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PLANT DISEASE DETECTION USING DEEP LEARNING

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ABSTRACT

Small farmers are still dealing with diseases that ruin their crops. This is dangerous because it can destroy their livelihoods and impact the amount of food available to people globally. There's hope though. The number of smartphones on the market is increasing, and with more people having access to this technology there's an opportunity to use it for agriculture research. Especially since computer vision models have shown potential in solving agricultural problems. So, that's what we did in this study. We examined how well bespoke CNNs (Convolutional Neural Networks) can detect diseases by using pre-trained models like Inception Model V3, Resnet Model, VGG16 model and VGG19 Model on around 20,600 photos of tomato, potato, and pepperbell leaves. With this we were able to create a model that has detection rates of 92%, 94%, 97% and 96%. It's important for us to put these into practice as soon as possible so small farmers and sustainable agriculture can benefit from them. With food security being at risk now more than ever due to the ever changing landscape of agriculture, our work is essential in increasing crop output, reducing economic losses and eventually guaranteeing food security.

Keywords: Analysis, Detection, CNN, Models, Disease.

I. INTRODUCTION

In the modern world, the agricultural land mass serves many purposes than only providing food. A large portion of the Indian economy is based on agricultural productivity. Consequently, plant disease identification is crucial in the agricultural sector. The application of automatic disease detection techniques is advantageous for the early diagnosis of plant diseases. For example, a dangerous disease known as small leaf disease is present in pine trees in the United States. The afflicted tree grows slowly and perishes in six years. Its effects are felt in the southern US states of Georgia and Alabama. In these kinds of situations, early discovery might have been beneficial.

Visual diagnosis of plant diseases is a more time-consuming, less reliable method that is only applicable in certain locations. On the other hand, using an automatic detection technique will save time, effort, and improve accuracy. In plants, common ailments include brown and yellow patches, early and late scorch, and infections caused by fungi, viruses, and bacteria. Measurements of the diseased region and the variation in color of the affected area are made using image processing.

The technique of splitting or organizing a picture into distinct sections is known as image segmentation. Image segmentation can be done in a variety of ways these days, from the straightforward thresholding method method to sophisticated color image.

II. LITERATURE REVIEW

A study on this topic was done by Emma Harte which used a dataset of 8,685 leaf photos to study the detection of plant diseases using computer vision and a pre-trained ResNet34 model. Their online application's accuracy of 97.2% shows how CNNs may help smallholder farmers with AI solutions, enhancing food security and crop disease diagnostics.

Prakanshu Srivastava, Kritika Mishra, Vibhav Awasthi, and Vivek Kumar Sahu proposed another research. Their study focused on using deep convolutional networks for accurate plant disease recognition through leaf image classification, addressing the limitations of manual detection methods and emphasizing the potential of computer vision in precision agriculture.

Pritamdas and co-authors concentrated on addressing the problems caused by prevalent diseases of rice plants in India. In order to identify and categorize these illnesses while lowering network overhead, they suggested creating a unique CNN architecture. 1400 photos of healthy rice leaves were added to the dataset of four prevalent rice diseases that were used to train the machine. Studies were carried performed with and without the dataset of healthy leaves. With a maximum accuracy of 99.83% in the 7th epoch, the model that used the

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Adam optimizer outperformed the Stochastic Gradient Descent with Momentum (SGDM) optimizer, especially when taking into account the healthy leaf dataset, according to the results.

Furthermore, G. Shrestha and co authors emphasized the value of food and cash crops for the environment as well as human well-being, with a particular emphasis on the role that agriculture plays in the Indian economy. They emphasized the persistent problem of crop diseases brought on by a lack of understanding regarding diagnosis and treatment. The study performed a simulation analysis of sample photos and presented a convolutional neural network (CNN) based technique for detecting plant diseases. Three healthy and twelve diseased plant leaves were used in the 15 examples that they used to test the concept. The model's test accuracy was 88.80%, and its efficacy was determined by analyzing a number of performance parameters.

