A Framework on Potato and Corn Disease Classification Grown in Red soil Using Deep Learning Algorithm.

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Abstract: Plant disease has been very big problem not only to the farmers, even to the small holders, who gets their daily needs by selling the crops grown by them. It effects not only to the public even to the government. According to the report, government loss crores of rupees in a year because of loss crops. In the proposed work, Convolutional Neural Network (CNN), with different technologies they are Resnet50, Inception V3, Resnet152V2 have been used for the detection of disease in Potato and Corn plant. And OpenCV library has been used to read the real time image and using the model built with CNN algorithm prediction has made. Prediction of plant diseases is conventionally carried out with the help of teeth RGB. Image processing steps are adopted, like Reading Image, Resizing the image to 256X256, and to convert it to the grayscale images. Multiclass Classification technique has been used to predict the disease in the plant. I have taken 2 crops namely Potato and Corn plant. Potato has 3 classes, and Corn plant has 4 classes. For Image classification Convolutional Neural Network Algorithm and Resnet50, Inception V3, Resnet152V2 have been adopted. The manual prediction may be true or not, but manual predicting takes more time compared to prediction done by system or machine, and prediction done by system or machine provides the accurate result to which class does plant disease belongs to. The system which has been built provides an accurate result to which class does plant disease belongs in very little time.

Keywords - Convolutional neural network, Resnet50, Inception V3, Resnet152V2, Potato, Corn, Plant disease, OpenCV

I. INTRODUCTION

The task of extracting information classes from a multiband raster image is known as Image Classification [1]. Images or data in the training dataset folder, should not repeat in the test dataset folder [1]. Unsupervised is the training of an Artificial Intelligence algorithm that uses the data or images which is not labeled nor classified [1].

Multilayer perceptron means fully connected networks it means all neurons of the next layer are connected by each neuron of the previous layer, this leads to over fitting of the data. CNN create a hierarchical pattern in the data, CNN use the smaller pattern and simpler patterns and assemble them into more complex patterns [4].

Image processing steps are adopted, like Reading Image, Resizing the image to 256X256. For image classification convolutional neural network Algorithm has been adopted. Image Augmentation has been used to increase the size of the images artificially by using different processing ways another way is combining the multiple processing like shifts, shear, etc. [6].

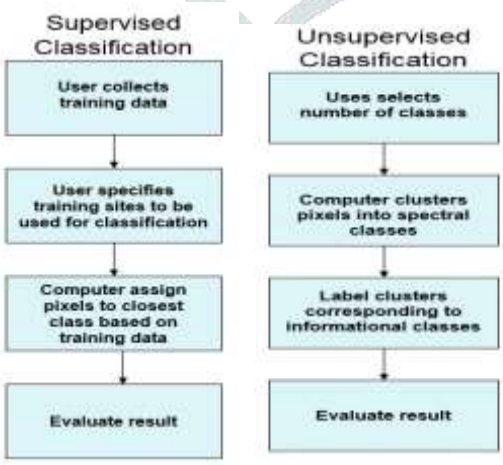

Figure 1: working of Supervised and Unsupervised classification of images by supervised and unsupervised learning.

The Figure 1 shows the classification of images by supervised and unsupervised learning.

Supervised dataset has been used in this proposed methodology. Images are classified into 2 sub dataset folders as a training dataset folder and test dataset folder. Training dataset folder and Test dataset folder has 7 sub folders each. Different classes of Corn and Potato plant, namely Corn Gray Leaf Spot, Corn Common Rust, Corn Healthy, Northern

Corn Leaf Blight, Potato Early Blight, Potato Healthy, Potato Late Blight. Images in the training dataset folder are not repeated in the test dataset folder. Images used in the proposed work are RGB images. Images used for classification in this are RGB images.

Deep learning algorithm namely Convolutional Neural Network, takes an image as an input, to the various objects CNN assigns biases and learnable weights in the image [2]. Regularized version of the Multilayer.

II. LITERATURE SURVEY

Image Classification using Deep Learning [1]

For Image classification, Author has used Convolutional Neural Network in Alexnet architecture. It has been seen that image has been classified properly, even its part of test image part, and shows the effect of deep learning algorithm. Test Images and validation Images were selected from Alexnet dataset for image classification.

Image classification model based on deep convolutional neural network [2]

One of the Deep Learning algorithm namely, Convolutional Neural Network have been used to analyze few forms of images like translation and scaling and other forms of distortion-invariant images. Convolutional Neural Network uses feature detection layer to learn from the training dataset to avoid explicit feature extraction. Compared to machine learning algorithm, deep learning algorithms have more advantages in image recognition and image classification.

