RICE LEAF DISEASE CLASSIFICATION USING CNN WITH TRANSFER LEARNING

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Abstract - Rice is one of India's largest commonly cultivated crops, and it is vulnerable to a variety of illnesses at different stages of production. With their inadequate understanding, farmers find it extremely difficult to manually diagnose these illnesses. Recent advances in Deep Learning have shown that automatic image recognition systems based on convolutional neural network (CNN) models can be quite useful in these cases. Because a collection of rice leaf disease images is not readily available, we constructed our own tiny dataset and developed our deep learning model using Transfer Learning. The suggested CNN architecture is based on VGG16, and it was trained and tested using data from rice fields and the internet.

Keywords *– Convolutional Neural Network, Transfer Learning, Fine-Tuning, Rice Leaf Disease, Deep Learning.*

1.INTRODUCTION

Rice is a staple food in both India and the entire globe. Various illnesses affect it at different phases of its development. To help farmers and enhance the accuracy of plant disease diagnosis, researchers used a variety of machine learning methods, such as Support Vector Machines (SVM) and Artificial Neural Networks. The accuracy of such systems, on the other hand, is greatly reliant on feature selection approaches.

Convolutional neural networks have lately made substantial progress in picture-based identification by eliminating the need for image preparation and allowing integrated feature selection.We developed an automated approach in which farmers may send photos of sick leaves to our server, where a neural network will diagnose the sickness and the disease classification, as well as the remedy, will be returned to the farmers.

2. METHODOLOGY

Deep learning is an end-to-end learning approach that eliminates the need for complicated hand-crafted feature extraction. As the layer depth rises, it learns characteristics at different levels of abstraction. The convolutional neural network (CNN) is the most widely used and famous image recognition algorithm. Convolutional, pooling, and fully linked layers make up the majority of the system. However, in order to train successfully, CNN requires a large labelled dataset, such as MobileNet, which is a difficult challenge in agriculture.

Otherwise, because of overfitting, CNN's performance on tiny datasets is not promising. Transfer learning models for building CNN modules using pre-trained networks. Transfer learning performs better when training the network on a small dataset. MobileNet, a deep network model pre-trained on the training photos, was utilised for training. MobileNet contains 1.2 million pictures with 1,000 classifications, and MobileNet comprises five convolutional layers, three pooling layers, and two fully connected layers. The MobileNet CNN model employed in this work requires 224x224x3 input dimensions.

As a result, all of the input photographs of rice plant diseases have been downsized to this size. However, we employed the MobileNet CNN model as a feature extractor rather than for classification. Figure 4 shows the MobileNet model architecture.

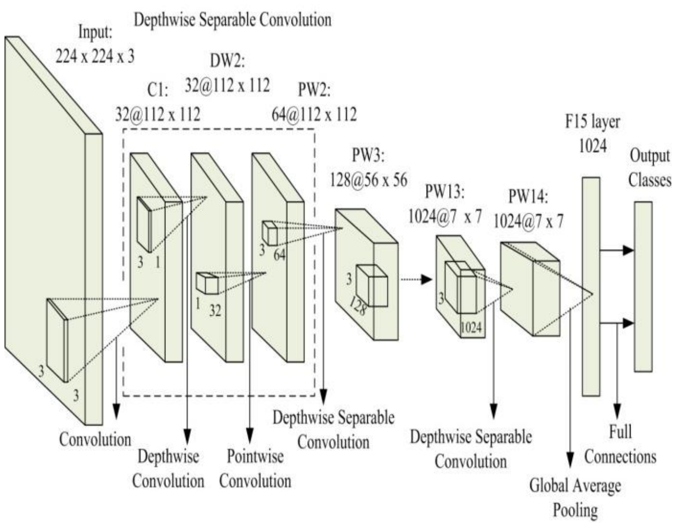

Fig.1. MobileNet Architecture

3. DATA DESCRIPTION

The rice leaf picture collection was gathered during the last few months, primarily from cultivation areas. The collection contains 1649 images of diseased rice leaves from three prevalent diseases: Leaf Blast, Leaf Blight, and Brown Spot. There are 507 pictures of healthy leaves. A variety of challenges were encountered when gathering data, including low lighting and the presence of many diseases in the same plant. We tried to overcome these by using image preprocessing operations such as resizing and zooming. Because the quantity of pictures acquired from the fields is limited for training CNN, we employed a variety of

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augmentation techniques like magnification, horizontal and vertical shift, and rotation, which are explained more in the Implementation Section. This is the first time such a huge rice disease dataset has been obtained from the Indian agricultural sector.

