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Original Paper

DEEP LEARNING BASED ORYZA SATIVA LEAF DISEASE DETECTION USING ALEX NET DEEP ARCHITECTURE

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ABSTRACT

Oryza Sativa is one of the essential food in Asia. Since there is a variety of rice and we use the rice in our daily life to get energy we should develop a method for the farmers to check the disease in the rice leaf so that they can find the solution in the beginning stage and the crop will not get destroyed by the disease. For quite half of the humanity rice shaped the economies of thousands of people. We should consider as an important part of each individual's life and it is a staple food of almost half of the world's population. The research was proposed based on Deep Learning Technique to support rice plant disease classification method. A CNN is a Deep Learning algorithm used to absorb an image as an input and assign importance to the many objects in the image. The CNN method is support-ed by feature extraction and gives success to obtain results that classify the dis-ease successfully with 99% of accuracy.

Keywords

Oryza Sativa Leaf Disease, Tensor flow, CNN, Deep Learning, Hispa, Brown Spot, Healthy, Leaf Blash.

1. Introduction

Since there are variety of crops and we use some of them in our daily life to get energy. Rice (Oryza Sativa) is one of the essential crop which is used in our daily life across the world. As we use rice in our daily life as a part of main meal in a day it is very necessary to protect the rice crop from the disease. Mostly rice disease is caused by the fungus and bacteria. We should develop a method for the farmers to check the disease in the leaf. The aim of this study is to develop a deep learning technique that uses the combination of a convolutional neural network (CNN) to diagnose disease automatically based on images of diseased leaves. A Convolutional Neural Network, it is a Deep Learning algorithm which is used to absorb an image as an input and it assign importance to the many objects in the image. Perceiving plant species from leaves is one of the huge and important uses of the example acknowledgment and picture handling procedures. The presence of plant leaf assumes a significant part for botanists to distinguish species and broad examinations have been done on scorch asterisking leaf picture designs for species acknowledgment in the example acknowledgment local area. Notwithstanding, not many at entices have been made for cultivar acknowledgment by breaking down leaf picture designs because of the absence of the information on whether leaf examples can give adequate data to cultivar acknowledgment. As can be seen from that it isn't extremely hard for human to separate those species leaves, and large numbers of them can be characterized by their form shape contrasts. However, by noticing the leaves of soybean cultivars cotton cultivars and nut cultivars we can track down that the leaves of various cultivars that have a place with similar animal types have exceptionally comparative visual examples, making the cultivar leaf acknowledgment a difficult open issue.

In this paper the below sections elaborates about Related works, Materials and methods, Proposed Methodology, Result & Discussion and Conclusion with References.

2. RELATED WORKS

Recent days, several advanced technologies have been developed for detecting diseases or pests on plants' leaves. Different types of crops are grown on different types of land, in different kinds of climates, and in different kinds of places every year. Some crops grow healthier, while others cause disease. The approach of Divyansh Tiwari et al. [1] was based on feature extraction, inception V3, VGG19, logistic regression and VGG16, fine-tuning algorithms, but logistic regression is diffi-cult to obtain complex relationships, while other compact algorithms, such as neural networks, are more easily possible. A Gaussian filter methodology was used by Su-rampalli Ashok and team [2],the Gaussian filter will blur edges and reduce contrast where In the Steps for pre-processing using Gaussian Filter, it consume more amount of time and also reduces the details. Along with convolution and pooling layer, Sam-my et al. [3] applied the (ReLU) function, while CNN strides the image to see if fea-tures are present. Vgg16 is a Convolutional Neural Network model developed by Shreya Ghosal1 and Kamal Sarkar [4] for the image classification task. The research was based on transfer learning, which only functions in the first round of training where the initial problem and target problem is similar. Marwan Adnan Jasim em-ployed image processing to enhance pictures for human interpretation in his study [5]. From Relu, the activation method implemented, where exploding gradient is op-posite to the vanishing gradient and which occurs where the large number of error gradients accumulate and lead to very large updates to neural network model weights during training. Information can be processed and extracted from images for ma-chine interpretation. The research was proposed for only one disease (rust), but there are many different types of disease, such as Banded sclerotium disease, Black rot, stripe, Brown spot, stripe, etc. The methodology in the study [6] involves three key stages: 1. pre-processing of data 2. Acquisition of data, 3. Image classification. Only one architecture, CNN, is suggested when using the deep learning technique, and it is possible to experiment with the model's effectiveness and accuracy by using various learning rates and optimizers. The author used adaptive deep learning in [7], which merge the old version of rule-based, simple ML, and DL address to machine intelli-gence. The employment of UAVs in [8] was made possible by their software's integra-tion of GPS (the Global Positioning System), which allows for exact programming and direction-finding of their movements. Drone usage would be ineffective if it hampered farmers' productivity and damaged their crops, insecticides, or fertilisers as a result of the time required to transfer data. Thus, if data transfer speed is sluggish, pain and damage may result during that time, resulting in a waste of all efforts.. The Deep Convolution Neural Network, which consists of eleven layers and includes four con-volution layers, four max pooling operations along with (ReLu) function, and three fully connected layers, was proposed by Md. Rasel et al.[9]. The suggested approach, image recognition, was unable to operate in low resolution, dim illumination, and complicated backdrop situations. As a result, it is limited to analyzing images of sick leaves that are clear and high quality. The Deep Residual Network approach was introduced by Ding Jiang et al. [10] and offers reduced training error when compared to counterpart plain nets, where the Classification Method is time-consuming and may result in confusion if the documents have identical names.

