Cotton Plant Disease Prediction Using Deep Learning

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***Abstract*— The use of deep learning models to identify lesions on cotton leaves based on images of the crop in the field is proposed in this work. It has become a target for a wide range of agricultural pests and diseases as a result of its tropical cultivation, demanding treatment. Furthermore, early indicators of significant pests and infections might be difficult to spot, making precise lesion diagnosis challenging for growers. The current research proposes a deep learning-based solution for cotton leaf screening to aid in the problem's resolution, allowing for better monitoring of the cotton crop's health and management decisions. The automated classifier CNN will be utilized in this technique to classify those two categories based on learning with certain training samples. Finally, simulation findings demonstrate that using a network classifier reduces training errors while improving classification accuracy.**

Keywords—Plant disease, deep learning, CNN, Classification.

I. INTRODUCTION

Cotton is one of the most commercially significant crops used in the textile industry. It is grown in more than a hundred countries throughout the world, and in Gossypiumspp. It was unsuccessful. because around 2.5 percent of the world's arable land is under cultivation. Cotton is referred to as "white gold". "The King of Fibers"

Agriculture is the backbone of Ethiopia's economy, providing 85 percent of employment and 90 percent of total international trade. Ethiopia is said to be good for a variety of agricultural products, including cotton. Traditional equipment and methods are unsuccessful .Using image processing techniques in an agricultural vision system, this study demonstrates how to diagnose cotton plant disease .Automatic plant disease detection is critical because it allows farmers to monitor large fields of crops and detect disease signs as soon as they appear on plant leaves. A farmer may find it difficult to recognize a variety of plant illnesses. Plant disease is predicted to cost the global economy $60 billion in crop losses per year. because they take a lot of physical labour and time. A plant disease is a physiological abnormality and it is doomed if it becomes infected with a disease. It will show certain signs and symptoms. One of the signs is a change in the appearance of the eyes. Some of the symptoms include wilted leaf patches, rots, cankers, and other issues. The main goal of this model is to identify and cure the disease in cotton plants. The CNN model is used to forecast whether or not the plant is sick based on its position on the leaves. The proposed study employs the ensemble learning concept, which is implemented using a deep learning algorithm. The data is compared after deployment to discover which model is the most accurate.

II. LITERATURE REVIEW

Gokulnath BV and Usha Devi G, [1] The goal of this study was to conduct a survey on the use of machine learning and deep learning techniques to forecast plant disease. This aspect has an impact on plant production when it comes to predicting illness in plants. The machine learning method aids in the detection of plant disease. Random forest, Bayesian network, Decision Tree, Support Vector Machine, and other techniques are used. Plant disease is caused by a variety of circumstances. Plant pathology is primarily concerned with pathogen research. Pathogens and environmental conditions are the two elements that cause plant disease. Viruses, fungus, bacteria, and other microorganisms are examples.

Azath M., Melese Zekiwos, and Abey Bruck [2] Deep learning-based image processing was used in this work to diagnose cotton leaf disease and pests. Cotton, also known as gossypiumsapp, is also referred to as "white gold" and "the king of fibres." The goal of this research was to create a model for identifying cotton plants.

Kalpesh Shinde, Nishant Dhamale, Sudarshan Dangat, and Prof. Anand Khatri, [3] The detection of cotton lesions was reported in this work utilizing a deep learning approach. Here, deep learning technology is used to detect the cotton plant's leaf base in photos. Each picture is processed and evaluated separately. Here is the diagnosis algorithm: The lesson's casual agent suggested an algorithm for implementing software usage.

S.Nandhini and K. Ashokkumar [4] Crop disease prediction by machine learning from crop leaf images is the goal of this

work. Plant diseases pose a significant threat to food security. The plant's illness is detected using a smartphone.

T.Linda J. Thomson , Sarina Macfadyen , and Ary A. Hoffmann [5] discuss the effect of climate change on natural enemies of natural pests. Climate change has an impact on plant productivity. Climate change will have an impact on the interactions between plants, natural enemies, and herbivores, demonstrating the difficulty of making predictions.