Multilevel Feature Extraction and Image classification [3]

This paper carries the explanation how does concept learning algorithm, shape recognition problem, and it has also described the complete analysis of this algorithm. At the end author says that this algorithm is to be classifiers, but classification cost as well as solution's intelligibility.

Image classification using Convolutional Neural Network [4]

While doing this research, author used one of the deep learning (CNN), which is considered as best algorithm for Image classification. Author has used CNN algorithm to classify the image to their respective classes. According to the author model trained by them has predicted the class of the image and accuracy is about 75%.

Heterogeneous Transfer Learning for Image Classification [5]

Heterogeneous transfer learning learns a cross-domain feature mapping between different domains, it also aims to create common latent feature space for both the domains. In some time when the training dataset does not have much train data to train the model as predictive model at that time heterogenous transfer learning helps.

Image classification using Artificial Neural Network [6]

Neural Network is merge of bonded hardware or software system's which works as small parts like how neurons are presented in the human brain. Artificial neural network is learning algorithm that are used in variety tasks, it can be small task like classification, or complex task like computer vision or recognition of speech. Artificial neural network is build based on neural networks of human beings.

Image processing [7]

In this paper, Author has explained that he has used image processing technique. He has proposed a novel technique, which helps the people who are physically challenged to cross the roads while traffic sign has turned red or on pedestrian crossing with help of automatic video surveillance.

Noise Removal in Image Classification [8]

This paper focuses on the noise removal part on image processing though they are other methods like histogram modification, contrast stretching and so on. Noise removal has two sub types, namely non-linear and linear noise filtering. In case of second type of noise filtering i.e., linear filtering. In case if an image has noise, which is not necessary or reason for wrong classification, then linear filtering features can be used to remove the noise, linear filtering converts the original image to blur image or image with mask that represent a low pass filter.

A New approach in image classification [9]

In this paper, Algorithm used for recognition and analysis of an image is explained. The method implemented in the technical part by the author is based on determinants of the Toeplitz and Toeplitz itself. The algorithm classifies the image characteristics points into feature vector whose elements from the essential entry data to Toeplitz matrices. The minimal eigen values of matrices are calculated. They form a monotonically non increasing series whose graph and sequence limit are of characteristic values.

Summary of the Literature Survey

The paper above mentioned helped in understanding and building the project. Like how CNN with different techniques works, Depth of image processing. And how does opencv works, and types of noise removal and how does it work. And how does Multilevel feature extraction help in getting better result.

DATASET COLLECTION

Dataset has been downloaded from Kaggle. Name of the dataset New Plant Disease. I took just Potato and Corn plant folders from the original dataset.

III. PROPOSED METHODOLOGY

The proposed methodology is shown in the block diagram. The Colour images of the potato and corn plant are considered for predicting the disease. The images are carried out with resizing for the pre-processing task. The pixel's feature extraction is carried out with CNN algorithm with Resnet50, Inception V2, Resnet152V2. These algorithms have been used to predict the disease of the plant.

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Block diagram for the proposed work is shown in the below figure 2.

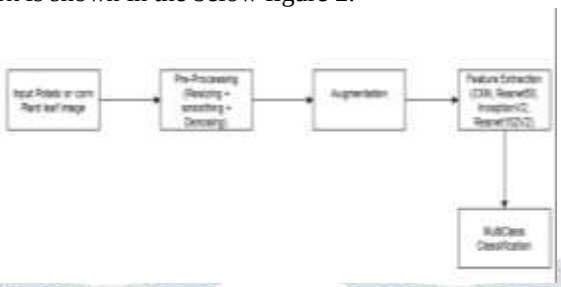

Figure 2: Block diagram of the proposed work to predict the plant disease.

Resizing: To visualize the change, two functions will be created. First function displays the one image, and the second function displays the two images. Later a function

Figure 3: Working of CNN

Figure 3 show working of the CNN algorithm. It is a multi-layer perception. Multi-layer perception means fully connected networks it means all neurons of the next layer are connected by each neuron of the previous layer.

The image analysis by CNN algorithm is shown in figure 3, 4, and 5.