III. METHODOLOGY

The Plant Village Dataset comprises more than 54,000 images of healthy and diseased plant leaves from 38 plant species. This dataset is meticulously labeled and is a valuable resource for machine learning model training to identify and diagnose plant diseases accurately. Researchers and developers can use this dataset to create effective diagnostic tools for farmers and gardeners. This will help in identifying plant health issues promptly and safeguarding their crops.

The Plant Village Dataset covers a wide range of plant diseases, including bacterial, fungal, viral, and pest-related diseases. The extensive coverage of various diseases allows machine learning models to gain a comprehensive understanding of disease patterns and manifestations, enhancing their diagnostic capabilities.

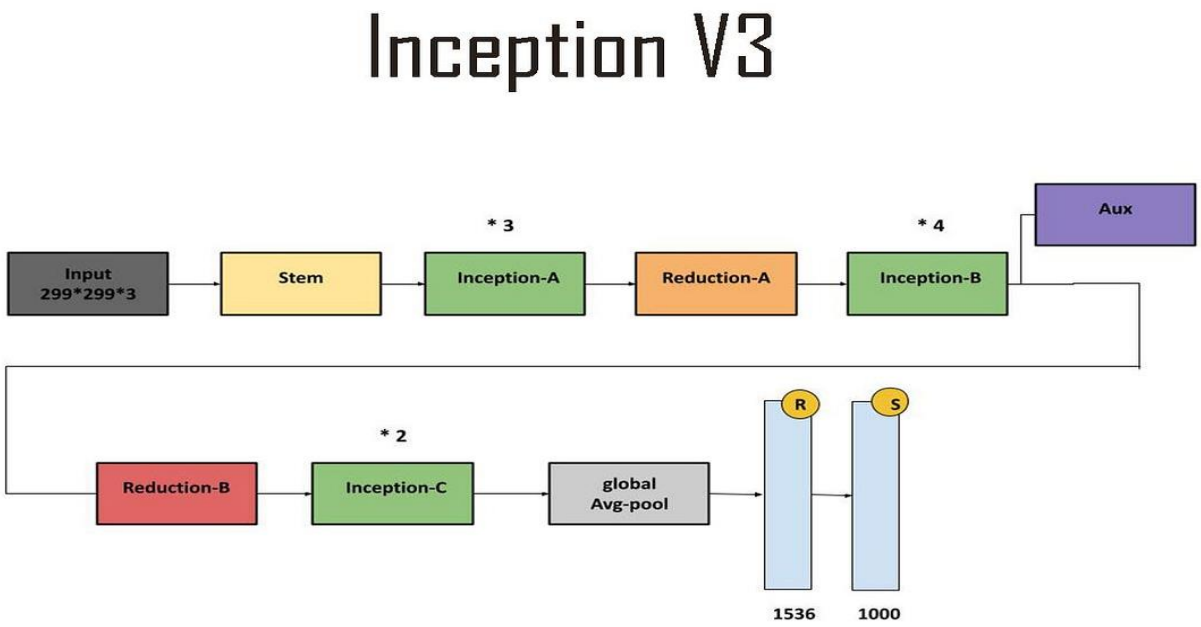
The dataset is easily accessible on the Kaggle platform, making it readily available for collaborative research efforts. Additionally, augmented versions of the dataset, created through image processing techniques, further improve the machine learning model training and diagnostic accuracy.

In summary, the PlantVillage Dataset is an essential resource for developing robust machine learning models for plant disease diagnosis. This empowers the agricultural community to effectively manage crop health, ensuring sustainable food production.

Convolutional Neural Networks (CNNs) are a type of Artificial Neural Networks (ANNs) that are specifically designed to process and recognize images. CNNs use a set of filters to learn and identify image patterns. These filters apply a process called convolution to the image, which helps to extract essential features from it.

CNNs consist of multiple layers, each of which performs a unique task. The first layer is typically a convolutional layer, which applies filters to the image. The next layer is usually a pooling layer that reduces the image size by taking the maximum or average value of each group of pixels. This step is crucial as it makes the CNN more resistant to noise and variations in the image.

