Classification and Identification of Multiple Leaf Diseases Using Inception-ResNet V2 (CNN Architecture)

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ABSTRACT

India is a agricultural country, most of the people here are farmers. Still farmers are not able to increase their income, productivity due to different types of diseases in plant. It has a negative impact on farming. Now a days number of diseases are increased, so identifying the name of disease is one of the challengefor farmers. If plant diseases are not discovered in early stage, then this can harm crop in large extent, so we need to create a system which can easily identify the name of disease. And also, in India most of the farmers are not educated so we also required to create a simple user interface either by using web development or by using Android app development.Usually, plant's leaf is primary source for identifying the name of the disease, so we required to create a CNN model which can easily identify the name of the disease by scanning the photo of leaf. If farmers are able to identify the disease in the early stage,they can take required action and loss of production can be reduced.

Keywords : - *Deep Learning, Machine Learning, Convolutional Neural Network , Inception ResNet V2, Image Processing, Pooling and Feature Extraction.*

1. INTRODUCTION

Machine learning (ML) and Deep learning (DL) are artificial intelligence fields that have exploded in popularity in Molecular Biology. In the recent years, due to advantages of automatic learning and feature extraction, it has been widely concerned by academic and industrial circles. It is a new, cutting-edge technique for image processing and data analysis that has a lot of promise and potential. In all levels of Cellular System Science, the key challenges are provided in terms of how to analyse large datasets and extract new information. The application of deep learning in Leaf Disease Detection can avoid the disadvantages caused by artificial selection of disease spot features, make leaf disease detection more objective. The main objective of this project is to design a model for Classification and Identification of Multiple Leaf Diseases using Inception Resnet V2 Architecture which can detect a specific character using the Convolutional Neural Network method.

Using ML/DL methodologies, we use Convolutional Neural Network models to identify and diagnose Leaf Diseases using simple leaf images of healthy and diseased leaf. We tarin our model and strive for the highest possible success rate. The model's high success rate makes it a valuable advisory or early warning tool, and it's an approach that could be extended to support an integrated leaf disease identification system that can work in real world conditions. We also looked at how to use Machine Learning to access public source databases in order to advance plant molecular biology, and we implemented new powerful tools like deep learning.

2. LITERATURE SURVEY

2.1 Plant Disease Detection and Classification by Deep Learning by LILI LI , SHUJUAN ZHANG , BIN WANG.

In this paper, they have introduced the basic knowledge ofdeep learning and presented a comprehensive review of recent research work done in plant leaf disease recognition using deep learning. Provided sufficient data is available for training, deep learning techniques are capable of recognizing plant leaf diseases with high accuracy. The importance of collecting large datasets with high variability, data augmentation, transfer learning, and visualization of CNN activation maps in improving classification accuracy, and the importance of small sample plant leaf disease detection and the importance of hyper-spectral imaging for early detection of plant disease have been discussed. At the same time, there are also some inadequacies.

Most of the DL frameworks proposed in the literature have good detection effects on their datasets, but the effects are not good on other datasets, that is the model has poor robustness. Therefore, better robustness DL models are needed to adapt the diverse disease datasets.

2.2 Tomato Leaf Diseases Detection Using Deep Learning Technique by Muhammad E.H. Chowdhury, Tawsifur Rahman, AmithKhandakar, Nabil Ibtehaz, Aftab Ullah Khan, Muhammad Salman Khan, Nasser Al-Emadi, Mamun Bin IbneReaz, Mohammad Tariqul IslamandSawal Hamid Md. Ali.

There are various pre-trained models, such as ResNet, MobileNet, DenseNet201 and Inceptions V3. But they found that DenseNet201 gives the high accuracy as compared to other models .So this trained model can be used to find the disease at early stage so preventive actions can be taken faster. The proposed model can be combined with feedback system so appropriate controls techniques and preventive action can be taken, resulting in improving the crop production

2.3 Plant Disease Identification Based on Deep Learning Algorithm in Smart Farming by Yan Guo, Jin Zhang, Chengxin Yin, Xiaonan Hu, Yu Zou ,ZhipengXue, Wei Wang.

In the complex environment achieving the high accuracy is difficult. In order to solve this issue author proposed RPN algorithm, CV algorithm, and TL algorithm, so we can solve the issue of identification in complex environment. As compare to traditional models this model is more robust and gives high accuracy. Thus, the model can help farmers to increase the production by preventing and curing the plant disease quickly.

