How to Cite:
Vamshi, P., Reddy, N. Y., Krishna, I. S. R., Vundi, S. H., & Mounica, M. (2022). Plant diseases prediction using image processing. *International Journal of Health Sciences*, *6*(S4), 4469–4480. https://doi.org/10.53730/ijhs.v6nS4.9095

Plant diseases prediction using image processing

Pabboji Vamshi
ECE Department, GRIET-HYDERABAD Telangana
Corresponding author email: vamshipabboji9822@gmail.com

N Yugendhar Reddy
ECE Department, GRIET-HYDERABAD Telangana
Email: yugendharreddy33@gmail.com

I Sai Rama Krishna
ECE Department, GRIET-HYDERABAD, Telangana
Email: sacroite200@gmail.com

Sri Harsha Vundi
ECE Department, GRIET-HYDERABAD, Telangana
Email: shksn162@gmail.com

Machunoori Mounica
Asst.Professor ECE Department, GRIET-HYDERABAD Telangana
Email: mounica432@gmail.com

***Abstract*---**Rice is one of India's most extensively farmed crops, and it can be infected with a number of diseases at different stages of development. Due to their lack of understanding, farmers find it extremely difficult to manually diagnose these diseases. We created our own dataset and generated our deep learning model using Transfer Learning because a collection of rice leaf disease photos was not freely available. The proposed cnn architecture was trained and tested using data from different sources, and it is based on VGG-16. The precision of the proposed model is 92.46 percentage. We also showed why and where it occurs, its symptoms and remedies for making it easy for the agriculturists.

***Keywords*---**deep learning, transfer learning, VGG-16, image processing, convolution neural networks.

Introduction

Rice is a common food across many regions. Various diseases affect it at various phases of cultivation. Pre-diagnosis and treatment of diseases is therefore beneficial in ensuring high efficiency, but this is quite difficult due to the huge amount of land under individual control, the wide variety of diseases, and the appearance of many diseases in the same leaf of the plant. Agriculture specialist awareness is unavailable in rural regions, and the process is time taking. As a result a better way is required. Artificial neural networks [4] have been utilized in research to assist farmers with their difficulties and improve plant disease detection accuracy.

On the other hand, feature selection procedures are critical to the accuracy of such systems. Convolutional neural networks have lately made substantial progress in image-based recognition by removing the requirement image pre-processing and allowing the required feature selection. The other problem is that large datasets for this kind of problems are tough to come by. It is recommended to create a model that is pre-trained on a large dataset in circumstances when the dataset is small. Due to the widespread availability of mobile phones, an automated technique has been devised in which agriculturists may upload images of leaves to a server, where a neural network will predict the disease, its symptoms as well as the precautions, can be returned to the agriculturists. The structure of the disease categorization component of the model is described in this study. Inspired by the work on convolutional neural networks in [5–8] and [14], this paper develops a deep learning strategy for the rice leaf disease dataset that has been collected. To accommodate our own dataset, the pre-trained VGG-16 model (trained on the enormous ImageNet data) and fine- tuned the fully connected layers using Transfer Learning are used. Finally, error analysis and explanation to the error's source are performed.

Literature survey

Plant leaf disease analysis using image processing technique with modified SVM-CS classifier AUTHORS

Shruti Jadhav, Dipika Harpale ABSTRACT: Plant diseases are one of the main reasons for decline in the efficiency of yield. Farmers have a lot of trouble recognizing and controlling plant diseases. As a result, it is important to treat plant diseases at preliminary stage so that farmers can take correct decision to avert future losses. The study focuses on a method for detecting rice leaf illness based on image processing and machine learning. We propose an Android application in this paper that assists farmers in recognizing plant disease by submitting a photo of leaf to the server. The system uses a series of steps to determine the type of disease kind. The image is processed by the server through several phases in order to identify the ailment, and the conclusions are given to the user through website.

Automatic recognition of plant leaves diseases based on serial combination of two SVM classifiers AUTHORS

Y. Es-saady, T. El Massi, M. El Yassa, D. Mammass, and A. Benazoun, ABSTRACT: A machine vision method for automatically recognizing plant leaf diseases from photographs is presented in this paper. The proposed system is based on a 2-SVM classifier series combination method. The 1st classifier employs color to categorize the photos; it assumes that diseases of identical or comparable color belong to the same set at this point. The 2nd classifier is then deployed to distinguish between the sets that have similar colors based on form and texture attributes. Six types of diseases are tested in this study, including 3 types of damage (Leaf miners, Thrips, and Tuta absoluta) and 3 types of pathogen symptoms (Early blight, Late blight and Powdery mildew). These findings demonstrate the proposed method's benefits over other existing methods.

