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Smart Disease Detection On Crops With Machine Learning

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***Abstract*— Agriculture been the most important work or task which has no end, the work with such an endless entity needs automation and smartness .As population increasing day by day the number to people to be stomach filled are increasing. To fulfill this increasing demand for food increase in yield is major concern. This needs hybridization, each innovation has major profits and some losses. In this case the crops have been acquainted to various diseases to tackle such an huge proportion diseases their need to have an prior knowledge about them and also quick identification for this disease. The document mainly focuse on the priority solutions for disease detection in crops (majorly corn) using machine learning and deep learning techniques.**

To maintain such an interesting disease record using image comparison to train the data the large dataset with huge sample images to train the model is must. The paper focuses on methodology and future trends in this disease detection with the learning technologies and maintaing accuracy at the results.

Keywords—CNN, Deep Learning, Corn Disease, Py Torch,

Resent.

I. Introduction

The project mainly focus on detecting leaf disease in corn crop. Corn has been extensively grown as it as multiple uses and has a great market, as the crop maize is profitable it also has large amount of diseases been prone to to tackle this diseases on leaves a system based on machine learning can help detecting diseases on the maize. With the help of huge amount of sample images in the dataset to detect the diseases in the maize leave works on training and testing model designed using machine learning algorithms. Corn, a staple crop globally, is acquainted as to various diseases that can significantly impact crop yield and quality. Detecting these diseases early is crucial for effective disease management and maintaining food security. The problem at hand is to develop a machine learning-based system that can accurately and efficiently detect and classify diseases affecting corn plants.The ultimate goal of this project is to contribute to sustainable agriculture by helping farmers protect their corn crops against diseases, reduce crop losses, and ensure food security for a growing global population.

Comon Rust

On both leaf surfaces, common rust causes elongated pustules that range in color from rust to dark brown. Cinnamon-colored rust spores are present in the pustules. Pustules mature and become darker. Sheaths and leaves alike may become diseased. Severe weather can cause leaf chlorosis and even death. Brown pustules that appear on both the top and bottom leaf surfaces of common rust help to distinguish it from Southern rust. this leaves are more prone to getting acquainted to less growth.

Common rust diseases affecting corn are fungal infections that can have a significant impact on corn crops. The most prevalent rust diseases in corn are common rust and southern rust . Here is some information about these diseases: Symptoms: Common rust appears as small, round to elongated, reddish-brown to black pustules or lesions on the

leaves, stalks, and husks of corn plants. These pustules often contain powdery, rust-colored spores. Leaves may have a general yellowing appearance as the disease progresses. Refer figure 1.

Figure 1

Corn Leaf Blight

Corn leaf blight is a fungal disease that can affect corn plants, potentially causing significant damage to the crop. There are several types of corn leaf blights, with the most common being Northern Corn Leaf Blight and Southern Corn Leaf Blight. Symptoms: Symptoms of NCLB include the development of long, elliptical, grayish-green to tan lesions on corn leaves. As the disease progresses, these lesions can expand and merge, leading to significant leaf damage. The lesions often have a characteristic "cigar-shaped" appearance. In severe cases, NCLB can lead to reduced photosynthesis, reduced yield, and increased vulnerability to stalk rots.

Wet, humid, cool weather that occurs later in the growing season is ideal for the growth of northern corn leaf blight. The fungus that causes this disease can spread its spores from afflicted areas over great distances by wind. Spores blown by the wind are also necessary for localized spread within and between fields.

Refer Figure 2.