3. MATERIALS AND METHODS

3.1 Deep Learning

DL estimations run data through the layers of neural network computations, which passes the data to the accompanying layer. Most AI estimations work splendidly on datasets that have up to a few hundred parts, or areas. In any case, an unstructured dataset like one from an image has such endless parts that this association becomes massive or absolutely unrealistic. A lone 800-

by-1000-pixel picture in RGB tone has 2,400,000 arrangements. Deep learning estimations adjust progressively more with respect to the image as it goes through each neural association layer.

3.2 Working Principle of Deep Learning

DL is an Artificial Intelligence system that urges PCs to do what turns out effectively for individuals: learn as an obvious signal. DL is a basic advancement behind automated vehicles, enables to watch a stop sign, or to perceive a walker from a light post. This is also a way to control customer devices such as phones, tablets, TVs, and speakers without touching them. DL is getting heaps of thought of late and considering current conditions. It's achieving results that were illogical beforehand. In DL, a PC model sorts out some way to perform game plan tasks clearly from text, pictures or sound. Deep learning models can achieve top tier precision, from time to time awe-inspiring human-level execution. Deep Learning neural network can be used to apply significant sorting out some way to the issues by performing developed learning or part extraction, where available models consolidate Alex Net, VGG-16 & VGG-19, similarly as Caffe imported using importCaffeNetwork. Fig. 1 indicates the working of CNN with input layer along with multiple hidden layer and at the last the output layer.

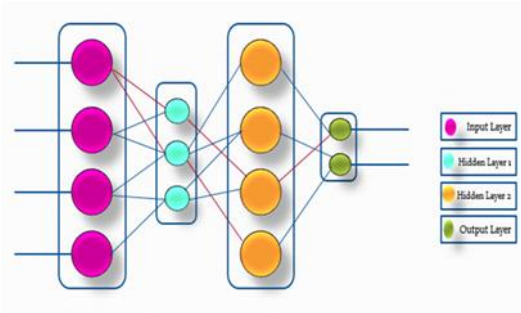

Figure 1. Working Principle of Convolutional Neural Network

3.3 Convolutional Neural Network

The CNN is one of the network architecture of DL. The CNN are prominent from other neural networks because of the performance with different kinds of input signals like audio, text and image. Through CNN, the need of manual feature extraction can be eliminated and adapt the automated feature from CNN. By adapting the CNN features the recognition results are highly accurate. The three types of layer in CNN which are as followed:

3.3.1. Convolutional Layer

The first layer in CNN is the convolutional layer which is the most crucial component in CNN. The objective of this layer is to compile a set of features from the photographs that are used as input. It is possible to accomplish this using convolution filtering. This concept involves dragging a window with a feature onto the image and computing the convolution between each segment of the scanned image and the feature. Thus, a feature is seen as a filter, and in this sense, the two definitions are equivalent. As a result, the convolutional layer takes several pictures as input and calculates the convolution of each one with each filter. The filters are precise matches for the traits in the photographs. The feature map are obtained for each pair of image and filter which indicates the specification value of the pictures.