System Analysis

Existing System

Farmers find it incredibly difficult to physically detect these diseases due to their lack of awareness. Recent Deep Learning breakthroughs have shown that Convolutional Neural Network (CNN)-based Automatic Image Recognition systems can be quite effective in certain situations.

Disadvantages of existing system

Various illnesses affect it at different phases of its development.

Proposed system

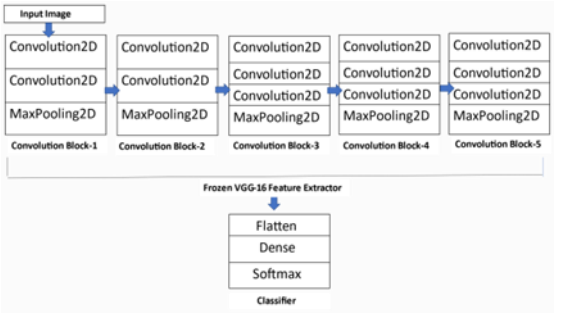
Because a photo dataset for rice leaf disease isn't widely available, we created our own, which is only a few megabytes in size, and built our deep learning model using Transfer Learning. The below CNN architecture was trained and tested using data from various sources, and it is based on VGG-16. The proposed model is 92.46 percent accurate.

Advantages of proposed system

To help farmers and enhance the accuracy of plant disease detection, researchers used multiple machine learning algorithms, including CNN, to conduct study.

System Design

System Architecture



Data flow diagram

1. It can be referred as bubble chart. It shows the system's input, processing and output data in a statistical format.
2. As shown in the DFD, data passes through the network and is transformed through a sequence of algorithms. It shows the data flow and the changes that happen when data moves from source to destination.
3. In a system, a DFD is used to show any extent of detachment. Each level of the DFD represents a different level of data flow and functional detail.
4.

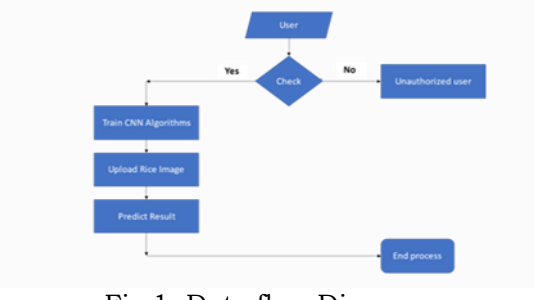


Fig.1. Data flow Diagram

Collaboration diagram

In this the relationships among different components are collaborated together. The exchanges are listed as numbered encounters, making it easy to study the course of events. The collaboration diagram helps us to find all the possible object connections.

1. Login()
2. Train CNN Algorithms()
3. Upload Rice Image()
4. Logout()

Fig.2. Collaboration Diagram

Implementation: Modules:

¡ Import Package
¡ Upload Image File
¡ Image Pre-processing
¡ TF learns with DL
¡ Model Generation
¡ Generate CNN & VGG16 Model
¡ Predict For Image

Algorithm

Convolutional neural network

The author of this study explains how Convolution Neural Networks, a Deep Learning technology, may be used to automate government functions (CNN). People can read news and announcements about new government schemes on the internet, then give their thoughts about them, which can help the government make better decisions. We need software that operates like human brains and can quickly determine whether the comments people are posting are good or negative in order to automatically find public attitudes about schemes. The author advocates employing a CNN model, which functions similarly to human brains, to construct such an automated opinion detecting system. This CNN model can be built for any service, and we can design it to perform as an automated decision-making system without the need for human input.