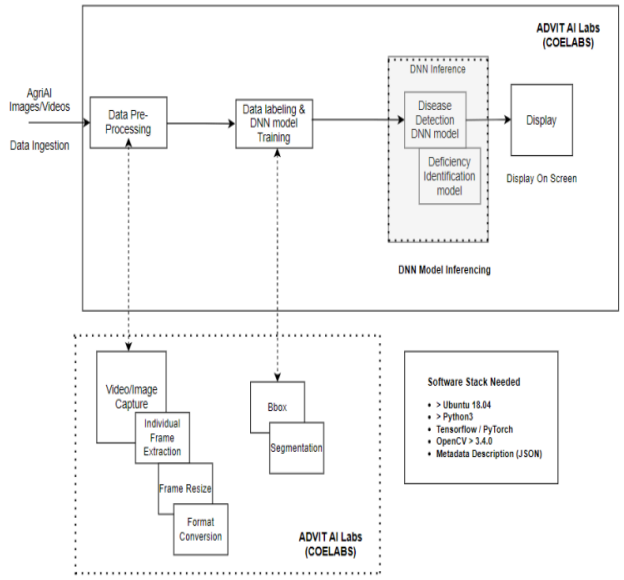
Figure 2

Corn Leaf Spot

Corn leaf spots, also known as leaf spot diseases, are fungal infections that affect corn plants. There are several different types of leaf spot diseases that can occur in corn, and each is caused by a specific fungal pathogen. Northern corn leaf spot primarily affects inbred seed production lines. On hybrids, the disease rarely poses an issue. Anthracnose, southern corn leaf blight, and northern corn leaf blight can occasionally be mistaken for this disease's symptoms. Northern corn leaf spot symptoms typically emerge during silking or at full maturity. On lower leaf blades, lesions that are grayish-tan in color and have a darker border initially show up. These are little, one-inch-long lesions. They can also appear on the husks and sheaths of leaves. The pathogen's race and the genotype of corn cause different symptoms. Race 2 causes oblong lesions that resemble southern corn leaf blight, mainly on lower leaves and on developing plants. Race 3 yields constrained, linear . This disease is a major cause for the reducation in growth for the maize cultivation.

Figure 3

The system mainly uses deep learning techniques to conquer accurate results in disease prediction towards high accuracy, as in machine learning the features or traits are to be manually



assigned it sometimes reduces the efficiency of the results identification of the disease. CNN algorithm is the primary aspect of the project to be understood the use of CNN algorithm to identify the disease is essential to get minute accuracy in the results

The sample images are been entered into the trained model for the analysis the sample images may have variety in it, their might be presence of disease in the leaf image and also possibilities of leaf been clean and healthy. In Data pre-processing the data is pre processed means been the detection with efficiency their need to be getting the data into proper way so that the the processing for the image detection becomes a steady process.

The next part is the data labelling and also the DNN model training . The model needs to be trained with the CNN approach further the dataset has approx 4000 sample of images . the maximum images needs to be used for training to get precise results while also some images are used for testing. The processing and model claims the efficiency on an average more than 85%. The next part includes the bifurgation of the images based on the disease unidentified . also leading this identified deificiency in the leaf and giving it out on display. This working goes under the DNN model inferencing module. Referring fig 4 the next part in the fig refers to the tasks under the data pre processing bracket. This includes tasks such as image capture so first collecting the image that needs to be tested the next part focuses on individual frame extraction,resizing the frame according to precise requirements and then converting it into required format.

Data labeling module mainly bifurgated into Bbox and e.

Literature review :

Plant diseases pose significant threats to crop yield and food security worldwide. Traditional methods of disease detection often rely on visual inspection by human experts, which can be time-consuming and subjective. With the advancement of technology, machine learning (ML) techniques have emerged as promising tools for automating the process of plant disease detection. This literature survey aims to provide an overview of recent research in the field of plant disease detection using ML, highlighting key methodologies, datasets, challenges, and

future directions.as increasing demand for food there is scarcity into production to. Also the latest techs suggest to move on image processing for this disease detection and segmentation,but simultaneously its accuracy is also important this needs large source of datasets and model that needs to be trained over. Acquainting deep learning methodologies and concepts which help the model to get itself into feedbacks with increase in accuracy has been a major advantage of AI/ML usage for this progress in the disease detection.

Methodology

The use of py torch framework here Accelerates the working and the efficiency of the model on the other hand pytorch has an important significance in the deep learning process the huge source of py torch libraries has greatly influenced the working of the training as well as testing model of the disease detection process.