ConvNets:

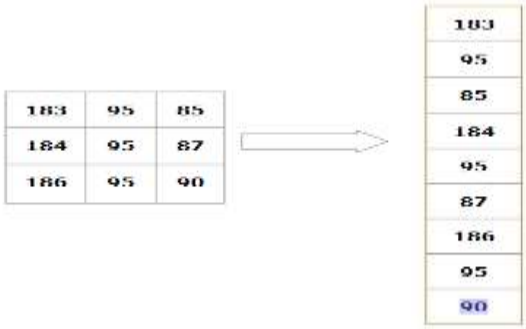

Figure 4: Flattening of the image information

The figure 4 shows the fattening of image for converting 2-Dimentional matrix to one dimension matrix.

Input Image:

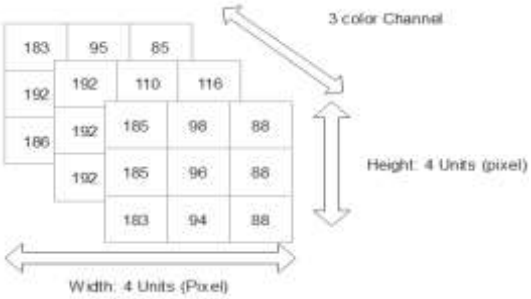

Figure 5: Details of an Input Image

The Figure 4 explains details of the input image like, format of the image (RGB), height and length of the input image.

We have an RGB image in the above Image and it is separated by three plane colors namely RED, GREEN, and BLUE. The role of the ConvNet is to reduce the images into a form that is easier to process, without losing features which are critical for getting a good prediction [4].

POOLING LAYER: Pooling layer works the same as Convolutional Layer, Pooling layer reduces the size of the feature of the convolved. Decreasing the computational power is required for processing the data through dimensional reduction by the pooling layer. It is a process of training the model effectively [6].

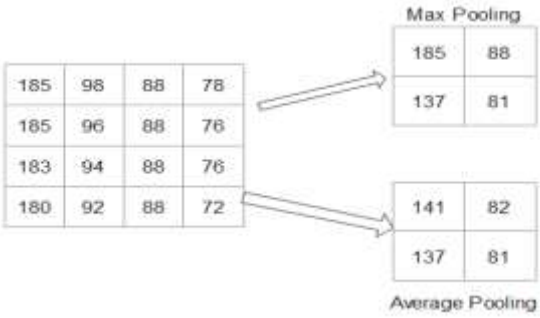

Figure 6: Types of Pooling Layer

Max pooling and Average pooling are types of pooling layer, in the proposed methodology, Max pooling is used which returns the maximum value from a part of the tooth image covered by the kernel.

SIGMOID: It is used for model's probability prediction of the output. It will be 0 or 1.

IMAGE AUGMENTATION: Image augmentation conducted in the proposed work adds the modified version of an image to the dataset this increases the size of the dataset artificially transforms include such as shifts, flips, zooms, and much more. Image data augmentation will be performed on the training dataset folder only. They must be performed consistently across all datasets that interact with the model. Extracting high-level feature from the input image is the objective of Convolutional operation [6].

IMAGE DENOISING: Image denoising will be used to remove the noise and other disturbance from the image. Noise, texture, and frequency of the edge are high. Denoised image can lose some details. [9]

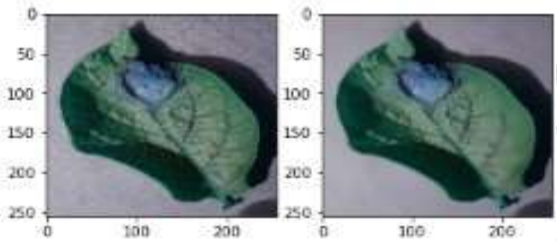

Figure 7: Image Denoising.

The Figure 7 shows the difference between tooth before applying image denoising technique and tooth image after applying denoising technique.

IMAGE SEGMENTATION: It is process of dividing the digital image into multiple chunks for simplifying the image [5] [9]

Figure 8: Image Segmentation

The Figure 8 shows the RGB image to gray scale converted image.

IMAGE SMOOTHING: Image blurring or Image smoothing is useful for removing high frequency content like noise and edges. Image smoothing takes input as an image will turn to blurred image. [9] Image smoothing has 3 sub types 1. Gaussian Blurring, 2. Median Blurring. 3.Bilateral Blurring

Figure 9: Bilateral Blurring

The Figure 9 shows one of the image smoothing techniques called Bilateral Technique

Figure 10: Gaussian Blurring

The Figure 10 shows one of the image smoothing techniques called Gaussian Blurring technique

Figure 11: Median Blurring

The Figure 11 shows one of the image smoothing techniques Called Median Blurring technique

Techniques with CNN algorithm	Accuracy
Resnet 50	67%
InceptionV3	95%
Resnet152V2	96.98%

Table 1: Accuracy rate

The above table shows the Accuracy rate of Three different Image classification techniques using CNN algorithm

In the technical part of this study, 3 different techniques namely Resnet50, InceptionV3, Resnet15V2 with CNN algorithm. According to accuracy rate got after predicting it east to tell that Resnet152V2 is more predictable and best to use as it gives 96.98%, Inception gave 95% and Resnet gave accuracy of 67%.

