluruhan dari eksperimen yang telah dilakukan, meliputi penjelasannya.