The dataset required for the implementation have been taken from Kaggle the dataset constitute of 4188 samples of corn images which are divided as healthy(1162),common rust(1306),gray leaf spot(574), blight(1146) this images are further used for the training of the model as well as testing. Because the data is not seperated, it should be splitted into Train, Validation and Test sets. To do that, I used splitfolders library and splitted the data into Train, Validation and Test sets by 70%, 20% and 10% respectively. The next step includes the. dividing data into different subtypes for testing, validation, and training purposes.Increasing the accuracy of the results is the primary goal of the research, which calls for using more sample photos to train the model. The process of transforming the photos into a format suitable for use in defect identification follows next in the project: data transformation.All of the datasets are subjected to resizing and normalizing procedures; however, data augmentation techniques are only used to the train set in an effort to enrich the data and potentially improve the model's accuracy. In order to rectify certain photos that are somewhat blurry and not quite clear, the function gaussianblur() ensures that the transformation is completed quickly and accurately, resulting in an appropriate visualization for the detection. When the data is loaded, it is obtained from the Kaggle website in order to apply the model to the example photographs.Virtualization is further facilitated by this. Additionally, the samples are divided as follows:

Images per Class in TRAIN:

1 914

3 813

0 802

2 401

dtype: int64

Images per Class in VALIDATION:

1 261

3 232

0 229

2 114

dtype: int64

Images per Class in TEST:

1 131

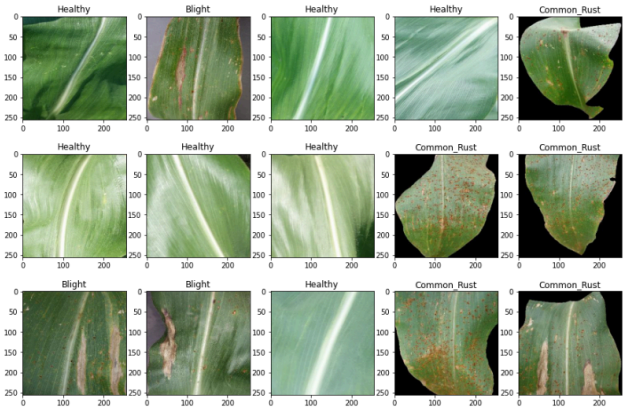
3 117

0 115

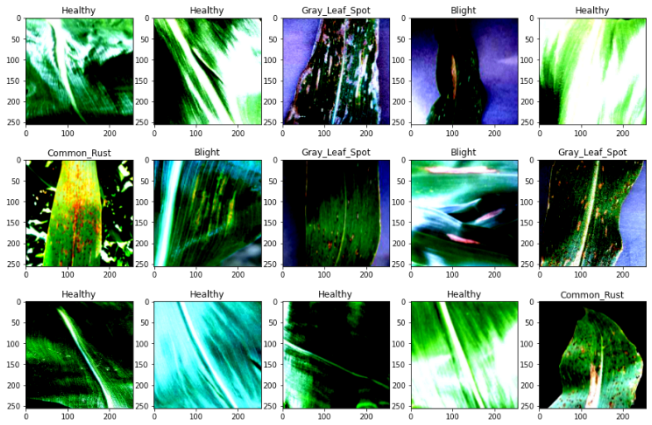
2 59

dtype: int64

the next involves plotting of images that are as shown in fig 5



Also then focusing on plotting of augmented images. Before passing the data in a neural network, it should be batched and shuffled. Since test will not be used in training process, there is no need to shuffle it.