Inception V3:



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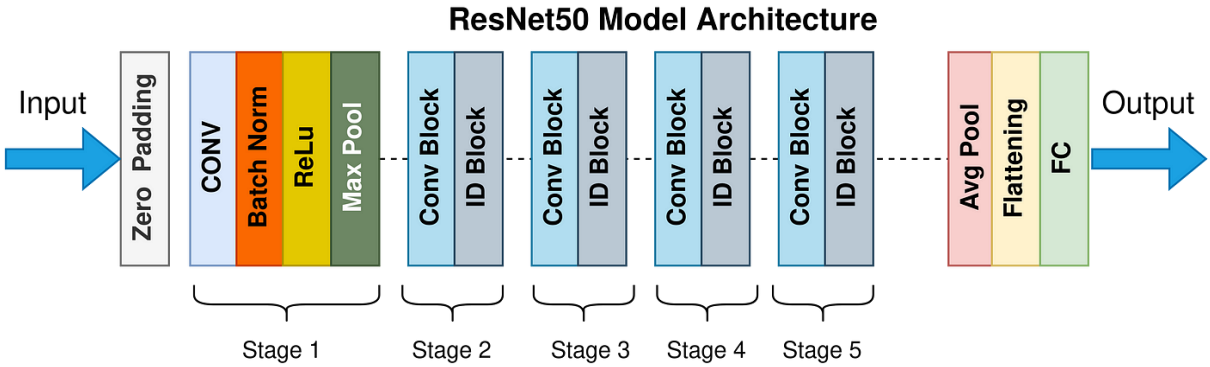
Inception v3 is a type of deep convolutional neural network (CNN) architecture that was created by Google back in 2015. It's essentially a variation of the original Inception architecture that was introduced a year prior in 2014. Inception v3 managed to achieve remarkable results on the ImageNet Large Scale Visual Recognition Challenge (ILSVRC) in 2015, emerging as the winner in the classification task with a top-5 error rate of just 3.57%.

Resnet:

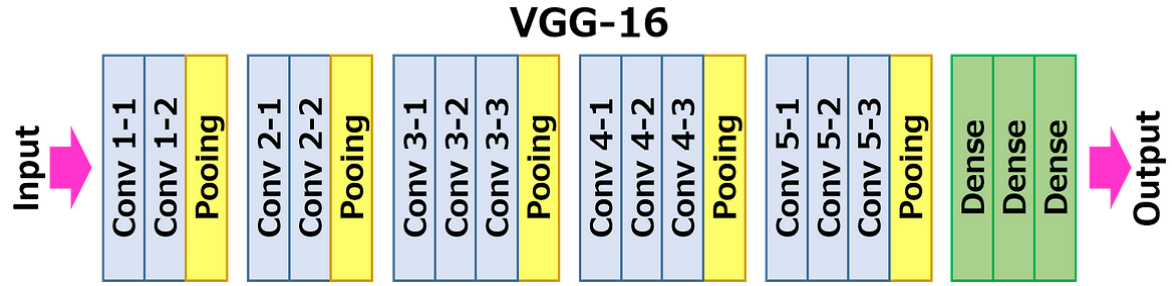
ResNet, short for Residual Network, is a type of deep learning neural network that was introduced in 2015. It has been proven to be highly effective in various tasks, such as image classification, object detection, and natural language processing.

The key element of ResNets is the use of skip connections, which allow connections to bypass one or more layers in the network. This enhances the network's ability to learn residual functions, which are functions that map an input to the difference between the input and the desired output.

