International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 03 | March - 2023 Impact Factor: 7.185 ISSN: 2582-3930

RICE LEAF DISEASE DETECTION AND REMEDIES RECOMMENDATION USING DEEP LEARNING

G Ravi kumar[1], K Vedavathi[2], K Dhanusha[3], M Ganesh Yadav[4],
K Vikram Chowdary[5],S Sai Charan Tej[6]
[1]Associate professor, [2,3,4,5,6] Students, Dept of CSE
[1,2,3,4,5,6] Siddartha Institute of Science and Technology, Puttur

---

ABSTRACT:

The agriculture sector is the main sector and India holds the record for the Second-Largest agricultural land in the world. Rice is an important food crop and has become the main food for most of the population. Thus Rice availability and its Quality are the factors that we need to consider. But Rice has a serious negative effect on crop yield. Correct and early diagnosis of rice is the key to avoiding those effects. Recent developments in deep learning show that automatic image recognition systems using convolution Neural Network(CNN) models can be very beneficial in such problems. So, here we have used Convolution Neural Network which has provided a breakthrough in an image-based reorganization by eliminating the need for image preprocessing as well as providing in-built feature selection. Here We have created our own rice leaf disease image dataset. The proposed CNN architecture is based on VGG16 and ResNet-50 and is trained and tested on the dataset collected from rice fields and the internet.

Key Words: Deep Learning, Transfer Learning, CNN, ResNet-50, Rice Leaf Diseases, Remedies

I. INTRODUCTION

Rice Plants are an important food crop that has become a staple food for more than half of the world's population. It is infected by various diseases, caused by weather, viruses or other types of animals, such as rats, and grasshoppers' number of diseases on rice plants and the degree of harm caused has increased due to the variation in pathogen varieties, changes in cultivation methods and inadequate plant protection techniques. There are several leaf diseases having various symptoms. It is very difficult to identify the type and intensity of diseases by the farmer.

In order to support the farmers with timely and quick remedies, and to improve the accuracy of plant disease identification, research has been done on automatic plant disease classification using various Machine learning algorithms including Support Vector Machine (SVM) , and Artificial Neural Network(ANN).In plant disease identification using machine learning algorithms, accuracy depends on feature extraction, feature segmentation, and classification algorithm used.

Deep learning is an advancement of Machine learning techniques that successfully trains a huge amount of data and automatically learns the features of the input and gives the output based on the decision rules. CNN is effective in processing visual imagery. It is a feed-forward artificial neural network that has three diverse layers input layer, hidden layer, and output layer.

Transfer learning is a method by which a pre-trained convolution neural network can be re-purposed for a new problem. Thereby the training time of the model can be reduced when compared to the model developed from scratch and gives an enhanced performance to the proposed model. Transfer learning can be utilized to create a model that can be used as a fixed feature extractor by eliminating the last fully connected layers or by fine-tuning the last few layers that will work more specifically for the concerned dataset.

So here we have come up with an idea of an automated system where farmers can upload disease leaf image and post it on our server where the neural networks will be used to identify the disease and disease classification along with remedy can be sent back to the farmer. In this work, we have developed the deep learning approach on our rice disease dataset that have collected over the past several months. we have used pre-trained VGG-16 and ResNet-50 model.

II. RELATED WORK

A lot of research has been done using traditional classifiers but the results are dependent on the feature selection techniques and image preprocessing is a major step. Therefore, CNN has attracted multiple researchers to take the advantage of high recognition accuracy as it eliminates the need for image preprocessing by providing inbuilt feature selection.

Rice plant disease detection and classification techniques: A survey this research paper provides a survey on various techniques and briefly discusses significant aspects of different classifiers and techniques used to detect rice diseases. Papers of the last decade are studied thoroughly, including the work carried on various rice plant diseases, and a survey is presented based on essential aspects. The survey focuses to distinguish different methods based on the classifier used. The survey gives insights of the different techniques used for the identification of rice plant disease. In addition, a hardware prototype and model using a Convolutional Neural Network (CNN) is proposed that detects rice disease. It further identifies the type of rice disease as rice blast, rice blight, brown spots, leaf smut, tungro, and sheath blight[2].