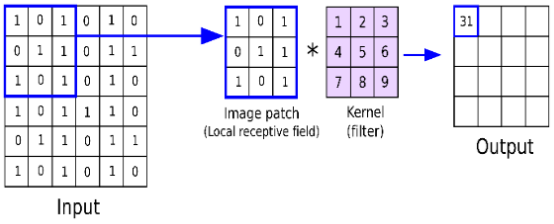

Figure 2. Working Principle of Convolutional Neural Network

3.3.2. Pooling Layer

The pooling activity comprises in diminishing the components of the photos while protecting their significant qualities. To do this, we cut the picture into standard cells, then, at that point, we keep the most worth inside every cell. Practically speaking, little square cells are frequently wont to try not to lose an extreme measure of data. The first normal decisions are 2x2 neighboring cells that don't cover, or 3x3 cells, isolated from each other by a stage of two pixels (accordingly covering). We get in yield the indistinguishable number of component maps as info, yet these are a lot more modest. The pooling layer diminishes the measure of boundaries and computa-tions inside the organization.

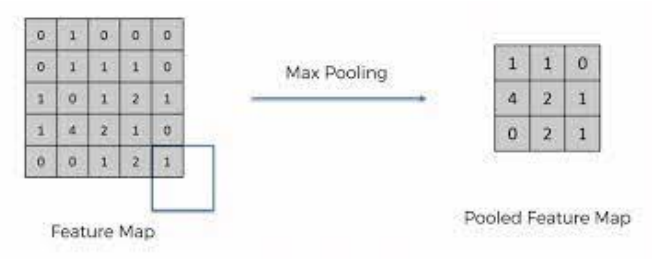

Figure 3. Working of Pooling Layer

3.3.3. Relu Layer

ReLU (Rectified Linear Units) alludes to the genuine non-direct capacity charac-terized by ReLU(x)=max(0,x). Outwardly, it resembles the accompanying:

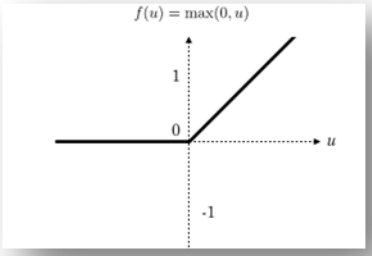

Figure 4. Working of Pooling Layer

The ReLU remedy layer replaces all regrettable qualities got as contributions by ze-ros. It goes about as an actuation work. The completely associated layer The com-pletely associated layer is regularly the last layer of a neural organization, convolu-tional or not — so it's not attribute of a CNN. This kind of layer gets an info vector and produces a fresh out of the box new result

vector. To do this, it applies a direct blend so conceivably an enactment capacity to the info esteems got. Every compo-nent of the vector demonstrates the likelihood for the information picture to have a place with a class. To work out the possibilities, the completely associated layer, con-sequently, increases each info component by weight, makes the total, thus applies an enactment work (calculated if N=2, softmax if N>2). This is regularly comparing to increasing the info vector by the network containing the loads. the established truth that each information esteem is associated with all result esteems clarifies the term completely associated.

4. PROPOSED METHOD

The below diagram indicates the architecture of the proposed work where the im-age will be taken from the dataset then, the feature extraction and selection will be processed and will move to the deep learning method where the image comparison will be done and the name of the disease will be indicated.

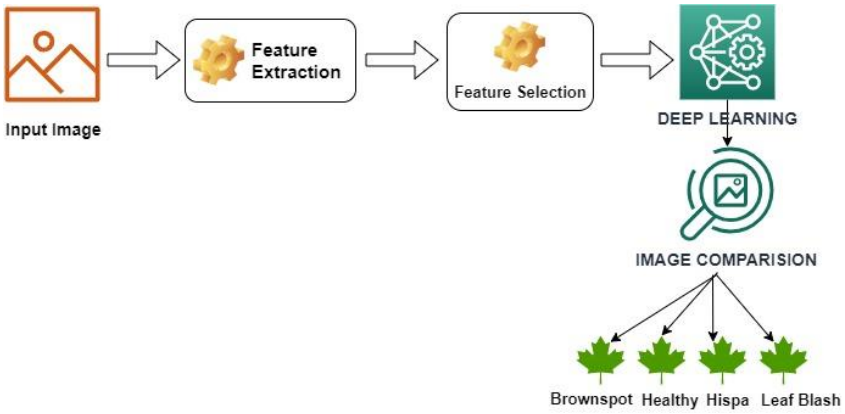

Figure 5. Working of Pooling Layer

4.1. ORYZA SATIVA LEAF DISEASE CLASSIFICATION USING ALEX NET

We proposed the method of CNN's deep architecture called Alex net for rice plant disease pre-diction method to forestall disease by cultivating. In Alex net Padding was included to keep the size of the feature maps from shrinking too much. This network has a standard Alex Net design, except each Conv and Pool layer contains 3D filters instead of 2D filtersAmong the leading architectures in the field of computer vision and artificial intelligence, Alex Net has a lot of potential for identifying objects. Alex Net is an eight-layer convolutional neural network. There are 1000 different types of object categories that this network can distinguish between, including keyboards, mice, pencils, and various types of animals. Consequently, the network has accumulated rich feature representations of various images. The proposed network accepts 227-by-227-pixel images as input. Dropout was also employed to reduce over fitting in the first two completely linked layers. While Alex Net was undeniably a game-changing technique at the time, it required the utilisation of at least two GPUs to function properly. The proposed system is designed to predicting plant dis-ease.