The author has already proposed an approach for developing multiple models, one of which can identify or recognize human handwriting numbers and the other of which can detect sentiment from text phrases about government programs provided by humans. Our extension model now includes a model that can detect sentiment from a person's facial image. Expressions on a person's face are more effective at conveying feelings than words or sentences. We can predict sentiments from images of people's faces as a consequence of our extensive research. To show how to design a convolutional neural network- based image classifier, we'll build a 6-layer neural network that can differentiate one image from another. This network that we will create is basic enough to run on a computer. Traditional image classification neural networks contain a huge number of parameters and take a long time to train on a normal CPU. Our goal, on the other hand, is to demonstrate how to design a real-world convolutional neural network using TENSORFLOW. To tackle optimization problems, mathematical models called neural networks are used. Neural networks are made up of neurons, which are the basic computer units. A neuron receives an input (say x), performs certain computations on it (say, multiplying it by w and adding another variable b), and then outputs a value (z= wx+b). To construct a neuron's ultimate output (activation), this value is transferred to a non-linear function

called the activation function (f). Activation functions come in many different sizes and shapes. A sigmoid neuron is a neuron that uses the sigmoid function to activate. The convolution layer includes filters that execute convolution operations when the input is scanned in terms of dimensions. Neurons are classified according to their activation roles, and there are numerous types, including RELU and TanH. The next component of neural networks is the layer, which is constructed by stacking neurons in a single line. Below is an image with layers.

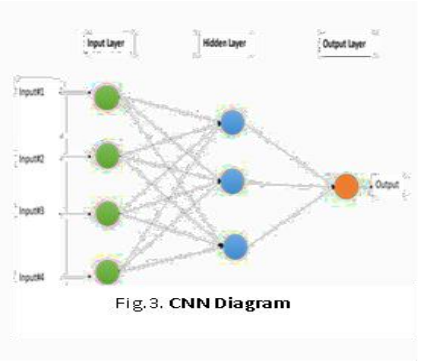


Fig.3. **CNN Diagram**

System Test

Testing is used to identify flaws in a product. The process of seeking to find all conceivable flaws or problems in a work product is known as testing. It can be used to check the functionality of individual components, sub-assemblies, assemblies, and/or the entire product. It is the process of ensuring that software fulfills its specifications and user expectations, and that it does not fail in an unacceptable manner. There are numerous testing choices available. Each test type is created to meet a certain testing requirement.

Test Results

All of the above-mentioned test cases were successful. No flaws were discovered.

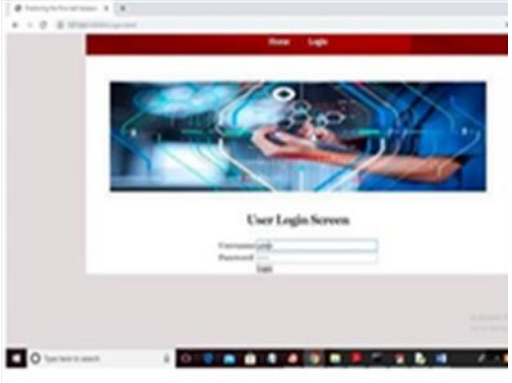
Use case ID	Predicting the Rice leaf diseases using CNN
Use case Name	Home-button
Brief	Show starting page of website
Primary- actor	user
Pre-condition	User have to open application
Post- condition	User must open application
Frequency of Use case	User must open application
Other use case	N/A

Results and Screenshots

To run project install python 3.7 and tensorflow package 1.14.0 and then install Django==2.17
After installation run below command from 'RiceDisease' folder
Python manage.py runserver Then open
browser and enter URL http://127.0.0.1:8000/index.html as and pressenter key to get below screen.

In above screen click on 'Login' link to get below login screen

Screen shot-1



In above screen enter username as 'admin' and password as 'admin' and then click 'Login' button to get below screen

Screen shot-2

In above screen CNN with transfer learning VGG16 got 95% accuracy and without transfer learning got 85% accuracy so VGG16 is giving better result. In below console you can see layer details of VGG 16 and Normal CNN

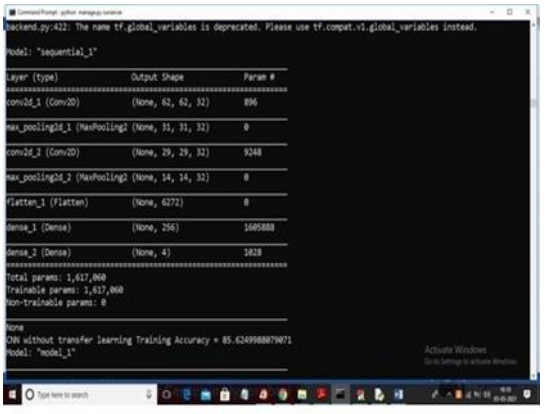
Screen shot-3

Now in above screen click on 'Choose File' button to upload leaf test image from 'testImages' folder