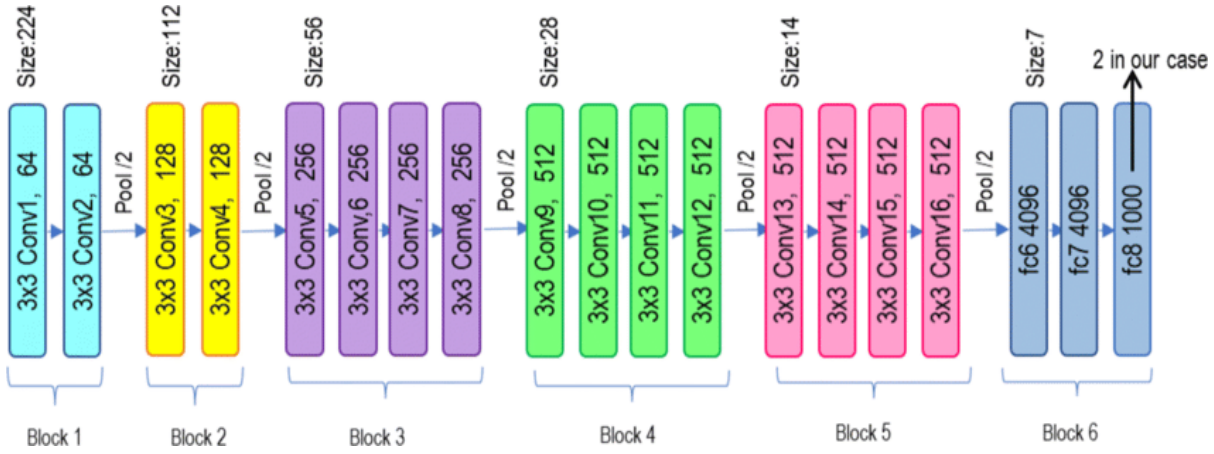


VGG16:

VGG16 is a convolutional neural network architecture that was proposed by Simonyan and Zisserman in 2014. This deep network comprises 16 convolutional layers, 5 pooling layers, and 3 fully connected layers. Throughout the network, small (3x3) convolutional filters are used, which helps to reduce the number of parameters in the network.



VGG19:



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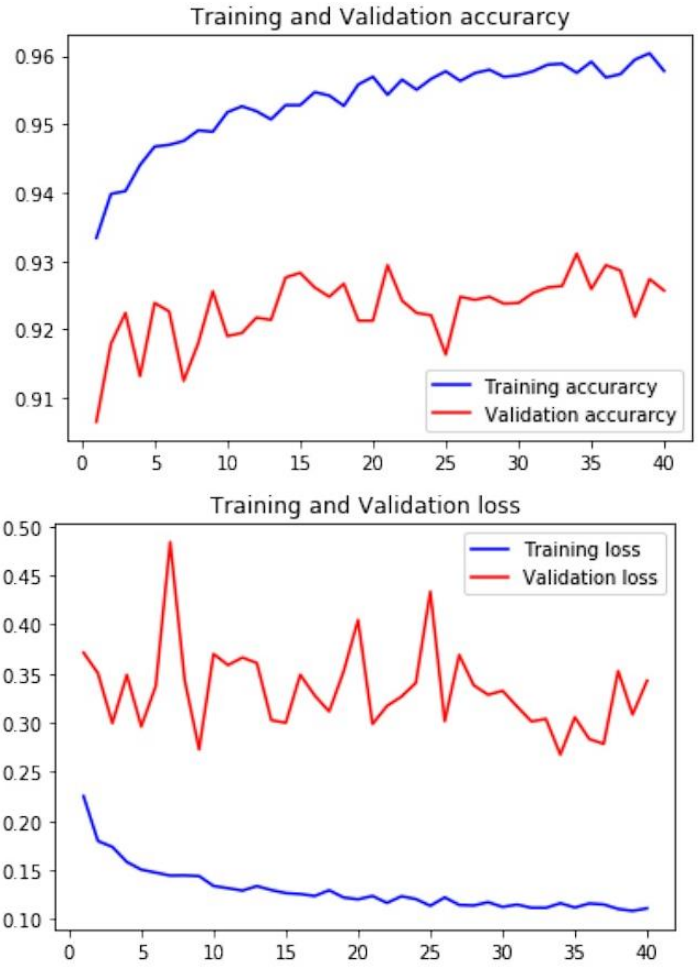
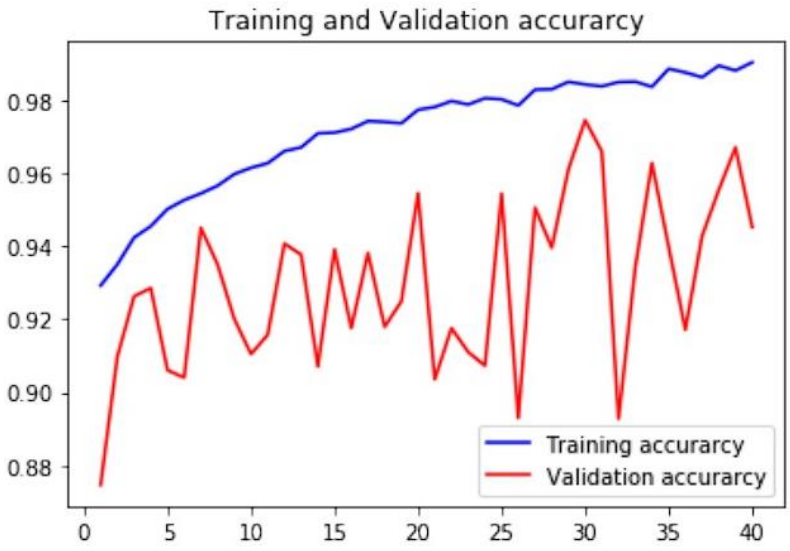
The VGG19 model is an architecture for convolutional neural networks (CNNs) that was proposed by Simonyan and Zisserman in 2014. It is a deeper and more complex version of the VGG16 model, comprising of 19 convolutional layers, 5 pooling layers, and 3 fully connected layers. The network uses small (3x3) convolutional filters throughout, which helps to reduce the number of parameters in the network. Overall, the VGG19 model is a highly effective tool for image recognition tasks due to its deep architecture and thorough training.