Rafael Faria Caldeira,Wesley Esdras Santiago and Barbara Teruel, [6] This paper uses deep learning techniques to identify the cotton leaf based on images of the crop. The images are pressed and analyzed individually. Here is the algorithm to diagnose the casual agent of the lesson. proposed algorithm for software implementation.

Chitranjan Kumar Rai, [7] The concept of deep learning was used to identify and predate the cotton plant disease using real-time images of leaves and plants. The DCNN architecture was used to automatically diagnose diseases in cotton leaves and plants by changing the parameters of the AlexNet architecture. On a test dataset of about 200 pictures, the recommended model functioned admirably. The rate of accuracy is 98 %. This research also shows how simple it is to implement this method. in order to obtain the required results.

Pratiti Saha and Dr. Nachappa MN, [8] Cotton plant disease prediction is widely used in agriculture. It's a sort of image processing used in vision systems that are automated. To assess whether or not the plant is infected, the CNN model is utilized. Several data mining models, for example, are used to successfully analyze data. Deep learning appears to have a lot of promise for organizations looking to enhance accuracy.

III. MOTIVATION

Human civilization has been able to generate enough food to feed approximately 7 billion people. Climate change, pollinator decline, and plant disease are the various issues that affect food security. In addition to that, crop plant disease is a worldwide problem, not just in one nation. They may be beneficial to food security, but they also have the potential to be devastating. Healthy crops are essential to people's livelihoods. Smallholder farms are home to the majority of hungry people (50%). As a result of the decrease in agricultural households, the number of small-scale farmers has decreased. They are more at risk.

IV. METHODOLOGY

The purpose of this paper is to obtain the CNN model used to predict whether a plant is infected or not based on leaf area. The proposed research work serves the concept of integrated learning, done with a deep learning algorithm. The model should be able to distinguish between disease and a fresh leaf. The dataset is divided into two sets of training and testing data. The model should be trained with additional data to obtain reading accuracy. The result from this model can be used to create plant classifications. Modules for diagnosing plant diseases image collection, pre-image processing, image classification, and separator selection.

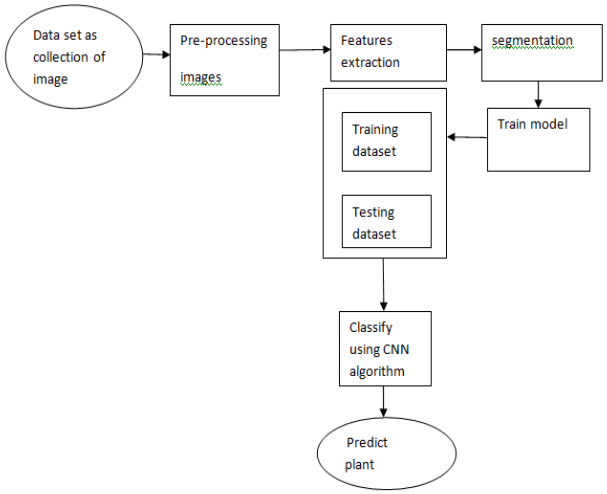


Figure 1:

Cotton Plant Disease Prediction Methodology

The steps that require to be followed are:

- Image collection
- Pre-image processing
- Image classification
- Separator selection

a. Image collection : For cotton plant disease prediction, the user must utilize a dataset, and the properties of this dataset are used to train the model.

b. Pre-image processing: Pre-processing is used to improve picture data by suppressing undesired distortions or enhancing other relevant image properties for later processing. For continuous segmentation, data is processed and sent.

c. Image classification: The process of splitting an enhanced image into distinct pieces is known as picture segmentation or classification

d. **Separator selection:** We're using CNN at this point to identify and Order the plant leaf diseases (Convolutional Neural Network). CNNs are commonly used for picture categorization and recognition. Convolutional Neural Networks specialized for application in images. CNN is mainly used in image analysis tasks like image recognition and Object detection & Segmentation.

