Disease identification of Groundnut leaves by Deep learning Technology

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Abstract:
Production of Groundnut in India is having impact on growth rate in agriculture filed. In this paper we explore about identification of groundnut leaves diseases using transfer Learning and suggesting their remedies. Farmers spend a lot of time and money managing diseases, and they identify diseases using naked eye that results in errors in identifying diseases. The development of agricultural technology substantially aids in the automatic detection of pathogenic organisms in the leaves of oilseed crops. We have discussed about Disease of groundnut leaves early spot, late spot, rust spot that are very common. Here we are using real time data that is collect from Durgapur agriculture research centre of Jaipur with the help of their staff and three model VGG16,AlexNet and Resnet50 were used to identify disease. Higher accuracy achieved by resnet50 82.30%.We hope our dataset useful for disease identification.

KEYWORDS: Deep Learning, Diseases, Groundnut, Model,AlexNet,VGG16,DenseNet
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1.Introduction: India is ranked second in output and first in groundnut acreage worldwide. In India, 68.63 lakh MT of groundnuts were produced over a total area of 39.31 lakh hectares in 2018–19, with an average productivity of 1,745 kg. India's main groundnut growing region is made up of marginal lands where the crop is cultivated using rainwater. It has been determined that five states—Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, and Maharashtra—acquire very huge groundnut land. The remaining land and output are mostly split between the states of Orissa, Punjab, Madhya Pradesh, Rajasthan, and Uttar Pradesh. During the kharif season (June-July to September-October), groundnuts are mostly grown in rain-fed environments with minimal irrigation for protection.

7.34 lakh hectares of groundnuts were grown in Rajasthan in 2018–19, yielding 16.12 MT and producing 1580 kg per hectare. In the Rajasthani districts of Bikaner, Hanumangarh, Jodhpur, Churu, Nagaur, Sikar, and Jaipur, groundnut is mostly grown. Due to their high selling price, groundnut planting is expanding daily in the Bikaner district. In 2018–19, the Bikaner district produced the most groundnuts (2.45 lakh ha), with a total production of 5.29 lakh tonnes and a productivity of 2159 kg ha-1[1].

A number of biotic variables, such as bacterial, viral, and fungal diseases, affect the productivity and yield of the groundnut crop. Only a few numbers, such as fungal diseases like early leaf spot, late leaf spot, collar rot/crown rot, dry root rot/dry wilt, and stem rot, are economically significant in India[2]. In our study we have done work on early, late and rust spot disease of groundnut which is also shown in figure 1.

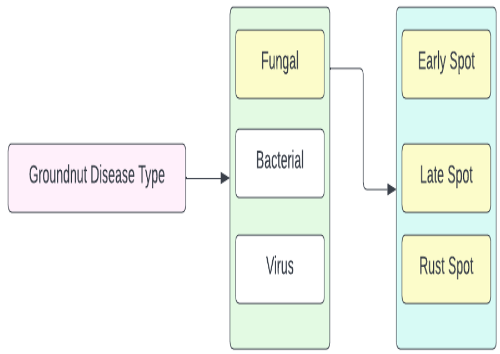

Fig1: Categories of disease in Groundnut [1]

Based on straightforward photos of healthy and sick plant leaves, a transfer learning model was trained and evaluated in this study to create an automated plant disease detection and diagnostic system. Images were acquired in both realistic field cultivation circumstances and experimental (laboratory) setups in the dataset that was made public. As opposed to shallow techniques, which learn from less data but are focused on fewer crops, the proposed deep learning methodology may find more universal solutions. The main tenets of the tested models are presented in the next part, together with the datasets used for training and testing and the experiments created to look into the variables that affect the generated system's performance and robustness. The application of the suggested models for plant disease detection and diagnosis is shown in Section 3, and the paper concludes with some observations and recommendations for future research aimed at the development and improvement of the produced system.

2. Literature:

Urbano B.Patayon et al.[3] has used a pre trained Convolution deep learning Model for disease identification of peanut leaf .Dense Net-169 have highest accuracy as compared to others Model in this paper. it has 98% accuracy when trained with SGD.

Vikash Kumar et al.[1] has proposed a formulas for calculating disease intensity. In Derajsar maximum intensity of disease is find out that is 28.57%.