2.4 Leaf Disease Detection using Deep Learning Algorithm by Kishori Patil, Santosh Chobe.

Here, how the disease analysis is done for the leaf diseases detection is addressed, the analysis of the different diseases that are present on the leaves can be effectively detected in the early stage before it can damage the whole plant. Here the technique presented can able to detect the disease more accurately, we can say that, we can archive good productivity by preventing the different diseases which are present on the leaves of plant using weather dataset and image processing. The usage of classification and feature extraction processes we have increase performance of our model to large extent.

2.5 Plant diseases and pests detection based on deep learning: a review by Jun Liu and Xuewei Wang

In this paper they provided a definition of plant disease and pests detection problem, and they compared their methods with traditional method to compare disease. They summarized various advantages and disadvantages of various methods. They also provided the future trend of plant disease and pests detection based on deep learning algorithms.

3. LIMITATIONS OF EXISTING SYSTEMS

1. The implementation is lacks in accuracy of result in some cases. More optimization is needed.
2. Database extension is needed in order to reach the more accuracy.
3. Very few diseases have been covered. So, work needs to be extended to cover more and more diseases.

3. PROPOSED SYSTEM

There are various models of CNNs available which can be used to for leaf disease detection. Some of the models are given below

1. Inception
2. LeNet
3. AlexNet
4. VGGNet
5. Incetion-Resnet V2
6. ResNet

Depending upon our requirement and performance of model we select the model. We have used Inception ResNet V2 in this Project.

We have used dataset from kaggle, which contains 38 different classes having around 70000 images. We divided dataset intotraining, validation and testing part. We loaded that dataset into tensorflow and while loading the dataset we used ImageDataGenerator to produce new images from one image by rotating, zoom in/out, flipping etc. so, our model can be trained on the all the types of images and accuracy can be increased. Later we define the learning rate to particular value and we create an object of InseptionResNet V2 pre-trained model. We also added various layers to that model. Then we train our model on training dataset. In this model we have added various layers such as pooling layer, flatten layer, normalization layer and so on. More the number of layers higher the accuracy of model. Also,we have used various activation function such as Relu, SoftMax, Tanh, etc. While training the our model we run number of epochs, so our model can be trained well and accuracy can be increased. After completing the training of model we test it on test dataset and compare true value with predicated value with the help of confusion matrix.

A. *Flow of working of model:*

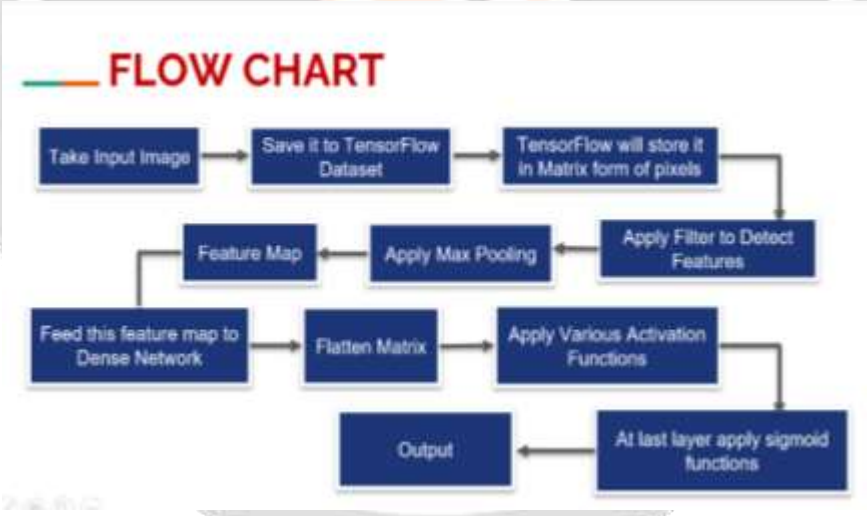

Fig 1 : Flow of working of model

B. *Pre-Processing on Image*

Before sending image to Model pre-processing on image is done. Normally image is in RGB colour but before providing that image to the model we convert that image into grey scale with a single monochrome channel to avoid unwanted noise in the image. While giving input to the model user can provide image with the different size, so we need to convert that image to the specific size. Here we have used 255 X 255 pixel image. While storing the image into tensorflow we store it in the form of matrix.