Screen shot-4

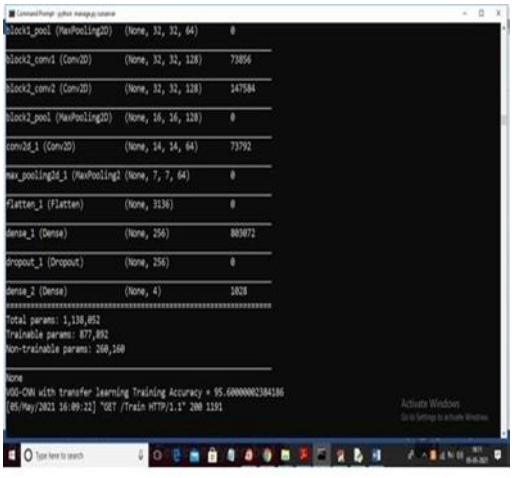
In above screen selecting and uploading '6.jpg' file and then click on 'Open' button then click on 'Submit' button to get below result

Screen shot-5



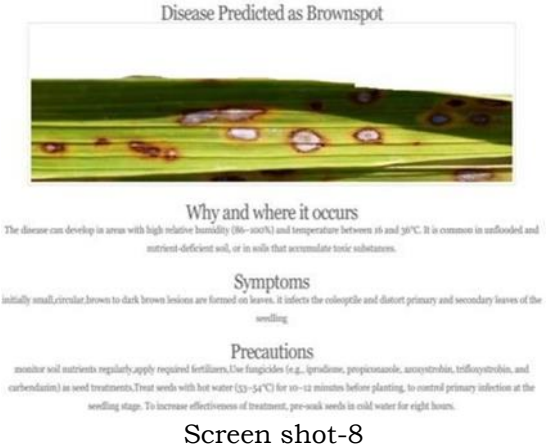
In above screen normal CNN created 4 layers and got 85% accuracy and in below screen you can see VGG16 layers

Screen shot-6

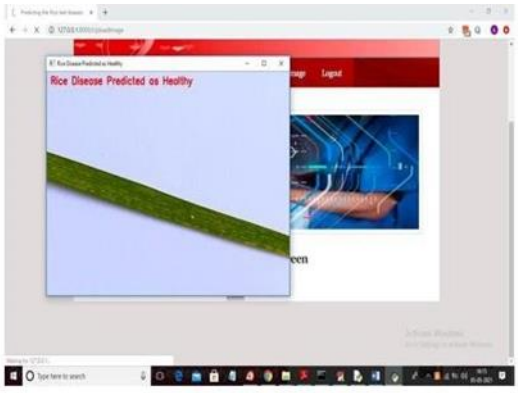


In above screen VGG16 contains so many layers and its accuracy is 95% and now in below screen click on 'Upload Rice Image' link

Screen shot-7



Screen shot-8



In above screen leaf predicted as healthy and similarly you can upload other images and test them

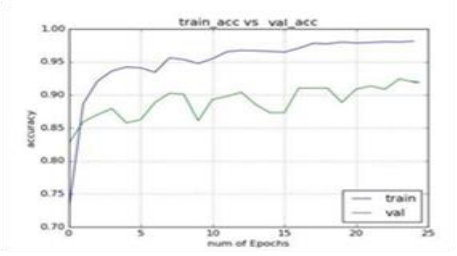
Screen shot-9

After 20 epochs on 150 training data, the proposed model accurately predicted 96 percent of the training data and 94 percent of the test data. The same data set was used to train and test a CNN model without transfer learning, but with different split ratios. The batch size, epochs, and rmsprop optimization settings were fine-tuned, but the maximum accuracy was still only 74 percent with batch sizes of 16, 30, and 0.4 epochs, respectively.

TABLE I. PERFORMANCE OF COMPARISON OF CNN WITH AND WITHOUT TRANSFER LEARNING

Model	Test Accuracy
CNN With Transfer Learning	92.46%
CNN Without Transfer Learning	74%

Fig.4. Plot of Accuracy versus Epochs



On computing, as you can see in the above screenshots 7&8 we predicted the rice leaf disease with an accuracy of about 94 percentage. As an extension we tried to show in the same Html about why and where it occurs, Symptoms and Precautions to be taken. It makes things easier for farmer. At the end of the day It is the farmer who works without corruption, racism etc. We tried to make the process easy for the farmer by showing everything required at the same place.