M.Rajmohan et al.[4] has proposed approach using image processing which has achieve 93% accuracy .in this paper segmented images are used for feature extraction and pre-processing is done.

S.Maheswaran et al.[5] has proposed a approach using artificial intelligence with CNN .96.50% accuracy has been achieved by this approach. In this paper four different diseases are identified with large number of dataset.

M.P.Vaishnnave et al.[6] has proposed a groundnut leaf diseases will be automatically categorized and classified by software. Image acquisition, picture pre-processing, segmentation, features extraction, and classifier using K Nearest Neighbor are some of the procedures that it entails (KNN). The KNN classifier is used in place of the SVM classifier to improve the performance of the current algorithm.

This work employs a variety of transfer learning architectures and demonstrates various forms of optimization that can be used to get the best outcomes. For this specific challenge, we present cutting-edge results.

3. Materials and methods

For the classification, we applied the idea of transfer learning. The main advantage of adopting transfer learning is that rather than starting from blank, the model begins the learning process by leveraging patterns that have been learned when handling a different problem that is similar in nature to the one being handled. By doing this, the model builds on existing information rather than starting from scratch. Using trained models for picture categorization is a common way to demonstrate transfer learning. A pre-trained model is one that has already been trained on a substantial benchmark dataset to address a problem that is related to the one we are attempting to solve. To classify photos, researchers have employed a variety of performance criteria in the literature. According to various Transfer Learning Models accuracy and loss rate, we categorize the results in this study. In this investigation, many optimization strategies were also applied. Model comparison using various optimization strategies is also performed.

The following three fundamental CNN architectures were put to the test in this study's investigation of the issue of identifying plant diseases from photographs of their leaves: AlexNet, Resnet 50, VGG 16, and The Google Colab deep learning computational framework, which employs the python programming language, was used to create these models as well as their training and testing procedures. The 11th-generation Intel Core i7-1165G7 CPU, which has 4 physical cores and 8 logical processors, operates at a frequency of 2.80 GHz and a memory speed of 2803 MHz.

Dataset: There are four categories of samples were taken in that three types of diseases of ground nut are considered and images of healthy leaves were considered in our work. The total sample of images taken for analysis groundnut parameters are 313 images:

(i) Early leaf spot: - Symptoms of early leaf spot include dark patches that penetrate both the upper and lower leaf surfaces. Early leaf spots often have a golden halo surrounding them; however, halos are NOT diagnostic because they are also frequent around late leaf spots[7].

Fig 2: Early leaf spot[7]

(ii) Late leaf spot: - Late Leaf Spot (LLS) is a serious foliar disease that has a negative impact on pod output, feed quality, and seed viability, when it comes to groundnuts. Previously, the name Cercosporin personata was in use, along with Cercosporidium personatum and Mycosphaerella berkeleyi[7].

Fig3: Late leaf spot on Groundnut Leaf[7]

(iii) Rust leaf spot: - Some plant diseases, called rusts, are caused by fungi and manifest themselves in the form of discolored leaves and tattered stems. Rust most frequently affects the leaves, but it can also show up on the stems, and even on the blossoms and fruit, on rare occasions. Different rust species and spore types result in different colored pustules caused byrusts[7].

(iv)

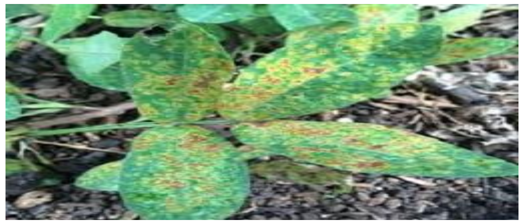

Fig4:Rust spot on groundnut leaf[7]

The entire dataset is designed using primary and secondary mode as it is combination of images taken from farming fields and using internet sources. In case of primary dataset images were taken in the proper lighting conditions on all farms, photographs were shot on a bright and sunny day between the time of 10 a.m. and 4 a.m. local time. The data is in JPG format, these photographs were captured using a Nikon DSLR equipped with a setting that yielded 25.4 megapixels (MP). Photos taken with these settings often have a larger file size but in order to maintain the size of dataset these images were compressed that falls anywhere between 45 and 70 KB when saved.

	disease	count_images
0	early_leaf_spot	73
1	rust_spot	74
2	fresh_leaf	60
3	late_leaf_spot	81

Fig5: Groundnut Data set

Proposed method

To classify photos, researchers have employed a variety of performance criteria in the literature. According to various Transfer Learning Models accuracy and loss rate, we categorize the results in this study. In this investigation, many optimization strategies were also applied

Phases of the implementation would be carried out in the order listed below:

Phase 1: Images of both healthy and infected leaves of ground nut crop have been collected at the beginning of the procedure. Images were divided for training, testing, and validation purposes later.