C. *Feature Extraction*

This is process in which we convert input data into set of features that can best represent input data. If we want to remove some feature then its size will be reduced. In this process we can apply various operations such as pooling ,

Normalization and other operations. After extracting the feature we convert that 2D matrix into flatten array and pass that array to dense layer.

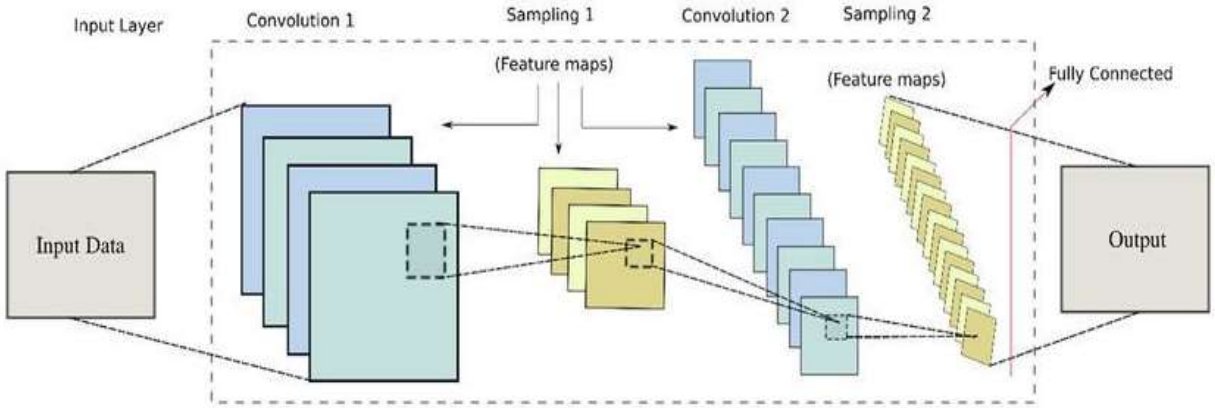

Fig 3 : Feature Extraction and Classification

D. ***Architecture of CNN used***

Inception ResNet-V2

The InceptionResNetV2 architecture is the combination of recent deep-learning models: residual connection and the Inception architecture [49]. This hybrid deep learning model has the advantages of a residual network and retains the unique char acteristics of the multiconvolutional core of the Inception network. In [50], the authors showed that residual connections are implicit approaches for training very deep archi tectures. This improved version of the Inception architecture significantly improved performance and accelerated the model. Figure 6.1 shows the basic block diagram of InceptionResNet-V2.

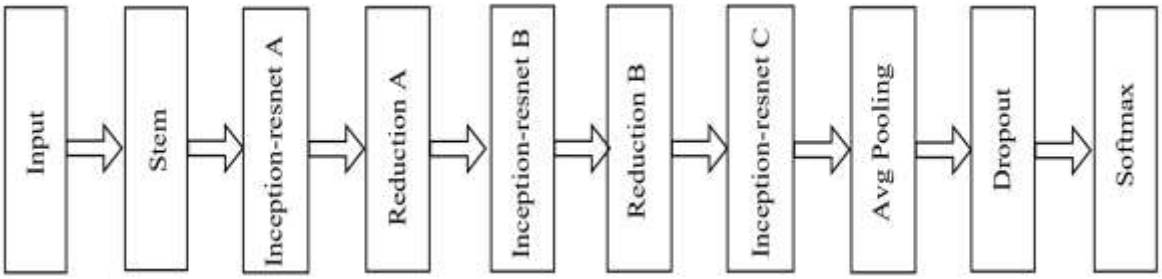

Fig 3 : Basic block diagram of InceptionResNetV2 model.

InceptionResNetV2 consists of three inception blocks. Figure 3a shows the modified InceptionResNet-A block where the inception module uses parallel struc ture to extract the features. The 3 * 3 standard convolution was replaced by 3 * 3 depthwise separable convolution. Figure 3b represents the modified InceptionResNet B block, where the 7 * 7 standard convolutional structure of inception model was replaced by 7 * 7 depthwise separable convolution.