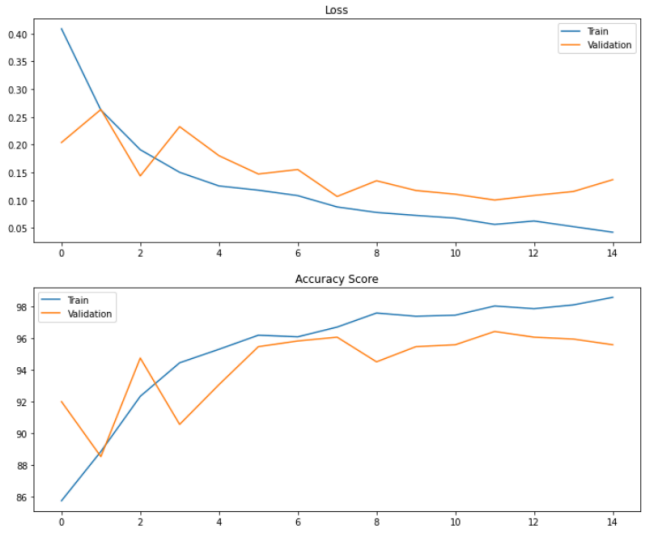
It is evident from examining the data order in the corresponding folder that the photos from the class "Blight" are arranged first, followed by "Common_Rust" in second place, "Gray_Leaf_Spot" in third place, and "Healthy" last. It may be difficult for the model to train impartially in such an order. To make sure the data is jumbled, let's choose a batch and examine the labels.

The deep learning model design and development is to be the most crucial part of project Custom neural network architecture can be designed for this machine learning problem. With a neural network similar to the one below, an accuracy score around 80-84% is obtained. But for this project, I opt to apply Transfer Learning using ResNet18 architecture

.ResNET18

Transfer learning is the act of applying machine learning models that have already been trained to a similar job instead of having to train the models from scratch. This can save time and potentially improve performance. The deep learning image training model is pre-trained.

Loss function and accuracy score



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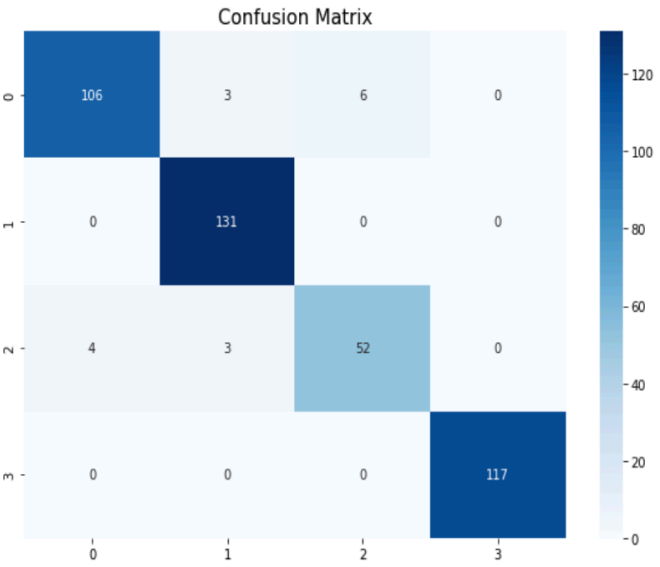


Also working on manual testing It is usually a good idea to manually test the model and make an effort to comprehend the prediction process.

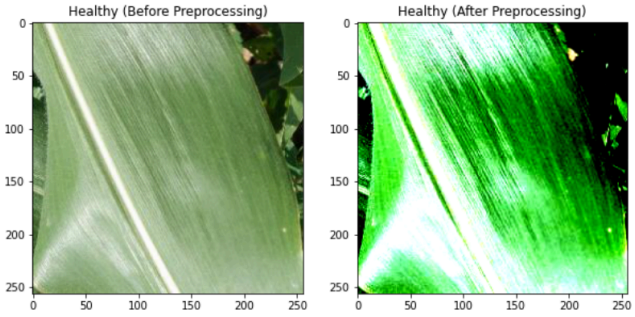
Parameters of the confusion matrix from code: plt.figure(figsize=(10, 7))

sns.heatmap(confusion_matrix(test.targets,all_preds), cmap="Blues", annot=True, fmt="d")

plt.title("Confusion Matrix", size=15)

plt.show()

Let's choose a single sample out of test set and make the model predict that single image.



Conclusion:

In conclusion, the project is successfully implemented with all required capabilities, the task of project is to detect various kinds of corn diseases which surely will be profitable foe early disease detection in corn so immediate action can be implemented in the crop. Also the system using machine learning algorithms to train the model for disease detection. The system maily focuses accuracy both at training as well as testing of the model . the system focuses on covering the most common and aggressive diseases in corn crop.the system also creates an user friendly and easy to use environment for the farmers to u se .

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