Rice disease detection using CNN

A convolutional neural network classifier is used on a dataset of 227 images of diseased and healthy rice plants [17]. The classifier is transfer learning based using AlexNet. Training the architecture an accuracy of 91.23% is achieved but it can only predict whether the plant is diseased or not. In [18], the authors collected 500 images of different rice diseases of leaf and stem. They developed an architecture inspired by le-Net and AlexNet and achieved 95.48% on the test set. Since the data is very less they used various preprocessing steps like image resizing to 512*512, normalization, PCA, and whitening. They used stochastic pooling instead of max pooling and it prevents overfitting.

III. RICE DISEASE TYPES AND DATASET DESCRIPTION

We have created our own dataset of diseased and healthy rice leaf images. The rice leaf image dataset has been collected over the past few months mostly from the cultivation fields of vadamalapeta village in Chittoor, tiragaladhinne in the Prakasam district, and in fields around kalahasti. The images we collected

were captured using our mobile phones. The symptoms and knowledge about the diseases and remedies have been collected from the internet (International rice research institute(IRRI) rice knowledge Bank website. we have a limited number of images. The dataset consists of 1000 images of diseased leaves of rice consisting of the three most common diseases namely rice leaf blast, rice leaf blight, and brown spot. there are 300 images of healthy leaves.

Here is the description of the classes of rice leaf diseases and their remedies on which we have worked.

A. Leaf Blast

Rice leaf blast is a fungal disease caused by Magnaporthe oryzae and it affects the leaf color. Initial symptoms appear as white or gray-green lesions or spots, with dark red to brownish borders. It occurs in areas with low soil moisture, frequent and prolonged periods of rain showers, and cool temperatures in the daytime.

Below are some measures that can be done to control leaf blast:

- Adjust planning time. Sow seeds early, when possible, after the onset of the rainy season.
- There are several pesticides that can be used to control leaf blast disease. Some common pesticides used for leaf blast include Azoxystrobin, Propiconazole, Tricyclazole, Metconazole, and Tebuconazole.

Fig.1: Leaf Blast

B. Leaf blight

Leaf blast is caused by Xanthomonas oryzae. It is one of the most deadly and destructive diseases of rice and it may lead to crop loss of 75%. Blight cause yellowing, drying of leaves, and wilting of seedlings. On seedlings, infected leaves turn grayish-green and roll up. It occurs in both tropical and temperate environments, particularly in irrigated and rainfed lowland areas. It is commonly observed when strong winds and continuous heavy rains occur.

Below are some measures that can be done to control leaf blight:

- Keep fields clean. Remove weed hosts and plow under rice stubble, straw, and rice ratoons.
- Some pesticides that can be used to control leaf blight in rice plants include:

Streptomycin, chlorothalonil, copper-based fungicides such as copper hydroxide, and copper oxychloride, and bactericides like streptomycin, oxytetracycline, and tetracycline.

Fig.2: Leaf Blight

C. Brown spots

It is a fungal disease that infects the leaves, leaf sheath, and panicle branches. The infected leaves have numerous big spots on the leaves which can kill the whole leaf.at the initial stage small, circular, dark brown, or purple lesions can be observed. It is common in unflooded and nutrient-deficient soil, or in soils that accumulate toxic substances.

Improving fertility is the first step in managing brown spots. Some pesticides to control brown spots on rice

leaves are tebuconazole, propiconazole, tricyclazole, and chlorothalonil.

Fig.3: Brown Spots

IV. METHODOLOGY

Convolution neural networks are multi-layered networks whose architecture determines the performance of the network. It consists of three parts namely, the convolution layer, poling layer, and the fully connected layer. The first two, convolution and pooling layers, perform feature extraction, whereas the third, a fully connected layer, maps the extracted features into the final output, such as classification. The pooling layer reduces the dimensionality of the feature extracted by the Convolutional layer. The fully connected layer followed by the data set uses the feature extracted to classify the images. The max pooling layer is a sub-sampling layer that reduces the size of the feature map. Then the fully connected layer provides a full connection to each of the generated features.