V. BUILD MODEL

The building of a model is a critical step in the cotton plant disease prediction process. The users apply the algorithms to build the model. [9]. The steps involved are:

1) Import the libraries

```
from tensorflow.keras.layers import Input, Lambda, Dense, Flatten
from tensorflow.keras.models import Model
from tensorflow.keras.applications.resnet50 import ResNet50
from tensorflow.keras.applications.resnet50 import preprocess_input
from glob import glob
```

2) Define the image size according to the standard set by ResNet50

```
# re-size all the images to this
IMAGE_SIZE = [224, 224]
```

3) Define the training path and testing path of the images of cotton plants

```
train_path = 'dataset/train'
valid_path = 'dataset/test'
```

4) Load the pre-trained model and define the weights and input image size

```
# use imagenet weights
resnet = ResNet50(input_shape=IMAGE_SIZE + [3], weights='imagenet', include_top=False)
```

5) Do not train the existing weights

```
# not to train existing weights
for layer in resnet.layers:
    layer.trainable = False
```

6) Use glob to get total categories so that we can add it at the bottom of our network

```
# get no of output classes
total_no_of_classes = glob('dataset/train/*')
```

7) Now flatten the output

```
# flatten all the layers
x = Flatten()(resnet.output)
```

8) Find the predictions and feed it to the mode

```
output_layer = Dense(len(total_no_of_classes), activation='softmax')(x)
```

9) Create model object

```
# create object for the model
resnet_model = Model(inputs=resnet.input, outputs=output_layer)

# show model architecture
resnet_model.summary()

# inform model about cost and optimization method to use
resnet_model.compile(
    loss='categorical_crossentropy',
  optimizer='adam',
  metrics=['accuracy'])
```

10) Use Image Data generator to import images from folder and for data augmentation

```
# utilize 'Image Data Generator' for importing images from the dataset
from tensorflow.keras.preprocessing.image import ImageDataGenerator

train_datagen = ImageDataGenerator(rescale = 1./255,
                                   shear_range = 0.2,
                                   zoom_range = 0.2,
                                   horizontal_flip = True)

test_datagen = ImageDataGenerator(rescale = 1./255)

# give same target size as input size for the images
training_set = train_datagen.flow_from_directory('dataset/train',
                                                 target_size = (224, 224),
                                                 batch_size = 32,
                                                 class_mode = 'categorical')
```

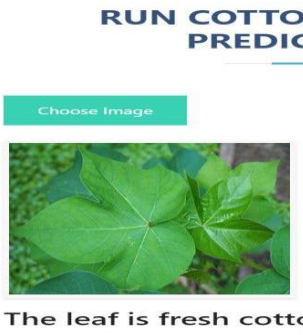
```
test_set = test_datagen.flow_from_directory('dataset/test',
                                            target_size = (224, 224),
                                            batch_size = 32,
                                            class_mode = 'categorical')
```

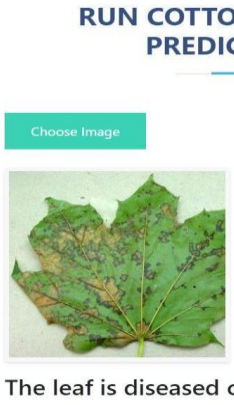
```
# run the resnet model
result = resnet_model.fit(
  training_set,
  validation_data=test_set,
  epochs=20,
  steps_per_epoch=len(training_set),
  validation_steps=len(test_set)
)
```

In this I have kept the epochs as 5 so the accuracy will be a bit less but if you increase the number of epochs, accuracy will definitely increase.

VI. RESULT

Based on the dataset provided, the prediction of cotton plant disease using deep learning may be classified as "fresh leave" or "disease". During training, the network classifier in use provides the least amount of error and the best degree of classification accuracy. The dataset contains images of different leaves that are fresh and diseased.





VII. CONCLUSION

This research describes a strategy for predicting cotton plant disease. A CNN model simulation is used to determine whether or not a plant is infected based on a spot on the leaves. The user first processed the data, then implemented a solution. To extract certain dataset characteristics, we used transfer learning resnet50. Then Finally, the simulated outcome reveals that network classifier in use produces the least amount of error during training and the highest level of classification accuracy. The dataset may be expanded, and deep learning algorithms or tools can be used to forecast cotton plant disease. This work has a lot of potential use in the future. Artificial neural networks (ANN) and convolutional neural networks (CNN) are the two most commonly used neural network models. The proposed algorithm will be implemented using software that can be used during actual field visits to aid in the construction of maps depicting the degree of pest and disease infestation.

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