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PLANT DISEASE DETECTION USING TRANSFER LEARNING

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Abstract - Plant diseases are essential in agricultural output, and early diagnosis of plant diseases is seen as critical. Current computational intelligence and computer vision approaches show promise in improving illness diagnosis. Convolutional Neural Network (CNN) models can identify plant illnesses in agricultural fields and in photographs of plantation leaves. Xception is an extension of InceptionV3 with fewer but superior feature extraction settings. This recommends using an ensemble of Densenet and Xception to increase plant disease detection performance by concatenating the derived features. When evaluating the whole Plant Village dataset, the Densenet, Xception, and ensemble models obtained 98.9% accuracy. The suggested model's performance evaluation shows that it successfully categorizes healthy, Scab, Rust, and Multiple Diseases, outperforming pre-trained models.

Keywords: CNN, Transfer Learning, Xception, Densenet, Plant Disease.

1. INTRODUCTION

The Plant Disease Detection project aims to automate the process of identifying plant diseases using deep learning techniques. Plant diseases can lead to significant economic losses, and early detection is critical to prevent further damage. Traditionally, plant diseases have been identified through manual inspection by agricultural experts, which can be time-consuming and costly. We developed a model that can categorize whether a plant is healthy or has Scab, Rust, and Multiple diseases by analysing an image of its leaf. The model is based on an ensemble of two pre-trained models, Xception and DenseNet, which are fine-tuned on a large dataset of plant images. The models are combined using average ensembling to improve the overall performance of the system. The application is implemented as a web-based user interface using Streamlit, which allows users to upload an image of a plant leaf and receive a prediction of whether the plant is healthy or has Scab, Rust, and Multiple Disease. The system also provides a confidence score for the prediction, allowing users to assess the reliability of the result. It has the potential to be used in real-world scenarios, such as in the agricultural industry, where it can help to detect plant diseases early and prevent the spread of infections. By automating the process of identifying plant diseases, this project can also save time and reduce the cost of manual inspection.

2. PROJECT OVERVIEW

Plant Disease Classification is the task of identifying the diseases that affect the health of plants using computer vision techniques. We developed a model that can classify the type of disease that a plant has based on its image. We have used the "Plant Village" dataset for this purpose, which is a large dataset of plant images with corresponding labels indicating the type of disease or whether the plant is healthy.

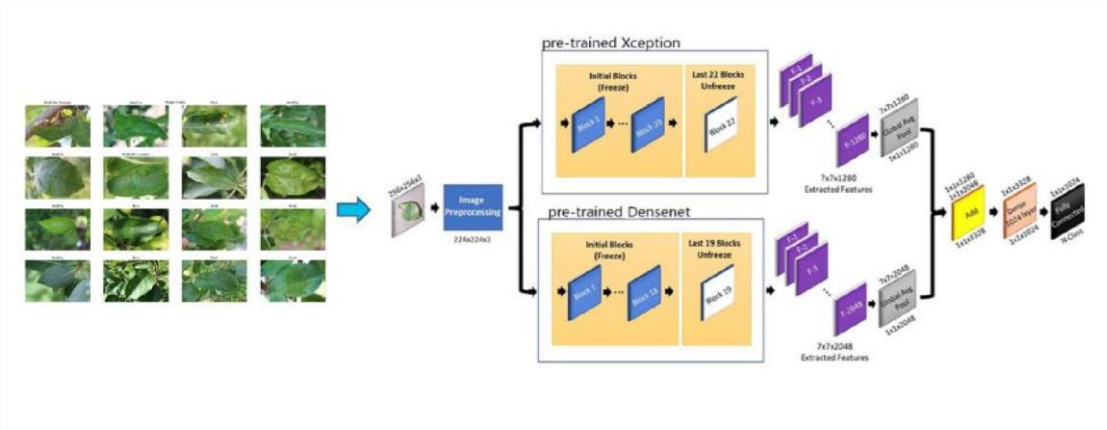
3. LITERATURE SURVEY

"Plant Disease Detection Using Deep Learning and Convolutional Neural Networks" by Y. Singh et al. (2021): This article provides an overview of several deep learning-based techniques for plant disease diagnosis, including those utilising CNNs. The authors also suggest a CNN-based algorithm for detecting tomato leaf diseases.
S. Shrestha et al. (2020) published "Deep Learning-Based Plant Disease Detection Using Convolutional Neural Networks": This work presents a CNN-based model for detecting tomato and potato illnesses via transfer learning. The authors compare the performance of their model to other cutting-edge approaches and establish its efficacy in illness detection.

