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Using Deep Learning Approach

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Abstract

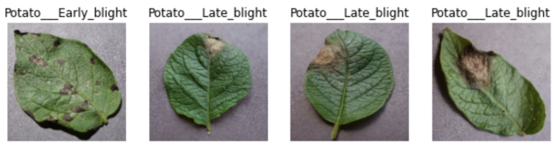
Plant diseases affect the growth of their respective species, therefore their early identification is very important. Many Machine Learning (ML) models have been employed for the detection and classification of plant diseases but, after the advancements in a subset of ML, that is, Deep Learning (DL), this area of research appears to have great potential in terms of increased accuracy.

Many developed/modified DL architectures are implemented along with several visualisation techniques to detect and classify the symptoms of plant diseases. Moreover, several performance metrics are used for the evaluation of these architectures/techniques. This review provides a comprehensive explanation of DL models used to visualise various plant diseases. In addition, some research gaps are identified from which to obtain greater transparency for detecting diseases in plants, even before their symptoms appear clearly.

Potato is one of the staple foods that widely consumed, becoming the 4th staple food consumed throughout the world. Also, the world demand for potato is increasing significantly, primarily due to the world pandemic coronavirus. However, potato diseases are the leading cause of the decline in the quality and quantity of the harvest. Inappropriate classification and late detection of the disease's type will drastically worsen the plant conditions. Fortunately, several diseases in potato plants can be identified based on leaf conditions.

Introduction

Farmers who grow potatoes are facing lot of economic losses every year because of various diseases that can happen to a potato plant. There are two common diseases known as early blight and late blight early blight is caused by a fungus and late blight is caused by a specific microorganism and if a farmer can detect these diseases early and apply appropriate treatment then it can save lot of waste and prevent the economic loss. The treatments for early blight and late blight are little different so it's important that you accurately identify what kind of disease is there in that potato plant. We have taken this project and have decided to build a Deep Learning Model which we can give it to a farmer. And farmer all they need to do is go to their farm and just take a picture of the plant and the mobile application will tell them whether the potato plant is healthy or it has one of these diseases and behind the scene it will be using deep learning and convolutional neural network.



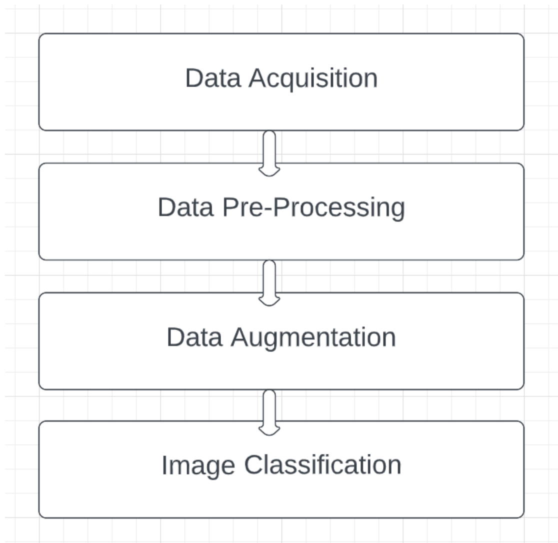
Potato Leaf Disease Detection and Classification using Deep Learning is an end-to-end deep learning project in agriculture domain. we'll start with data collection first and then we'll move towards model building. ML Ops using TF serving. We will build our backend server using fast API and then we'll deploy the model to Google Cloud or GCP and we'll have Google Cloud functions running on top of it and that those functions can be called my mobile or web application developed using world's most popular Javascript library React so it will be an end-to-end application very useful in agriculture domain.

RELATED WORK

1. Eftekhar Hossain et al, proposed a system for recognizing the plant leaf diseases with the appropriate classifier K-nearest neighbor (KNN). The features that were extracted through the images of diseased image were used to execute the classification. In the paper, the system KNN classifier classified the diseases commonly found in plants like bacterial blight, early blight, bacterial spot, leaf spot of various plant species. This method exhibited an accuracy of 96.76%.