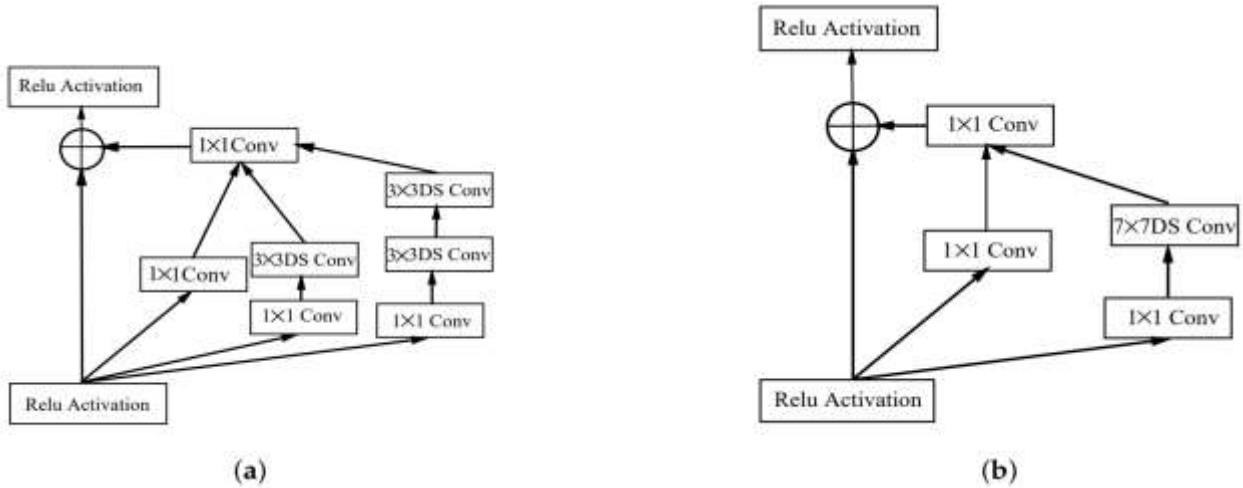

Fig 5 : (a) Modified structures of Inception-Resnet-A.
(b) Structures of Inception-Resnet-B of Inception-ResNetV2 model.

In the InceptionResNet-C block, the 3 Ö 3 convolutional structure was replaced by successive 3 Ö 1 and 1 Ö 3, as shown in Figure 4. By replacing the original con volutional kernel with multiple smaller convolutional kernels, this model effectively reduced computational complexity. An increase in the number of convolutional layers and the deepening of the network improved performance accuracy.

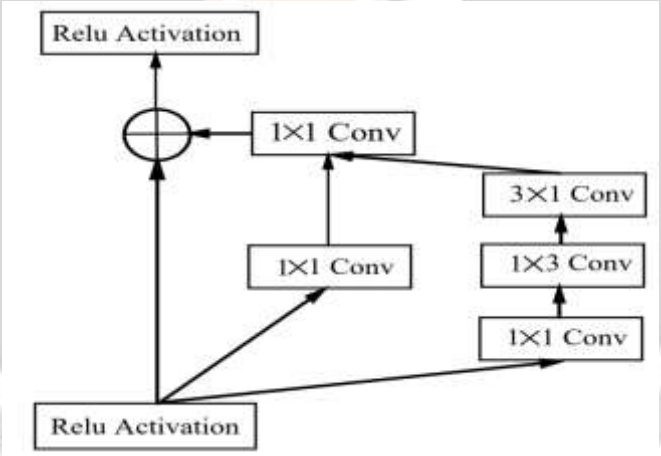

Fig 5 : Structures of Inception-ResNet-C in Inception-ResNetV2.

4. CONCLUSIONS

Thus, we have created a Inception ResNet V2 model for detecting the diseases in leaf of plant. This model can be used by Farmers for detecting the diseases on plant in early stage so loss of yield can be reduced. We can create a Android app for front end so farmers can easily use it. Accuracy of given model can be increased by running more epochs and introducing new datasets.

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6. REFERENCES

[1] LILI LI , SHUJUAN ZHANG , BIN WANG (2021) Plant Disease Detection and Classification by Deep Learning—A Review Citation information: Digital Object Identifier 10.1109/ACCESS.2021.3069646

[2] B. Liu, C. Tan, S. Li, J. He, and H. Wang, "A data augmentation method based on generative adversarial networks for grape leaf disease identification," IEEE Access, vol. 8, pp. 102188–102198, 2020.