"Plant Disease Detection Using Convolutional Neural Networks: A Review" by T. Pham et al. (2019): This review paper provides an overview of various CNN-based approaches for plant disease detection, including those using Tensorflow. The authors discuss the challenges and opportunities in this field and provide insights for future research.
H. Fan et al. (2020) published "Deep Learning-Based Plant Disease Detection Using Multiple Convolutional Neural Networks": This paper presents a multi-network CNN-based model for detecting grape leaf diseases. The authors demonstrate the efficacy of their model in identifying illnesses and compare it to other cutting-edge technologies. 5. "Plant Disease Classification Using Convolutional Neural Networks with Fine-Tuning" by S. K. Shah et al. (2019): Using fine-tuning, this work presents a CNN-based model for the categorization of tomato leaf diseases. The authors examine the performance of their model using several measures and demonstrate its efficiency in identifying disorders.
Overall, these studies highlight the effectiveness of CNN-based approaches for plant disease detection and demonstrate the potential of Tensorflow in this field. They also provide insights into the challenges and opportunities in this area and suggest directions for future research.

4. METHODOLOGY

4.1. MODEL ARCHITECHTURE:



4.2. CNN:

CNNs, a kind of Deep Neural Network, are often used for image analysis and are effective at recognising and categorising certain characteristics in images. Image classification, image analysis for medical use, picture and video recognition, computer vision, and natural language processing are some of its uses. CNN is beneficial for picture recognition because of its high degree of accuracy. Several industries, including phone, security, and medical image analysis, and recommendation systems, use image recognition.

4.3. XCEPTION:

Xception is a 71-layered convolutional neural network. A pretrained version of the network trained on over a million photos from the ImageNet database [1] may be loaded. The pretrained network can categorise photos into 1000 different object categories, including keyboards, mice, pencils, and a variety of animals.

4.4. DENSENET:

DenseNet (Dense Convolutional Network) is a deep learning network design that focuses on helping deep learning networks go deeper while also making them more effective to train by employing shorter connections between the layers. DenseNet was created specifically to enhance accuracy caused by the vanishing gradient in high-level neural networks due to the great distance between input and output layers, which causes information to evaporate before reaching its destination.

4.5. KERAS:

Keras is a deep learning API written in Python. It was designed with the goal of facilitating speedy experimentation. To perform good research, one must be able to move swiftly from a notion to a conclusion. Keras is neither simple nor complex. Keras frees up developer cognitive strain, allowing you to focus on the most important components of the problem.

- Versatile - Keras conforms to the concept of progressive disclosure of complexity, which argues that although simple processes should be quick and easy, more advanced workflows should be conceivable via a clear route that builds on what you've already learned.
- Stable - Keras has scalability and performance that rival the finest in the industry; NASA, YouTube, and other organisations use it.

4.6. TENSOR FLOW:

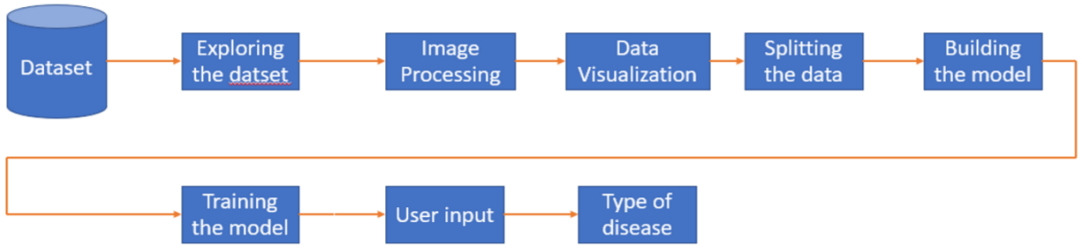
TensorFlow gives programmers access to all of this. Python is easy to use and comprehend, and it provides valuable ways for representing the coupling of high-level abstractions. TensorFlow may work on earlier versions of Python, but this is not guaranteed.

TensorFlow works with Python versions 3.7 through 3.10. The Keras library is used for sophisticated TensorFlow operations like creating nodes and layers and linking them. A simple model with three layers may be defined in less than 10 lines of code using the Keras API, and training code is only a few lines longer. If you want to "lift the hood" and do more precise repair.

4.7. STREAMLIT:

The nicest part about Streamlit is that you can get started and build your own online application without learning any web programming techniques. As a consequence, if you're interested in data science and want to deploy your models fast and easily with only a few lines of code, Streamlit is a suitable answer.
One of the most important aspects of an application's success is its user interface. Many of today's data-intensive software must solve the difficulty of quickly developing a suitable user interface without requiring complicated methods. Developers may easily design engaging user interfaces with the aid of the promising open-source Python tool Streamlit. Streamlit is the easiest approach to incorporate code into a web site, especially for individuals without frontend skills.