IV EXPERIMENTAL SETUP

The image classification process involves many steps they are 1. Data-set collection, 2. Normalization of the data-set (training and testing), 3. Building of a model, 4. Classification of the image into the respective class and 5. Evaluating does the model predicted class is correct or incorrect.

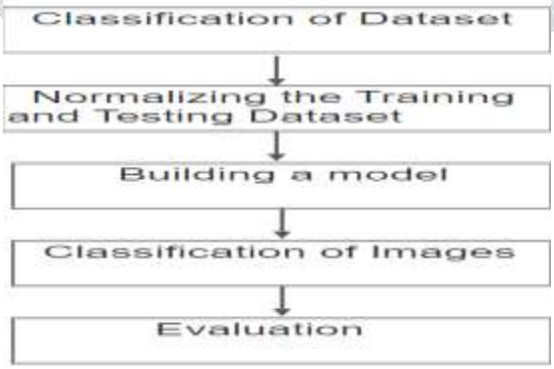

Figure 12: Flow Chart of Plant Disease Prediction System

A) Classification of Dataset: The dataset created for image classification has into 2 sub dataset folders as a training dataset folder and test dataset folder. Training dataset folder and Test dataset folder has 7 sub folders each. Different classes of Corn and Potato plant, namely Corn Gray Leaf Spot, Corn Common Rust, Corn Healthy, Northern Corn Leaf Blight, Potato Early Blight, Potato Healthy, Potato Late Blight. Images in the training dataset folder are not repeated in the test dataset folder. In total dataset has 13000+ RGB images

B) Normalizing the training dataset and testing dataset: Normalization is the process that changes the pixel intensity values range. The process of normalization is converting an input image into a range of pixel values that which are familiar.

C) Model Building: Deep learning namely the Convolutional Neural Network technique has used to build the model for image classification. It is the best deep learning technique for image classification.

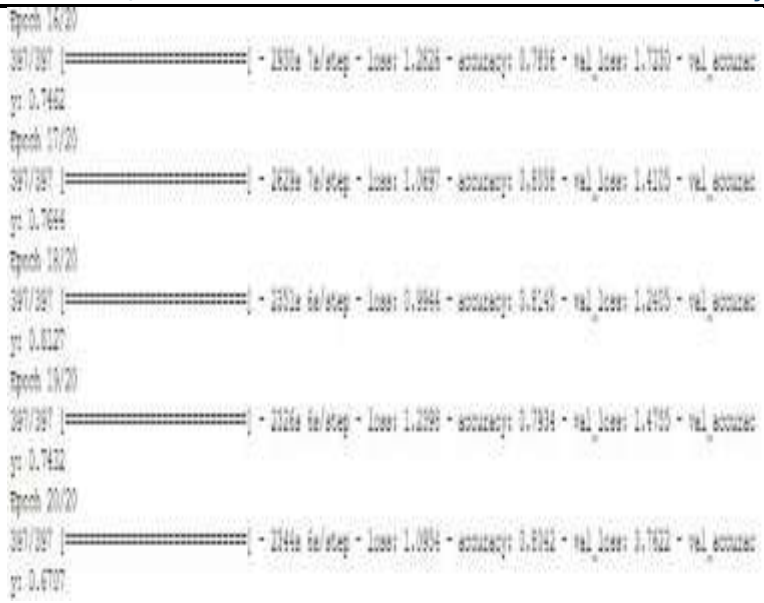

Figure 13: Result of model trained with Resnet50.

Figure 13 shows the image of model trained with Resnet50, and accuracy is 67%.