[3] Jun Liu and Xuewei Wang(2021)Plant diseases and pests detection based on deep learning: a review. https://doi.org/10.1186/s13007-021-00722-9

[4] Kishori Patil, Santosh Chobe (2020)"Leaf Disease Detection using Deep Learning Algorithm ".

[5] Yan Guo,1,2 Jin Zhang,3 Chengxin Yin,4 Xiaonan Hu,1 Yu Zou,1 Zhipeng Xue,1 and Wei Wang (2020) Plant Disease Identification Based on Deep Learning Al gorithm in Smart Farming . https://doi.org/10.1155/2020/2479172

[6] Muhammad E.H. Chowdhury, Tawsifur Rahman, Amith Khandakar, Nabil Ibte haz, Aftab Ullah Khan, Muhammad Salman Khan, Nasser Al-Emadi, Ma mun Bin Ibne Reaz, Mohammad Tariqul Islam and Sawal Hamid Md. Ali (2020)"Tomato Leaf Diseases Detection Using Deep Learning Technique ". Citation information : DOI: http://dx.doi.org/10.5772/intechopen.97319

[7] Lawrence C. Ngugi a,* , Moataz Abelwahab a , Mohammed Abo-Zahhad (2020) Recent advances in image processing techniques for automated leaf pest and disease recognition – A review. Citation information : https://doi.org/10.1016/j.inpa.2020.04.004 2

[8] V. Singh, N. Sharma, and S. Singh, "A review of imaging techniques for plant disease detection," Artif. Intell. Agricult., vol. 4, pp. 229–242, Oct. 2020

[9] Q. Wu, Y. Chen, and J. Meng, "DCGAN-based data augmentation for tomato leaf disease identification," IEEE Access, vol. 8, pp. 98716–98728, 2020.

[10] Sk Mahmudul Hassan 1 , Arnab Kumar Maji, Micha l Jasi ´nski , Zbigniew Leonowicz and Elzbieta Jasi ´nska Identification of Plant-Leaf Diseases Using CNN and Transfer-Learning Approach (IEEE, 2020).

[11] H.-Y. Wu, "Identification of tea leaf's diseases in natural scene images based on low shot learning," M.S. thesis, Dept. Inf. Eng., Anhui Univ., Hefei, China, 2020.

[12] X.-R. Li, S.-Q. Li, and B. Liu, "Apple leaf disease detection method based on improved faster R-CNN," Comput. Eng., vol. 46, no. 11, pp. 59–64, Nov. 2020.

[13] D. Li, R. Wang, C. Xie, L. Liu, J. Zhang, R. Li, F. Wang, M. Zhou, and W. Liu, "A recognition method for rice plant diseases and pests video detection based on deep convolutional neural network," Sensors, vol. 20, Jan. 2020, Art. no. 578.

[14] J.-H. Xu, M.-Y. Shao, Y.-C. Wang, and W.-T. Han, "Recognition of corn leaf spot and rust based on transfer learning with convolutional neural network," Trans. Chin. Soc. Agricult. Mach., vol. 51, no. 2, pp. 230–236, Feb. 2020.

[15] C.-S. Wang, J. Zhou, H.-R. Wu, G.-F. Teng, C.-J. Zhao, and J.-X. Li, "Identifi cation of vegetable leaf diseases based on improved multi-scale ResNet," Trans. Chin. Soc. Agricult. Eng., vol. 36, no. 20, pp. 209–217, Doc. 2020.

[16] A. Picon, M. Seitz, A. Alvarez-Gila, P. Mohnke, A. Ortiz-Barredo, and J. Ec hazarra, "Crop conditional convolutional neural networks for massive multi-crop plant disease classification over cell phone acquired images taken on real field conditions," Comput. Electron. Agricult., vol. 167, Dec. 2019, Art. no. 105093.

[17] Sk Mahmudul Hassan 1 , Arnab Kumar Maji, Micha l Jasi ´nski , Zbigniew Leonowicz and Elzbieta Jasi ´nska Identification of Plant-Leaf Diseases Using CNN and Transfer-Learning Approach (IEEE, 2020).

[18] Lee, S.H.; Go¨eau, H.; Bonnet, P.; Joly, A. New perspectives on plant disease characterization based on deep learning. Comput. Electron. Agric. 2020, 170, 105220.