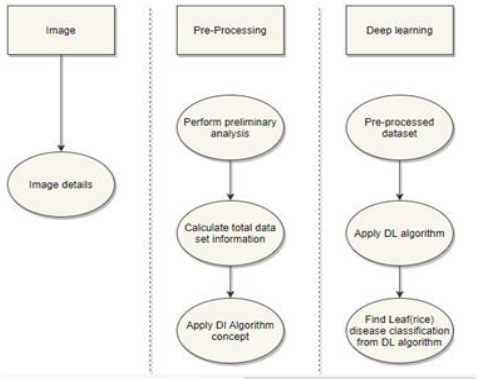

Figure 6. Process Flow Diagram

Samples of more number of images are collected from Kaggle dataset that com-prised of various classes like rice blast, brown spot of rice, sheath blight of rice, bacterial blight, and sheath rot of rice. For each class different images are collected which classifies into input images. The success rate of obtained result will increase when the feature extraction methods is added along with CNN. In order to solve an image classification problem, the data must be in a particular format.

The process of picture classification model is often designed and we divided this process into 4 stages and each stage requires a specific amount of time to execute:

Pre-Processing – 30%

Model architecture – 10%

Training – 50%

Estimation of performance- 10%

5. RESULT AND DISCUSSION

The below table indicates the performance matrix which defines the values of loss, accuracy, area of curve , precision , recall, (TP) as true positives, (TN) as true negatives, (FP) as false positive, (FN) as false negative, value loss, vale accuracy, value precision & value recall.

2.8. Figures and Tables

Table 1. Performance Table

Performance Matrix	**Epoch 48**	**Epoch 49**	**Epoch 50**
loss	0.1838	0.0983	0.0601
accuracy	0.9420	0.9710	0.9928
Auc(Area Under Curve)	0.9953	0.9994	0.9995
precision	0.9485	0.9710	0.9928
recall	0.9348	0.9710	0.9928
true_positives	129.0000	134.0000	137.0000
true_negatives	407.0000	410.0000	413.0000
false_positives	7.0000	4.0000	1.0000
false_negatives	9.0000	4.0000	1.0000

val_loss	0.2524	0.0830	0.6400
val_accuracy	0.8889	0.9778	0.7222
val_auc	0.9892	0.9991	0.9419
val_precision	0.9268	0.9775	0.7303

To appraise the performance in this paper two matrices are utilized namely accuracy and loss. In Fig. 7 & 8 the orange plot indicates the test data and the blue plot indi-cates train data of accuracy and loss model.

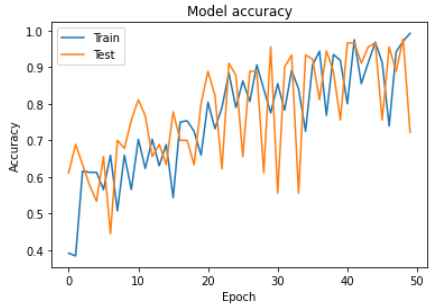

Figure 7. Accuracy Plot

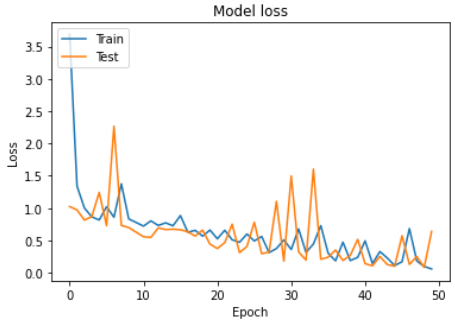

Figure 8. Loss Plot

5. CONCLUSION

This research work focused to classify rice leaf image as normal or diseased image which helps farmers to increase the productivity. The diseased and healthy rice leaf image dataset are taken from Kaggle website where 70% of data's are used for train-ing and 30% of data's are taken for testing. For classification, CNN is utilized where the input passes through number of layers. The proposed method is compared with different algorithms in literature and successfully obtains the maximum accuracy of 99.28%.

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