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Plant Disease Detection usingCNN Model

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Abstract— This study has combined four CNN models to create a plant disease detection method. An open source library of 36258 photos divided into 61 classes of healthy and diseased plant leaves and 10 plant species was used in the experiment. A total of 36258 photos were split into two datasets, the training set containing 31718 images, and the validation set containing 4540 images. Four CNN models—Inception, Resnet, Inception Resnet, and Dense net—were used, and their output was processed using a stacking technique. Compared to the outcome of utilizing a single CNN model, the stacking method's accuracy rate of 87% was significantly higher. The relatively high accuracy rate suggests that stacking a number of CNN models together could be a suitable way for creating an advanced plant disease warning system that can be applied to real-world cultivating circumstances.

Index Terms— **Plant Disease; Deep Learning; Transfer Learning; Inception Network; Residual Network (Res Net); Dense Net**

I. Introduction

It identify and manage plant diseases to reduce crop losses. Plant disease, which causes 10–16% annual losses in the global agricultural harvest, is a serious challenge to food security, according to Strange RN and Scott Early stages of plant diseases are easier to control. However, because early changes are frequently subtle, farmers frequently miss growing pathogenic infections. Significant crop losses from such inability to detect result in decreased plant production and negative economic effects. Even though plant diseases are a danger to crop output, it is inefficient to put too much human effort into plant disease identification. Learning diagnosing techniques and standards would take a lot of time, and improving accuracy would take hundreds of practice sessions. A machine would therefore be useful in this situation. Before a system to identify plant infections is developed, diagnosing plant diseases mainly relies on knowledgeable agronomists or psychopathologists. Based on their research and observations of the plants in the field, they created a checklist of requirements to treat the illness before it spread. Even experts with specialized optical equipment, however, would be unable to recognize early-stage infections due to the wide diversity of infectious symptoms and significant variations in the same symptom among several. The theory-based approach is thus proven to be unmatched by a well-trained machine in terms of efficiency and accuracy.

II. Related Work

The researcher first performed an exploratory data analysis before beginning to add the photographs to the model. Exploratory data analysis (EDA) is a method used in statistics to examine data sets and summarize their key features, frequently using visual techniques. The data distribution visualization shows that there is a serious class imbalance issue in the training dataset. As a result, the researcher employed an up-sampling technique. The researcher duplicated

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photographs from the other classes, processed them with augmentation, and then added them to the dataset in order to reduce the amount of images in the classes that occur the most. The procedure was repeated until there were an equal number of photographs in each class.

III. THE PROPOSED MECHANISM

This research used four fine-tuned models and a procedure a fine tuning phase to make models meet the purpose, drawing inspiration from the preceding four alternative model structures. The training datasets were divided into batches at random, with a batch size limit of 16. Once all of the batches had been fed, one epoch was complete. These batches were fed into the model in a stochastic order. Each model underwent 20 epochs of training, one epoch of training was evaluated, and the model was saved when there was an improvement in score loss. After each model had completed training, a stacking technique was used by utilizing the results of four various models. The model generated a 61- dimension vector with each element representing a likely associated class to which each image of a plant leaf belongs. Four separate models' outputs were fed into a straightforward ANN model, which produced a new vector with 61 elements. The class with the highest value in the matching value in the new vector would be the final predicted outcome.

IV. PERFORMANCE EVALUATION

This technique detects the presence of illness in leaf at early stages. The leaf image is taken by the camera attached to the Raspberry Pi device and processed in both ARM processor and anaconda navigator for CNN illness classification. To determine the afflicted area, the processed image is further clustered in MATLAB using a clustering technique.

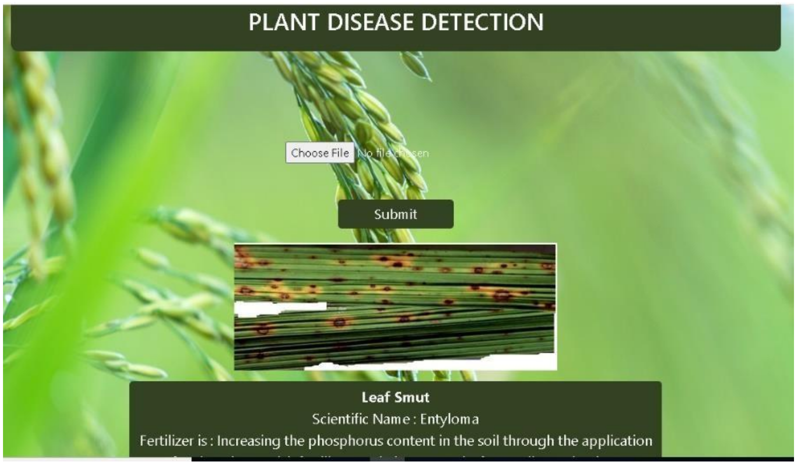

Fig.1 Output

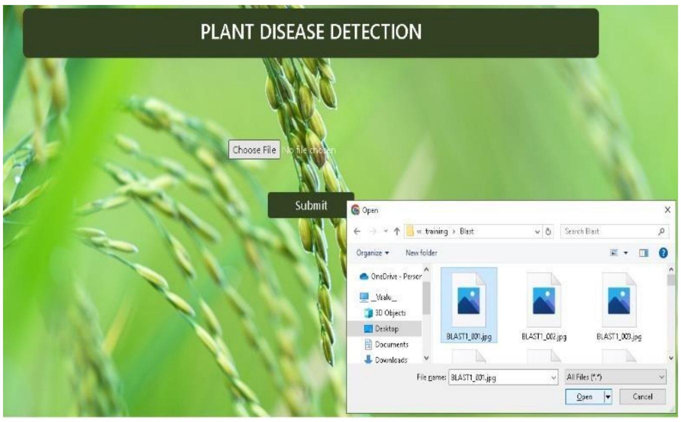

Fig.2 Dataset Schema

V. Conclusion

Despite the fact that numerous studies have already produced plant disease detection systems utilizing various computer vision algorithms, CNN performs better. This study combined a voting mechanism with four previous models—Inception, Resnet, Inception Resnet, and Dense net—to identify 61 types of both healthy and diseased plant leaves. An accuracy rating of 87% was reached using the stacking technique. This research has merged several CNN models and recognized more plant diseases (61 diseases), as compared to another study that also used combined CNN modules to detect 10 plant diseases and achieved an accuracy of 91.7% on the test data set

Together, the four models enhanced the training process's results. Thus, a trained machine that can diagnose plants quickly and accurately has the potential to boost the agricultural sector. If the technology is widely used, it will stop plant illnesses before they spread and relieve farmers and specialists from having to observe plants in their areas. The goal of future study should be to reduce the number of parameters while preserving accuracy. Future study should also look into ways to enlarge the database' size in order to boost the variety of species that the machine system can diagnose. Additionally, the system can only diagnose illnesses that are already present; it cannot predict when an infection might occur. Therefore, the next step is to investigate how to assess the likelihood that a plant would receive affected or even forecast the kind of disease the plant would acquire.

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