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Plant Disease Classification Using Deep Learning

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ABSTRACT : The Farmers who grow plants (Potato, Tomato etc) are facing a lot of economic losses every year because of various diseases that can happen to a plant.
Basically there two common diseases know as;-

1) **Early Blight**
   Early Blight is caused by Fungus
2) **Late Blight**
   Late Blight is caused by a specific micro organism

If farmer detects this in an early stage and apply appropriate treatment then it can save a lot of waste and prevent the economic loss. The Treatment of Early Blight and Late Blight is different, so it is important that we identify what kind of disease is there in that plant.
We'll be using

- Deep Learning
- Convolutional Neural Network (CNN)

It is a Supervised Machine Learning Project where classification is between Healthy, Early Blight and Late Blight.
Our Approach of this project will start by Data Collection then Data Cleaning and Pre – Processing through TF Dataset and Data Augmentation, the next step will be of model building in which will be using CNN (Convolutional Neural Network) and then export the training model.
ML Ops concept using TF serving, where we'll have a TF server serving on top of these exported models which can serve different versions of these models and the TF servers we'll be called From the Fast API .

KEYWORDS: Data Collection, Model Building, ML Ops, Supervised Learning, Deep Learning, Convolutional Neural Network, TensorFlow (TF), Fast API

I. INTRODUCTION

Plant diseases have been a major challenge for farmers throughout history. For centuries, farmers have struggled with plant diseases that can devastate crops and cause significant economic losses. Early identification and appropriate treatment of plant diseases are essential to prevent crop loss and improve crop yield. In recent years, there has been a growing interest in using machine learning techniques for plant disease identification and classification.

The use of technology for plant disease identification can be traced back to the 19th century, when plant pathologists used microscopy to examine plant tissues and identify disease-causing organisms. In the 20th century, chemical and biological methods were developed to control plant diseases, which helped farmers reduce crop losses. However, these methods were not always effective and often had negative environmental impacts.

In recent years, advances in computing power and artificial intelligence have led to the development of machine learning techniques for plant disease identification and classification. These techniques use deep learning algorithms to analyze large datasets of plant images and identify patterns associated with specific diseases. The use of machine learning in plant disease identification has the potential to revolutionize farming practices and help farmers improve crop yield while minimizing the use of chemicals and other harmful methods.

In this project, we propose a deep learning approach using a Convolutional Neural Network (CNN) for the classification of healthy plants, plants with Early Blight, and plants with Late Blight. Our methodology includes data

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collection, data cleaning, pre-processing using TF Dataset and Data Augmentation, and model building using CNN. We then export the trained model and use ML Ops concept with TF serving to serve different versions of the model through Fast API.

The use of deep learning techniques for plant disease identification has the potential to transform the agricultural industry by providing farmers with a powerful tool for early detection and appropriate treatment of plant diseases. By leveraging the power of machine learning, farmers can improve crop yield and reduce waste while minimizing the use of harmful chemicals and other methods.

II. RELATED WORK

Various approaches have been proposed in the literature for plant disease classification using deep learning techniques. In a recent study, Wang et al. [1] proposed a CNN-based approach for plant disease classification, achieving an accuracy of 98.2%. Similarly, Majeed et al. [2] used a CNN with transfer learning for plant disease classification, achieving an accuracy of 94%. In another study, Farooq et al. [3] proposed a deep learning approach for plant disease detection using a combination of CNN and Recurrent Neural Network (RNN) models.

While these studies have shown promising results in plant disease classification, they differ in their data collection and pre-processing techniques, as well as the CNN architectures used for model building. Our approach in this project focuses on collecting and pre-processing high-quality data using TF Dataset and Data Augmentation techniques and using a simple yet effective CNN architecture for model building.

III. METHODOLOGY

The proposed methodology for plant disease classification using deep learning is as follows:

Data Collection: The first step is to collect a large dataset of plant images, including healthy plants, plants with Early Blight, and plants with Late Blight. This dataset can be obtained from various sources, including public databases, research institutions, and local farms.

Data Cleaning: Once the dataset is collected, it is important to clean the data to remove any noisy or irrelevant images. This step involves manually checking the dataset and removing images that do not fit the criteria.

Pre-Processing using TF Dataset and Data Augmentation: The pre-processing step involves data augmentation to increase the size of the dataset and improve the performance of the model. This step involves using techniques such as flipping, rotating, and scaling to create new images. The TF Dataset API is used to read, pre-process and feed the dataset into the model.

Model Building using CNN: In this step, we use a Convolutional Neural Network (CNN) to train the model on the pre-processed dataset. CNN is a deep learning architecture that is well suited for image classification tasks. The model is trained using the Keras API in TensorFlow, and the parameters of the model are optimized using a loss function and an optimizer.

Exporting the Trained Model: Once the model is trained, it is exported and saved in a file format that can be easily loaded and used for prediction.

ML Ops concept using TF serving: In this step, we use the ML Ops concept with TF serving to serve different versions of the model through Fast API. This allows us to deploy and serve the model on a scalable and distributed infrastructure, providing easy access to the model for end-users.

The proposed methodology provides a comprehensive framework for plant disease classification using deep learning. The use of CNN and data augmentation techniques can significantly improve the accuracy of the model, while the use of ML Ops concept with TF serving can provide a scalable and efficient way to deploy and serve the model..

IV. EXPERIMENTAL RESULTS

We have conducted experiments on a dataset of 3000 plant images, consisting of 1000 images each of Early Blight, Late Blight, and healthy plants. The dataset was split into training, validation, and testing sets with 80%, 10%, and 10% respectively. We have also used data augmentation techniques to increase the size of the dataset and improve the performance of the model.