Conclusion

We propose a deep learning architecture that properly detects 92.46 percent of the test photos after training on comparatively huge data set. Transfer learning, in combination with fine-tuning the default VGGNet, considerably enhanced the model's performance on such a tiny dataset, which was previously insufficient.

Future Enhancement

To increase the accuracy even more, we need to gather more datasets from various sources in the future. We'd like to incorporate a cross-validation approach to validate our results in the future. We'd also like to compare our findings to other cutting-edge studies and superior deep learning models. The created model can be utilized to predict various rice leaf diseases that are worrisome in agriculture industry in the future.

Reference

1. T. Gupta, "Plant leaf disease analysis using image processing technique with modified SVM- CS classifier," Int. J. Eng. Manag. Technol, no. 5, pp. 11-17, 2017.
2. Y. Es-saady,T. El Massi,M. El Yassa,D. Mammass, and A. Benazoun, "Automatic recognition of plant leaves diseases based on serial combination of two SVM classifiers," International Conference on Electrical and Information Technologies (ICEIT) pp. 561-566, 2016.
3. P. B. Padol and A. A. Yadav, "SVM classifier based grape leaf disease detection," Conference on Advances in Signal Processing (CASP), pp. 175-179, 2016.
4. L. Liu and G. Zhou, "Extraction of the rice leaf disease image based on BP neural network," International Conference on Computational Intelligence and Software Engineering ,pp. 1-3,2009.
5. S. Arivazhagan and S.V. Ligi, "Mango Leaf Diseases Identification Using Convolutional Neural Network," International Journal of Pure and Applied Mathematics, vol. 120,no.6, pp. 11067-11079,2008.
6. B. Liu,Y. Zhang, D. He and Y. Li, "Identification of Apple Leaf Diseases Based on Deep Convolutional Neural Networks Symmetry," X. X. & Suen, C. Y. A novel hybrid CNN–SVM classifier for recognizing handwritten digits. Pattern Recognition,vol. 45,pp. 1318–1325,2012.
7. Y. Lu, S. Yi,N. Zeng,Y. Liu, and Y. Zhang, "Identification of Rice Diseases Using Deep Convolutional NeuralNetworks," Neurocomputing, 267, pp. 378-384,2017.
8. S.k. Sana, G. Sruthi, D. Suresh, G. Rajesh, G.V. Subba Reddy, "Facial emotion recognition based music system using convolutional neural networks",Materials Today: Proceedings,2022, https://doi.org/10.1016/j.matpr.2022.03.131.ISSN 2214-7853.
9. 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.

10. 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.
11. P. Konstantinos Ferentinos, “Deep Learning Models for Plant Disease Detection and Diagnosis,” Computers and Electronics in Agriculture ,vol. 145,pp. 311–318,2018.
12. S. P. Mohanty, D. P. Hughes, M. Salath´e, “Using Deep Learning for Image-Based Plant Disease Detection,” Frontiers in plant science ,vol. 7.
13. S. Xie, T. Yang, X. Wang, and Y. Lin, “Hyper- class augmented and regularized deep learning for fine-grained image classification,” IEEE Conference on Computer Vision and Pattern Recognition,CVPR2015,pp. 2645–2654,June 2015.
14. Y. Lu, S. Yi, N. Zeng, Y. Liu, Y. Zhang, ” Identification of rice diseases using deep convolutional neural networks”, Neurocomputing 267,pp. 378–384,2017.
15. K. Simonyan, A. Zisserman, “Very Deep Convolutional Networks for LargeScale Image Recognition”, Arxiv preprint arXiv: arXiv,pp. 1409-1556,2015.
16. Khidoyatova, M. R., Kayumov, U. K., Inoyatova, F. K., Fozilov, K. G., Khamidullaeva, G. A., & Eshpulatov, A. S. (2022). Clinical status of patients with coronary artery disease post COVID-19. *International Journal of Health & Medical Sciences*, *5*(1), 137-144. https://doi.org/10.21744/ijhms.v5n1.1858
17. Widana, I.K., Sumetri, N.W., Sutapa, I.K., Suryasa, W. (2021). Anthropometric measures for better cardiovascular and musculoskeletal health. *Computer Applications in Engineering Education*, *29*(3), 550–561. https://doi.org/10.1002/cae.22202