Phase 2: Using image preprocessing techniques, images have be scaled and manipulated. An array of pre-processing methods is available for enhancing the photographs captured by DSLR Cameras.

Phase 3: After phase 2, a dataset would be expanded once images have been collected using image augmentation. Due to the obvious ability to modify the angle and rotate photos, it can create many images from only one original photograph.

Phase 4: After augmentation on data of training, testing, and validation. .In this creation of dataset labeling of training, testing and validation data is done with the help of encoding.

Phase 5: Transfer learning approach is used in this phase so we are using pre-trained models (VGG-16, ResNet50, AlexNet) for the classification with Adam optimizer.

Phase 6: In the last step, the System recommends remedies based on the diseases identified by the system.

Performance metrics

To classify photos, researchers have employed a variety of performance criteria in the literature. We categorize the results of various Transfer Learning Models using accuracy and loss rate. In this investigation, many optimization strategies were also applied.

4. RESULTS AND DISCUSSION

In this section we present our findings. We plotted the loss vs epochs, accuracy vs epochs and Different pertained Model with Adam optimizer Vs Ad delta optimizer. In this module, we are using VGG-16 + Adam, ResNet50 + Adam, and Alex Net + Adam models. The accuracy of VGG-16 is 70.19%, and ResNet50 has 82.30% accuracy, Alex Net has 81.30% accuracy. ResNet50 is higher than others with 82.30% accuracy.

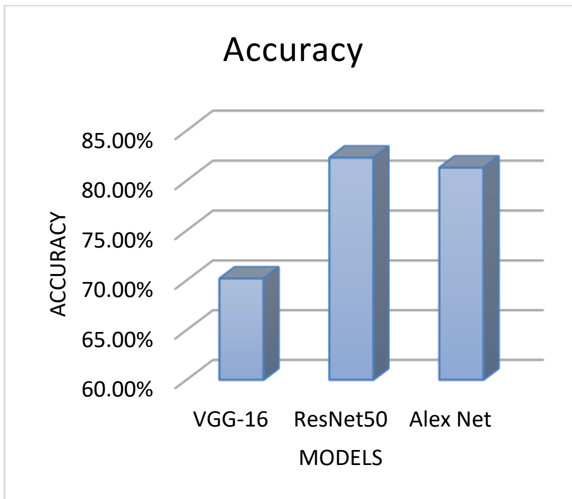

Fig6: comparison analysis of accuracy models

Different Model and Optimizer with Accuracy Vs epochs :

VGG-16 + Adam (Model Accuracy)

ILSVR (ImageNet) competition in 2014 was completed by the VGG16 convolution neural net (CNN) architecture, which was developed by Google. It remains one of the most impressive vision model designs. The feature that differentiates VGG16 the most from other models is the absence of hyperparameters. During the process of training the model, they would be making use of the Adam optimizer to get to the global minimum. If they become trapped in a local minimum during the training phase, the Adam optimizer would assist the local minimum and arriving at the global minimum. Train and test the accuracy of the VGG-16 about the number of images of types of diseases. Figure 7 shows the accuracy of train and test models.

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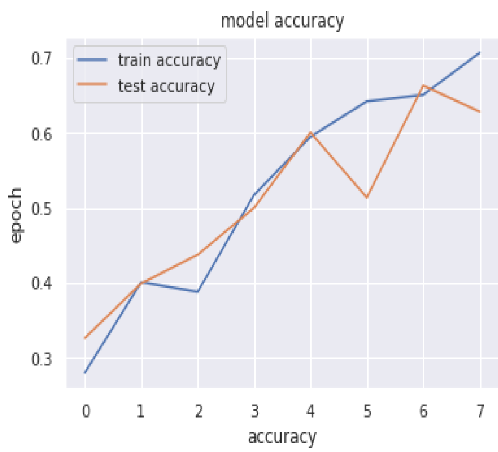

Fig7: Model accuracy of VGG-16 + Adam.

