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Plant Leaf Diseases Recognition Using Convolutional Neural Network (CNN) with Attention Mechanisms

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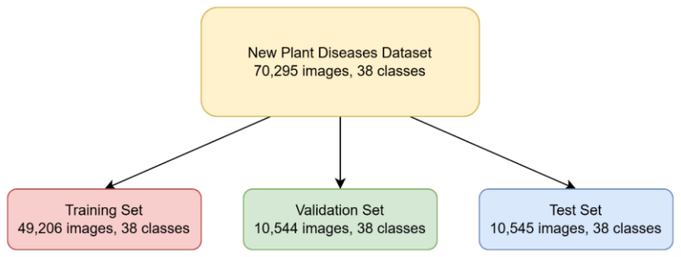
Abstract

Over the past decades, the population has been increasing, and the demand for agricultural products has been growing. However, plant diseases can lead to a decline in the quality and quantity of agricultural production. Therefore, using Convolutional Neural Networks (CNNs) to improve the accuracy of plant leaf diseases recognition can help improve agricultural production affected by various plant diseases. This project presents a scheme to recognize plant leaf diseases using ResNet model with Channel and Spatial Attention Mechanisms. This model can recognize 38 diseases of 14 plant species. In this project, the performance of the model was evaluated by loss, accuracy, ROC-AUC curve, recall, precision, sensitivity, specificity, confusion matrix, F1-score, precise-recall curve, and Grad-CAM. The results show that the model has a very good performance with the accuracy of 99.29%. In addition, this project also includes a Flask web application with an easy-to-use GUI for users to upload images for recognition.

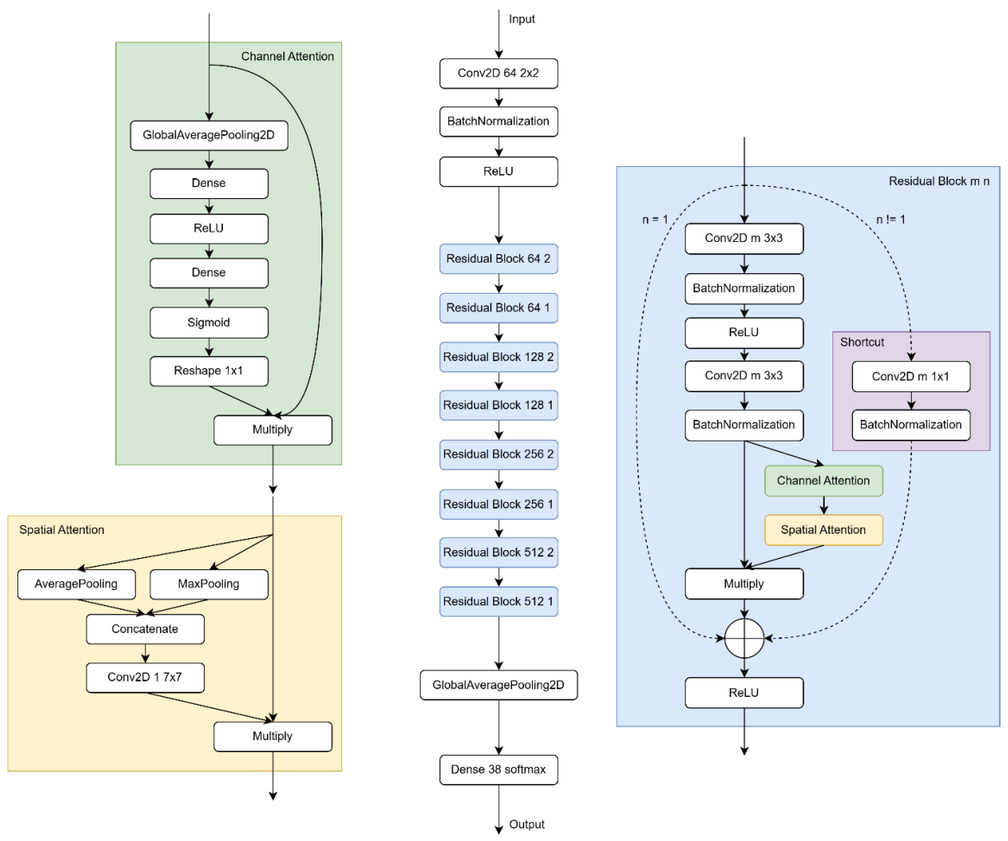
Dataset

PlantVillage Dataset is a dataset with over 50,000 professionally curated images of healthy and infected leaves of crops plants. The dataset collects images of plant leaf diseases in 38 different categories, covering 14 different plant types and 38 different disease types. New Plant Diseases Dataset is a dataset obtained through data augmentation processes such as image rotation, inversion, and brightness enhancement on the basis of the PlantVillage Dataset. This project uses 70,295 images from the training set of New Plant Diseases Dataset for model training, validation, and testing. The dataset has been split in the ratio of 70:15:15, and preprocessed according to the appropriate steps.



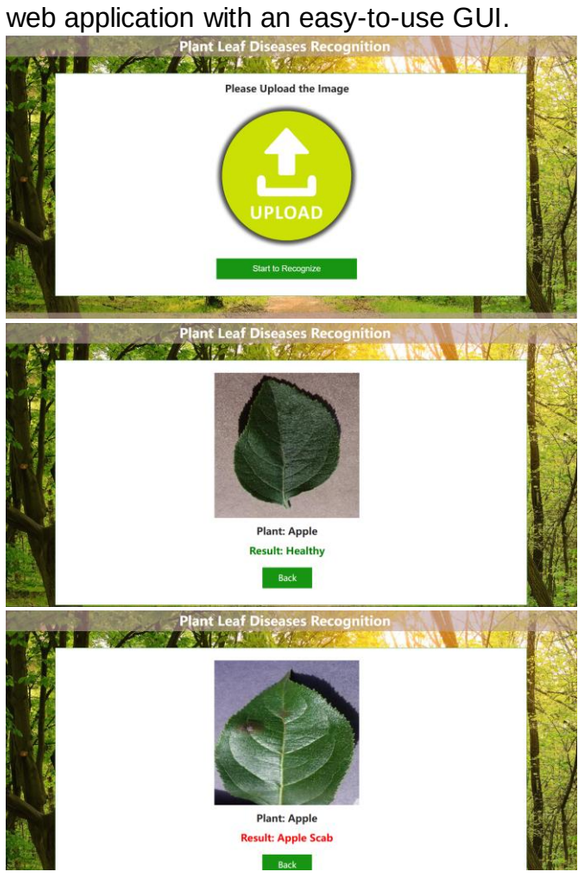
Model Architecture

The project used the ResNet model with Channel and Spatial Attention Mechanisms. The following is the architecture of the model.



Graphical User Interface

In order to make the system easily accessible to users, this project also designed a Flask web application with an easy-to-use GUI.



Future Work

In the future, the following works can be done to improve this project. For the problem of unable to monitor in real time, an interface between the web application and the camera will be implemented. For the problem of limited dataset, more plant leaf disease images from different sources or environments will be collected to further improve the generalization ability and accuracy of the model. For the problem of computational complexity, model compression techniques or lightweight architectures can be explored so that the model can be deployed to more resource-constrained devices.

Results

Accuracy	Precision	Recall	F1-score
99.29%	99%	99%	99%