IV. RESULTS AND DISCUSSION



Accuracy and loss of Inception V3



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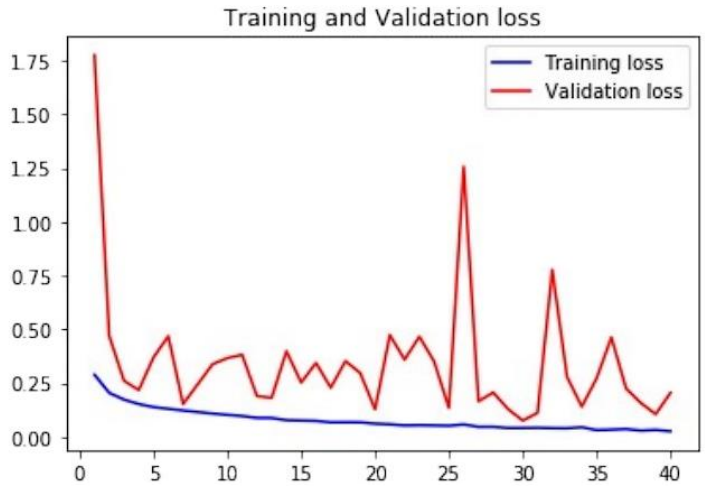
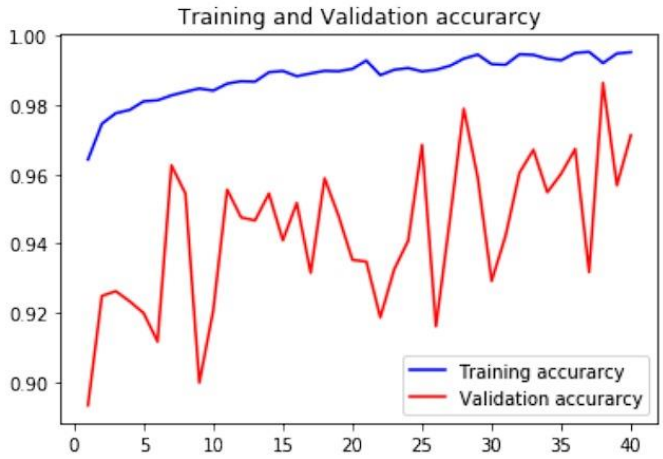
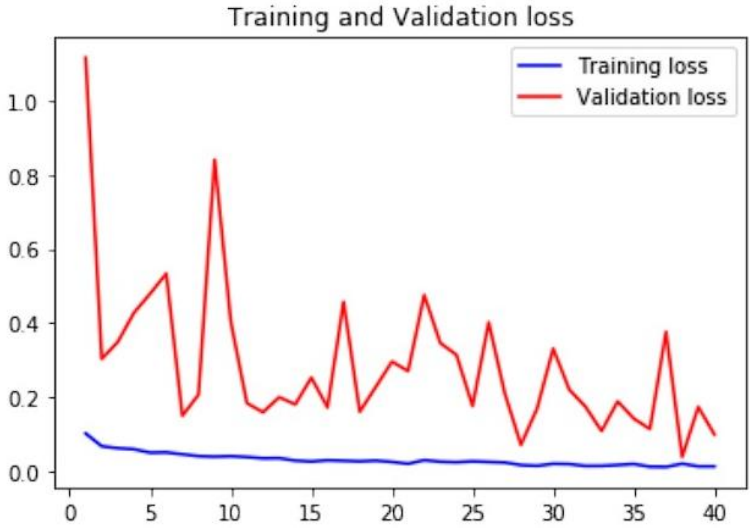