5. IMPLEMENTATION



5.1. Steps involved in proposed system

Data collection: We used dataset from kaggle which contained Healthy leaves, scab diseased leaves, Rust diseased Leaves, and Multiple diseases leaves images.

Data pre-processing: We resize the images to a standard size, convert them to grayscale, and normalize the pixel values.

Data augmentation: We augmented the data using techniques like flipping, rotation, and zooming to increase the size and diversity of the dataset.

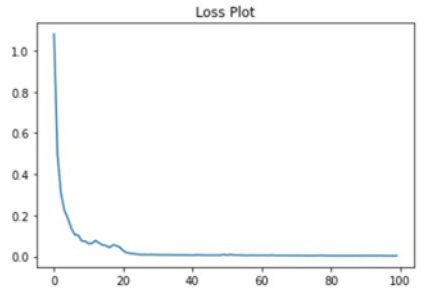
Model selection: We selected two pre-trained deep learning model i.e. Xception, Densenet as the base architecture for the proposed system.

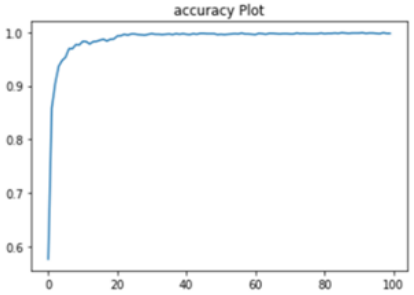
Model customization: Removed the top layer of the pre-trained model and replaced it with Global Average Pool and Dense layers with the appropriate number of output classes based on the number of plant diseases to be detected.

Model training: Train the customized model on the augmented dataset using techniques like transfer learning, fine-tuning, and hyper parameter tuning to optimize the model performance.

Model evaluation: On a separate test dataset, assess the trained model's performance using measures like accuracy, precision, recall, and F1-score.

- **Results and Analysis**

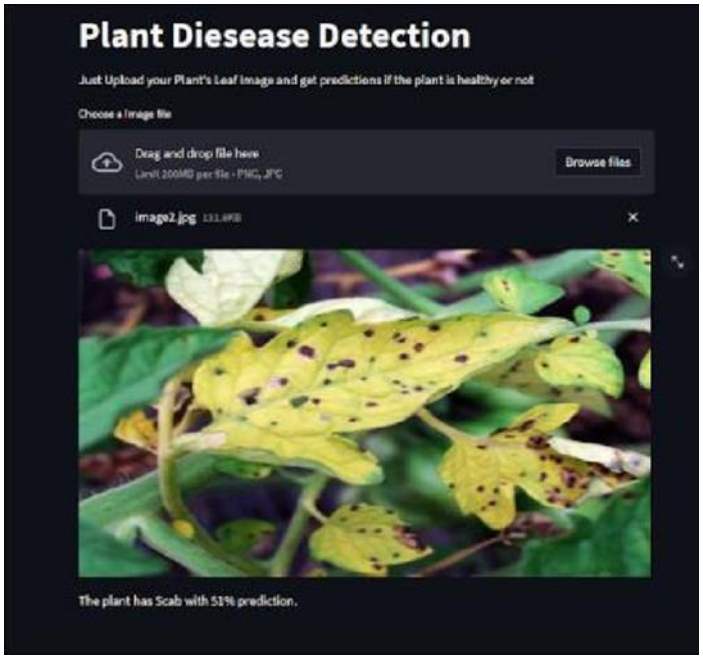




Model deployment: Deploy the trained model as a web application using a suitable web development framework like Streamlit.

User interface: Create a user interface for the web application that allows users to upload an image of a plant leaf and receive the corresponding disease diagnosis.

Output:



6. CONCLUSION

In conclusion, the plant disease detection system developed in this project using deep learning algorithms can accurately identify the diseases in plant leaves with a high level of accuracy. This application is designed to be user-friendly and accessible, allowing farmers and agricultural researchers to easily identify the diseases affecting their crops and take appropriate measures to prevent them.

Overall, this system can help reduce crop losses caused by diseases, resulting in increased productivity and higher yields. It can also aid in the development of targeted treatments and management strategies for specific diseases. The accuracy of the model can be further improved by adding more data to the dataset and using advanced algorithms. This system has the potential to revolutionize the way plant diseases are detected and treated, thereby contributing to the growth and development of the agriculture sector.

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