Alex Net + Adam (Model Accuracy)

Alex Net participated in the ImageNet Large Scale Visual Recognition Challenge (ILSVRC), where they demonstrated the extraordinary capabilities of GPUs in deep learning. The optimizer that they have been using is SGD with momentum, which is still utilized up to the present day but necessitates an excellent training routine and therefore is difficult to train. Therefore, Adam is the optimizer by default. Regarding Alex Net's situation, a momentum of 0.9 has been applied. Figure 8 shows the accuracy of train and test models.

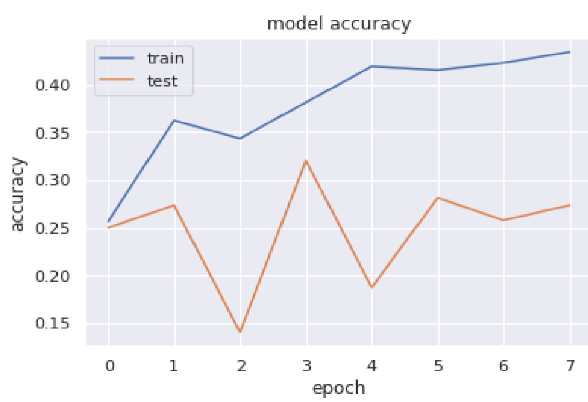

Fig8: Model accuracy of Alex Net + Adam

Res Net 50 + Adam (Model Accuracy)

Architecture based on ResNet for addressing the challenge of image categorization. The observation has shown that the Momentum algorithm is superior to ADAM when it comes to training ResNet, even though many academics maintain that ADAM is the superior algorithm. The ResNet-50 network is a convolutional neural network that has a total of 50 layers. Individuals have the option of loading a network that has already been trained on more than a million images that are stored in the ImageNet database. Figure 11 shows the accuracy of train and test models.

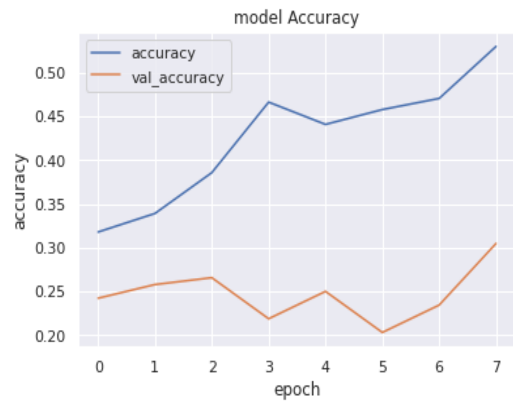

Fig9: Model accuracy of Res Net 50 + Adam

VGG-16 + Adam (Model Loss) shows the tests and train losses of ground nuts in the graphical representation format.

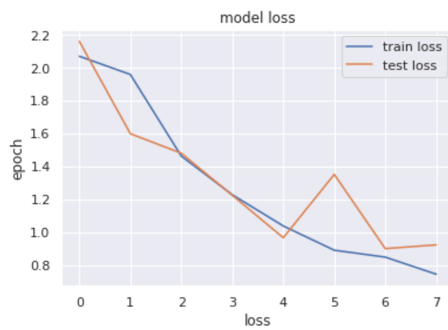

Fig10: Model loss of VGG-16.

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Alex Net + Adam (Model Loss) shows the tests and train losses of ground nuts in the graphical representation format.

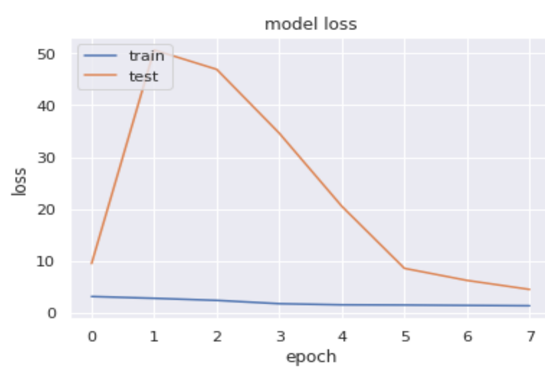

Fig11: Model loss of Alex Net

Res Net 50 + Adam (Model Loss) shows the tests and train losses of ground nuts in the graphical representation format.