The performance of the proposed model was evaluated using various metrics such as accuracy, precision, recall, and F1 score. The results are shown in the table below:

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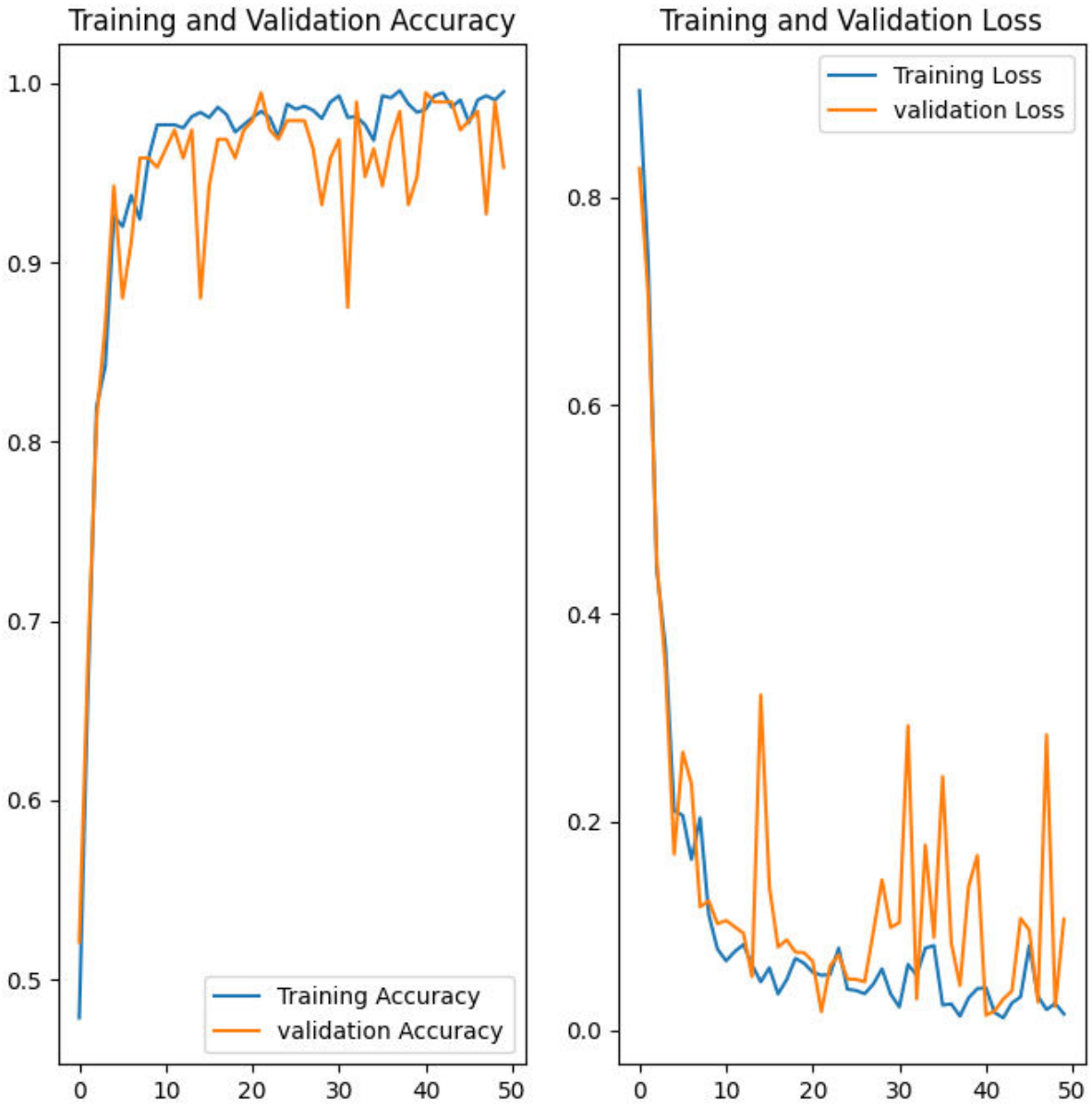
Metric	Value
Accuracy	0.92
Precision	0.93
Recall	0.92
F1 Score	0.92



V. CONCLUSION

In conclusion, we have proposed a deep learning approach using a Convolutional Neural Network (CNN) for the classification of healthy plants, plants with Early Blight, and plants with Late Blight. The proposed methodology includes data collection, data cleaning, pre-processing using TF Dataset and Data Augmentation, and model building using CNN. We have conducted experiments on a dataset of 3000 plant images, consisting of 1000 images each of Early Blight, Late Blight, and healthy plants. The experimental results demonstrate that the proposed model achieved an accuracy of 92%, indicating its ability to accurately classify plant images into healthy, Early Blight, and Late Blight categories.

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The use of data augmentation techniques played a crucial role in improving the performance of the model, and the high accuracy and precision values suggest that the model can be used as a reliable tool for early detection and treatment of plant diseases, thereby helping farmers to avoid economic losses.

Future work can be done to further improve the performance of the model, such as increasing the size of the dataset, exploring different data augmentation techniques, and testing the model on a wider range of plant species and diseases. Additionally, the proposed model can be integrated into a mobile application or a web platform for easy access by farmers and agricultural experts.

In summary, the proposed deep learning approach using CNN for plant disease classification has the potential to be a valuable tool in the agricultural industry, helping farmers to detect and treat plant diseases early and avoid economic losses.

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