The Prediction model based on the deep learning framework ResNet-50 is constructed to extract features. It provides a novel way to add more convolutional layers to a CNN, without running into the vanishing gradient problem, using the concept of shortcut connections. While the original Resnet had 34 layers and used 2-layer blocks, other advanced variants, such as the ResNet-50, made use of 3-layer bottleneck blocks to ensure improved accuracy and lesser training time. VGG16 is a type of CNN. It is one of the popular algorithms for image classification and is easy to use with transfer learning. It is a type of object detection and classification algorithm that is able to classify 1000 images of 1000 different categories.

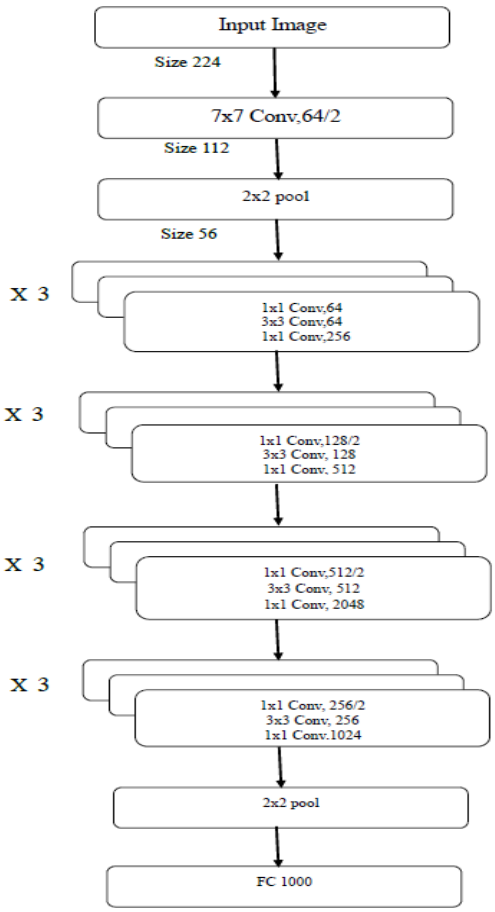

Fig.4: Architecture of ResNet-50

V. IMPLEMENTATION

A. Experimental Setup

The experiment was performed on a Windows 10 PC equipped with a GPU P4000,64-bit operating system. The CNN-based model was implemented in Keras deep learning framework with TensorFlow backend and python.

B. Data Collection

The images of rice leaves are collected from the cultivation fields as well as from the internet. As discussed in the dataset description, data consists of 3 types of diseases namely leaf blight, leaf blast, brown spot, and healthy plant images.

C. Image Preprocessing And Augmentation

The images collected are preprocessed to 224*224 pixels and a number of augmentation techniques like zoom, rotate, vertical shift, and horizontal shift are applied using an image data generator in Keras to generate new images and to train our model.

D. CNN-Based Model Training

The image dataset is loaded for training and testing. The class labels and the corresponding images are stored in respective arrays for training. 70% of the data is used for training and 30% of the data is used for testing. The class labels are encoded as integers and then, one hot encoding is performed on these labels making each label represented as a vector rather than an integer. Next ResNet-50 model and VGG-16 model are loaded from keras. We have flattened the output of the feature extractor part, followed by a fully connected layer and output layer with softmax. Then we compiled our model using the Adam optimizer with categorial-cross-entropy as the loss function for classification. We have stopped at 25 epochs since after this the results were stable.