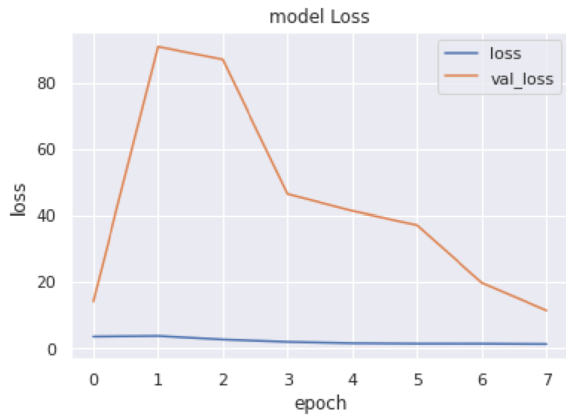

Fig12: Model loss of Res Net 50

In last step of experiment suggest remedies according to disease here in table 1 shown about it. For early and late leaf spot same treatment is used but for leaf spot leaf disease different treatment is used.

Tests losses of groundnut

In this module, we are using VGG-16 + Adam, ResNet50 + Adam, and Alex Net + Adam models. The testes losses of these models are given below:

VGG-16 is 1.528%, and ResNet50 has 1.538% accuracy, Alex Net has 1.543% accuracy. In which the loss of VGG-16 is minimum. Hence it is more fruitful than others.

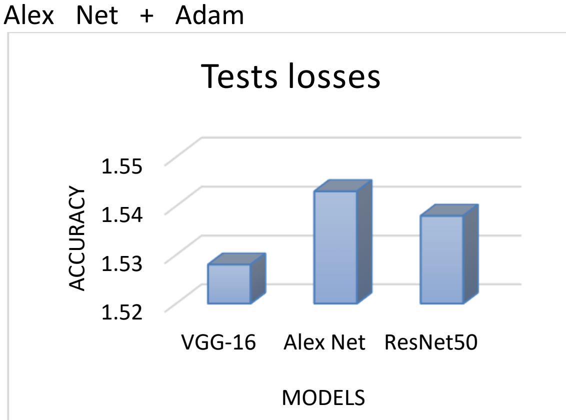

Fig13: comparative analysis of different models' tests losses.

Table1: Remedies of Groundnut leaf Disease [8]

Disease Name	**Remedies**
Early leaf spot and Late leaf spot	• Reducing the principal source of infection requires the removal of volunteer groundnut plants and "ground keepers," as well as the removal or burial of infected crop trash. • The main factor in preventing early-season infection is crop rotation. • The timing of sowing and plant spacing are crucial factors. Where possible, there should be a noticeable gap in time between subsequent groundnut crops. • Spraying Carbendazim 0.05% + Mancozeb 0.2% successfully controls the early and late leaf spots. Beginning 4-5 weeks after planting, at intervals of 2-3 weeks, twice or three times.

Rust spot	Many of the early and late leafspot management methods also apply to rust control. In addition to this, the following actions can effectively manage rust. To stop the transmission of rust on pods or seeds to disease-free areas, strict quarantine rules for plants should be put into effect. Spraying Tridemorph 0.07 percent at intervals of 14 to 21 days effectively controls rust. Usually, 3 to 4 sprays are needed. Triadimef 100g/acre spray applications 35 and 50 days after sowing.

5. LIMITATIONS

We are having less data due to non availability of public data on any platform. Lake availability so we collect data directly from research center. Here we using Different Model for training and testing purpose and categorized our data according to disease.

6. CONCLUSIONS AND FUTURE WORK

In this paper we were discuses about groundnut and its related disease with remedies which is help full for giving a same platform related to groundnut. A comparative study with the help of VGG16, AlexNet and ResNet-50 has been done in this paper on the data set of Groundnut leaf. Here we consider three different categories of Groundnut leaf diseases. Here we represent the graph of training accuracy, validation accuracy, training loss, validation loss with different transfer learning model. Here we are using real time data that can also increase by using augmentation technique of deep learning in future.

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