2. Sammy et al., proposed a CNN for the classifying the disease types and in this paper the author used 9 different varieties of leaf diseases of tomato, grape, corn, apple and sugarcane. In this paper the training is conducted on the system for nearly about 50 epochs and they used 22 size of batch. In this model with the help of categorical crossentropy, Adam optimizer is conducted. Accuracy obtained is 96.5%.
3. Ch Usha Kumari et al., developed a system that deploys the methods of K-Means clustering and Artificial Neural Network and performs computation of various features like Contrast, Correlation, Energy, Mean, Standard Deviation and Variance were performed. The major limitation was that accuracy of four different diseases was analyzed and the average accuracy is comparatively low.

IMPLEMENTATION METHODOLOGY



The proposed methodology in this paper includes the following four main steps: data acquisition, data pre-processing, data augmentation, and image classification.

Data Acquisition

Different image resolutions and sizes were obtained from kaggle dataset (https://www.kaggle.com/datasets/arjuntejaswi/plant-village) containing 2000+ images of Potatoes.

Data Pre-Processing

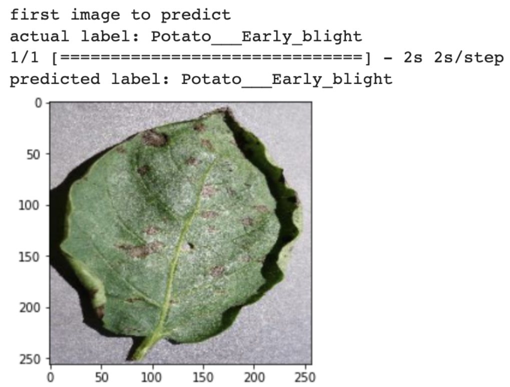
Pre-processing data aims to improve the quality of data to realize an accurate training model output. The first step is to minimize the noise in the image, and if there is excessive noise in the image, then it will not be used. Acquired images have a variety of sizes, and images are resized to 800x600 pixels to standardize the input of images in datasets

Data Augmentation

Deep Learning requires much data when compared to the shallow network of machine learning. The lack of training data and the balance of the amount of data in each class are common problems in Machine Learning. The method used to overcome this problem is data augmentation. Data augmentation is a technique of manipulating data without losing the essence of the data. Data augmentation needs to be applied in this study because 2000 images are still inadequate to get optimal performance. Number of augmented data that we can generate is 5000+ images. Many methods are used in data augmentation, ranging from simple image transformation methods such as turning, rotating, enlarging, and cropping images to the histogram-based method. In this study, only simple transformation methods such as rotating and cropping were applied.

Image Classification

Deep learning (DL), similarly known as deep neural learning or deep neural network, is part of machine learning (ML) in artificial intelligence (AI). The term "deep" means that Deep Learning has more layers than Machine Learning. Deep learning methods have improved the state-of-the-art in image classification, speech recognition, visual object recognition, object detection, and many other domains. In Deep Learning, Convolutional Neural Network is one of the popular classes. Some studies use the convolutional neural network method to detect diseases in plants based on leaf conditions. Convolutional Neural Networks generally consist of one or more convolutional layers that are grouped by function. Often the subsampling layer is followed by one or more layers that are fully connected as a standard neural network. Each feature layer receives input from a feature set located in a small area on the previous layer. LeNet was the beginning of the CNN architecture model and has now evolved into modern CNN architectural models such as AlexNet, VGG network, GoogLeNet, residual networks (ResNet), densely connected networks (DenseNet).



References

● Plant Disease Detection using CNN & Remedy (A High Impact Factor, Monthly, Peer Reviewed Journal) Vol. 8, Issue 3, March 2019

● K. . A. Beals, "Potatoes, Nutrition and Health," American Journal of Potato Research, no. 96, pp. 102-110, 2019.

● Ministry of Agriculture's Food Security Agency, 2017 Annual Report of the Ministry of Agriculture's Food Security Agency, Jakarta: Ministry Agriculture's Food Security Agency, 2018.