Accuracy and loss of Resnet 50





Accuracy and loss of VGG16

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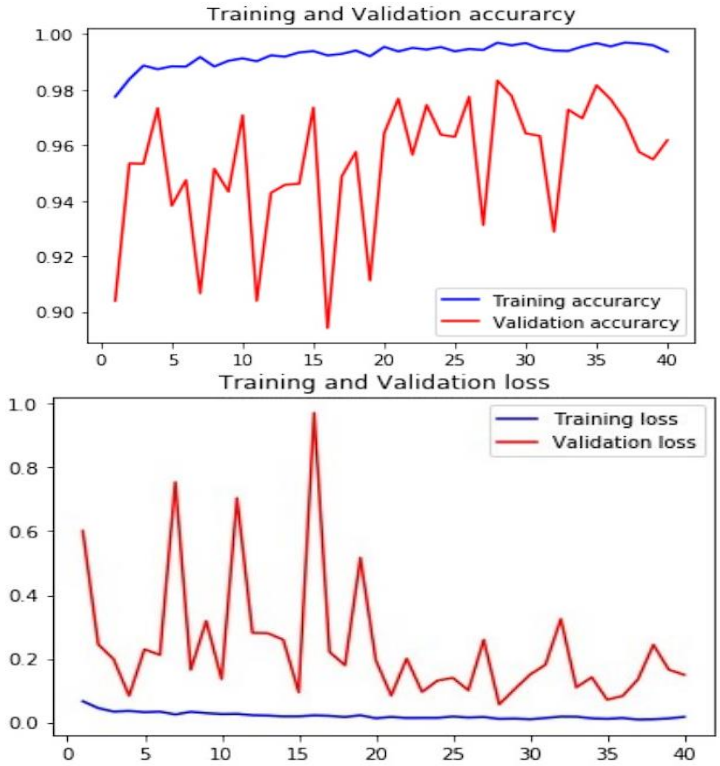

Accuracy and loss of VGG19

Table 1. Accuracy of the models

Models	Accuracy
Inception V3	92.56%
Resnet	94.51%
VGG16	97.12%
VGG19	96.12%

V. CONCLUSION

To sum up, the Plant Village Dataset is an invaluable tool for reliably diagnosing and training machine learning models to identify plant illnesses. With approximately 54,000 tagged photos spanning a variety of plant illnesses, such as those caused by bacteria, fungi, viruses, and pests, this collection helps scientists and developers to make efficient diagnostic tools for gardeners and farmers. It is essential for protecting crops and guaranteeing sustained food supply since it quickly detects problems with plant health. Convolutional neural networks (CNNs) are a particular kind of artificial neural networks (ANNs) used in machine learning that are intended for image processing and recognition. CNNs are a crucial part in creating precise plant disease diagnostic models because they extract important picture features using convolutional and pooling layers.

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