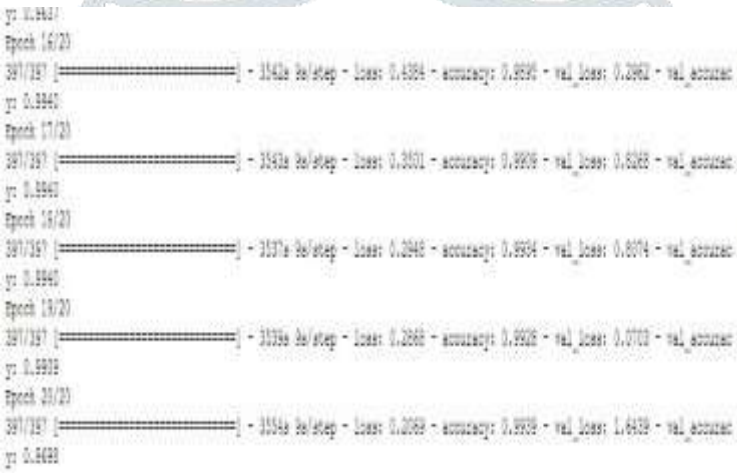

Figure 14: Result of model trained with Inception152V2.

Figure 14 shows an image of model trained with Inception152V2, and its accuracy value is 96.987%.

D) Classification of Images: This is one of the processes of image classification. The model which has been built using Convolutional Neural Network should classify the input image to respective class.

E) Evaluation: This is the final step of image classification. The model which has built using Convolutional Neural Network should classify the image properly to the respective class with high accuracy.

V. RESULT ANALYSIS

The image dataset is analyzed for the detection of plant disease using the Convolutional Neural Network algorithm with other techniques. dataset has 13000+ RGB images of 7 classes and in which 9156 images of training dataset and 3924 images in testing dataset, 7 classes namely Corn and Potato plant, namely Corn Gray Leaf Spot, Corn Common Rust, Corn Healthy, Northern Corn Leaf Blight, Potato Early Blight, Potato Healthy, Potato Late Blight. Model built using Convolutional neural network algorithm with Resnet 50 provides 67%, model trained with CNN algorithm with InceptionV2 provides 95%, model trained with CNN and Resnet152V3 provides 96.98% of accuracy, respectively.

Figure 15: Corn Rust

The Figure 15 shows Image has classified to the Corn Rust Leaf disease. And it also specified how to control disease.

Figure 16: Predicting Northern Corn Leaf Blight Disease

The Figure 16 shows it been passed to image disease prediction model, it has classified it to the NCLB disease. And it also specified how to control disease.

Figure 17: Predicting Corn Gray Leaf Spot Disease

The Figure 17 shows image been passed to image disease prediction model, it has classified it to the Corn Gray Leaf Spot disease. And it also specified how to control disease.

Figure 18: Predicting Potato Early Blight

The Figure 18 shows image been passed to image disease prediction model, it has classified it to the Potato Early Blight disease. And it also specified how to control disease.

Figure 19: Predicting Potato Healthy

The Figure 19 shows it been passed to image disease prediction model, it has classified it to the Potato Healthy class, and it also specified how to yield more.

Figure 20: Predicting Potato Healthy

The Figure 20 shows Image been passed to image disease prediction model, it has classified it to the Potato Healthy class, and it also specified how to yield more.

Figure 21: Predicting Corn Gray Leaf Spot at Real time

The Figure 21 shows Corn image had been scanned at the real time, it predicts that this leaf has Corn Gray Leaf Spot.

VI. CONCLUSION

To classify the images into various categories convolutional neural techniques have been used. CNN methodology has been adopted to perform image classification. CNN is one of the Deep Learning algorithms which takes an image as an input, it gives biases and learnable weights to the different segments in the image and separate from one another. CNN has different layers namely Conv2D layer, Pooling layer, Fully Connected Layers, Activation functions, Dense, Flatten. Pooling layer has 3 sub types in it namely, minimum pooling layer, average pooling layer and maximum pooling layer, in this technical part of the project maximum pooling layer has been used. When images are passed to train the model, each image will be converted to the matric of numeric, let us consider matric is 9X9, first 3 columns and rows number will be considered out of which maximum number will be considered, same goes till last matric of column and rows. Flatten is used to convert the matric form to single column and multiple rows. Dense technique has been adopted to drop the neurons while training the model to avoid over-fitting. Activation function like sigmoid, Relu helps in converting several negative number or number which is more than 1 to 0 to 1.

This project helps in predicting the disease of the corn or potato plant, and it helps in what medicine to put to the plant, if it has any disease. And mainly it helps the farmer to know the disease before, so that they can take the necessary steps before itself.

Comparison analysis is done on few techniques based on accuracy. Convolutional neural network provided an accuracy of about 80 - 90 percent. To reduce the over fitting issue few layers has been dropped.

VII. ACKNOWLEDGMENT

I would like to express my deepest sense of gratitude to my guide **Dr.Divya TL**, Associate professor MCA Department for her constant support and guidance.

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