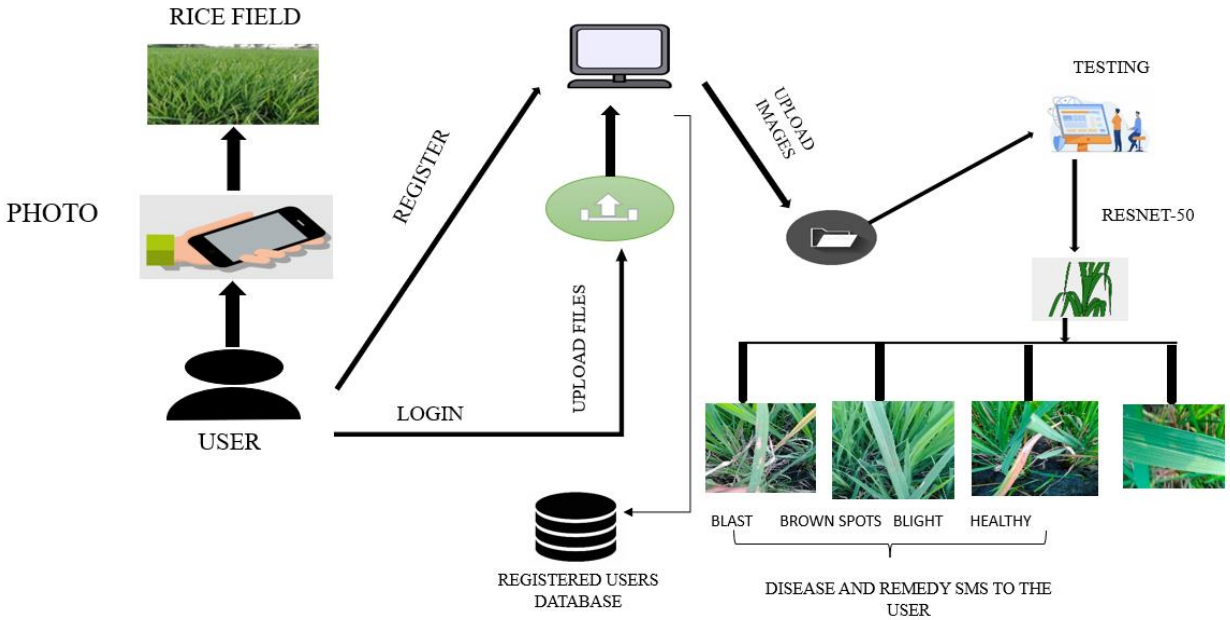

Fig.5: System Architecture

VI. RESULT

The proposed model is executed for 25 epochs over 2000 training data followed by 500 test data the accuracy of the training set is 97% and the test accuracy is 95%. The batch size, Number of Epochs, and optimizer were fine-tuned. The accuracy of the proposed CNN model using ResNet-50 and VGG-16 is comparatively more than the Existing models.

Error analysis

The below figures are misclassified by the proposed CNN model. The misclassifications are described below:

Image(a) is actually leaf blight but is classified as healthy. The reason might be poor illumination.

Image(b) is actually a leaf blast but is classified as brown spots. This may be Because of the Brownish Texture color on the leaf.

Fig.6.Misclassified Images, Image(a) leaf blight, Image(b)Leaf blast

VII. CONCLUSION

Farmers are facing issues with rice crop disease identification and are unable to find effective pesticides or insecticides to control the disease. So we can solve this issue by developing a deep learning model using the Convolution Neural network (CNN) algorithm that detects the rice blast, leaf blight, and brown spots. the proposed CNN architecture is based on ResNet-50.the system is robust, user-friendly, fast, and cost-efficient.

REFERENCES

[1] Vasantha, S. V., Kiranmai, B., & Krishna, S. R. (2021). Techniques for rice leaf disease detection using machine learning algorithms. Int. J. Eng. Res. Technol., 9(8), 162-166.

[2] Tawde, T., & Reddy, A. (2021). Rice plant disease detection and classification techniques: A survey. Int. J. Eng. Res. Technol., 10(7), 560-567.

[3] Prakanshu Srivastava, Kritika Mishra, Vibhav Awasthi, Vivek Kumar Sahu, Mr. Pawan Kumar Pal, "Plant Disease Detection Using Convolutional Neural Network", International Journal of Advanced Research · January 2021

[4] PrajwalGowda, B. S., Nisarga, M. A., Rachana, M., Shashank, S., & Raj, B. S. (2020). Paddy crop disease detection using machine learning. International Journal of Engineering Research & Technology, 8(13).