Fig. 1. (a)-(c) From Left to right. (a) Leaf Blast (b) Leaf Blight and (c) Brown Spot

A. Leaf Blast:

Magnaporthe oryzae causes this fungal disease. White to grey-green dots with dark red to brownish edges appear first. Some are shaped like diamonds, with wide cores and sharp ends. Figure 1(a) depicts spindle-shaped lesions with white dots and a dark brown border.

B. Leaf Blight:

It is a bacterial disease caused by the bacterium Xanthomonas oryzae. The diseased leaves turn a greyish green tint and roll up, followed by yellowing, and eventually dying after withering. The lesions have wavy borders and spread downward. Bacterial slime like morning dew might be seen on early lesions. Figure 1(b) depicts Leaf Blight-affected leaves.

C. Brown Spot:

It is a fungus gnat. The diseased leaves have multiple large spots on them that can destroy the entire leaf. Fully formed lesions are round to oval in shape, with a light brown to grey core surrounded by a reddishbrown edge created by the fungi's toxin. Brown Spot diseased leaves are seen in Fig 1(c).

4. IMPLEMENTATION

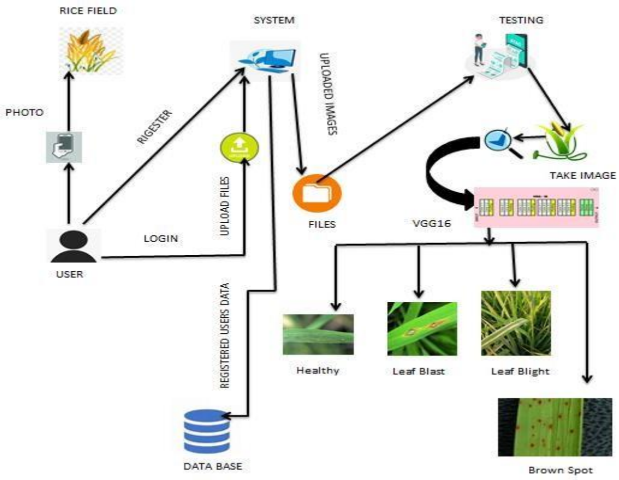

Fig.3. Model of Image Classifier

The Ensemble Model was implemented in a software architecture and user interface app. The software system was divided into two components: the client and the server. The client is installed on the smartphone, while the server is installed on a server PC.

The Python language was chosen for server-side programming since the Ensemble Model was trained and ran using Pycharm, which is based on the Python language.A robust web server was built using Flask, a Python-based free and open-source web framework. The client sends a picture of the rice illness to the web server. When the server receives a POST request from the client, it calls the Ensemble Model to identify the picture and delivers the results in JSON format to the client. The outcomes contain information about the leaf's state, disease type, and probability score. After receiving the JSON data, the client parses it and presents it on the screen for the client to view. The disease name and remedy can be returned to the farmer.

5. RESULT

In this experiment, diverse and sophisticated CNN models such as ResNet, MobileNet, and VGG16 are utilised, and all of them are run on the same dataset and watched to see how they function. We found from our work that MobileNet and VGG16 perform almost similarly on the same dataset in terms of accuracy and validation loss. When compared to other models, MobileNet performs effectively. It will quickly identify and diagnose rice plantation-based diseases in the agricultural sector. We may classify diseases in rice leaves as Leaf Blast, Brown Spot, Leaf Blight, and healthy leaf. Further therapy may be done easily by recognising the type of disease using our application.

Fig 4: System predicted disease is Leaf Blast

Fig 5: System predicted disease is Leaf Blight

Fig 6: System predicted disease is Brown Spot

Fig 7: System predicted leaf is Healthy

6. CONCLUSION

In this research, we present a deep learning architecture that accurately classifies 92.46 percent of the test images after trained on 1509 images of rice leaves and testing on 647 distinct images. Transfer Learning, which included fine-tuning the default ResNet50 model, significantly enhanced the model's performance, which had previously failed to generate good results on such a tiny dataset. The number of epochs employed was limited to 25 since we obtained a cut point after which the accuracy and loss did not improve on both training and validation data.

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