[5] Ghosal, S., & Sarkar, K. (2020, February). Rice leaf diseases classification using CNN with transfer learning. In 2020 IEEE Calcutta Conference (CALCON) (pp. 230-236). IEEE.

[6] Andrianto, H., Faizal, A., & Armandika, F. (2020, October). Smartphone Application for Deep Learning-Based Rice Plant Disease Detection. In 2020 International Conference on Information Technology Systems and Innovation (ICITSI) (pp. 387-392). IEEE.

[7] K. Trang, L. TonThat, N.G.M. Thao, Plant leaf disease identification by deep convolutional autoencoder as a feature extraction approach. 2020 17th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON), IEEE, 2020, pp. 522–526.

[8] Sethy, P. K., Barpanda, N. K., Rath, A. K., & Behera, S. K. (2020). Deep feature based rice leaf disease identification using support vector

machine. Computers and Electronics in Agriculture, 175, 105527.

[9] P. Konstantinos Ferentinos, "Deep Learning Models for Plant Disease Detection and Diagnosis," Computers and Electronics in Agriculture ,vol. 145,pp. 311–318,2018.

[10] Ahmed, K., Shahidi, T. R., Alam, S. M. I., & Momen, S. (2019, December). Rice leaf disease detection using machine learning techniques. In 2019 International Conference on Sustainable Technologies for Industry 4.0 (STI) (pp. 1-5). IEEE.

[11] Aydin Kayaa, Ali SeydiKecelia, et.al. "Analysis of Transfer Learning for Deep Neural Network Based Plant Classification Models" in "International Journal of Computers & Electronics in Agriculture, published by Elsevier",vol. 158, issue 3, pp. 20-29, 2019.

[12] Sue Han Lee, HerveGoeau, Pierre Bonnet& Alexis Joly,"New Perspectives on Plant Disease Characterization Based on Deep Learning", in "International Journal of Computers & Electronics in Agriculture, published by Elsevier",vol. 170, issue 3, 2020.

[13] Jayme Garcia,ArnalBarbedo"Plant Disease Identification from Individual Lesions and Spots using Deep Learning","Journal of Biosystems Engineering, published by Elsevier", vol. 180, pp. 96-107, April 2019.

[14] Sk Mahmudul Hassan, Arnab Kumar Maji, Micha? Jasi ´nski, Zbigniew Leonowicz, Elzbieta Jasi ´nska, \"Identification of Plant-Leaf Diseases Using CNN and Transfer-Learning Approach\", Electronics 2021, 10, 1388.

[15] S. Ramesh, D. Vydeki "Recognition And Classification of Paddy Leaf Diseases using Optimized Deep Neural Network with Jaya Algorithm" in "Journal of Information Processing in Agriculture, published by Elsevier", vol. 6, issue 3, Sep. 2019.

[16] Shrivastava, V. K., Pradhan, M. K., Minz, S., & Thakur, M. P. (2019). Rice plant disease classification using transfer learning of deep convolution neural network. International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences, 3(6), 631-635.

[17] R. R. Atole, D. Park, "A Multiclass Deep Convolutional Neural Network Classifier for Detection of Common Rice Plant Anomalies," International Journal Of Advanced Computer Science And Applications, vol. 9,no. 1,pp. 67–70,2018.

[18] Y. Lu, S. Yi,N. Zeng,Y. Liu, and Y. Zhang, "Identification of Rice Diseases Using Deep Convolutional Neural Networks," Neurocomputing, 267, pp. 378-384,2017

[19] V. Singh, A. Misra, "Detection of Plant Leaf Diseases Using Image Segmentation and Soft Computing Techniques," Information Processing in Agriculture, vol.4 no. 1,pp. 41–49,2017

[20] Prajapati, H. B., Shah, J. P., & Dabhi, V. K. (2017). Detection and classification of rice plant diseases. Intelligent Decision Technologies, 11(3), 357-373.