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Study of Leaf Disease using Deep Learning

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***Abstract*—** Indian economy is largely dependent on the crop produce provided by the farmers. The agricultural output is affected by the condition of the plants which will be baring the consumable products. Diseased plants show stunted growth and are way below the optimal output which needs to be generated. Thus, such plants need to be treated in timely manner so such diseases could be treated before the health of the plant deteriorates further. The project is aimed at solving this problem by detecting the disease which the plant is facing by using concepts of image classification and deep learning. A camera is used to take a picture of the leaf and image is passed through a pre calibrated weighted neural network which uses alexnet architecture. the Output neuron which the plant ends up after passing through neural network is disease identified by the Neural network and measures are suggested to improve the condition for helping the plant get rid of the disease and provide optimal results in agricultural output. Thus, focus is on detecting the disease preventing the plants growth and thus provide precautionary measures to solve the problem.

***Keywords*—** *Agriculture, leaf disease, deep learning, alexnet architecture,CNN.*

I. INTRODUCTION

India is a country of farmers and crops. Most of the Indian population in the rural areas have taken up agriculture as the main source of income for the family. Importance of agriculture in developing the Indian economy is incomparable. This produce is affected when the plant is affected by a disease which has stunted the growth and productivity of the plant. Around the world, these plant diseases challenge the growth of plant and crop production. The damage caused by these diseases by the pathogens shifts from mellow side effects to decrease of the tainted plants, contingent upon the forcefulness of the pathogen, have opposition, natural conditions, the span of disease and different elements. Thus efforts should be directed in the way of helping to detect these diseases so timely solutions could be provided to help improve the condition of the plant. These precautionary measures can prevent future occurrences of these diseases and help prevent the drop in plant productivity.

Paper is sorted out as pursues, this area contains presentation of paper, trailed by related works with this field of study. Methodology is clarified straightaway and pursued by Results and Discussions. In Final area, the paper is summated and finished up with references used at the end.

II. RELATED WORK

Image segmentation and Soft computing techniques, Image segmentation, which is an imperative perspective for malady identification in plant leaf disease, is done by using the genetic algorithm. MATLAB is used for experiment After various experiments, Five classes of diseases are used in the process. Except for very few samples of frog eye leaf spot and bacterial leaf spot were not accurately identified. a couple of leaves with bacterial leaf spot are identified as frogeye leaf spot and one frogeye leaf spot is classified as bacterial leaf spot. However, The Average accuracy of the proposed algorithm is around 97.6% to 92.7% [1].

Detection and Classification of Leaf Diseases using K-means-based Segmentation the network was trained. Once the training is marked complete, Each class of leaves are tested. Five different classes are used in this paper. The results yielded classification accuracies for most of the data models. In particular, the first model achieved the highest overall classification accuracy. The second model is at 89.5% of accuracy, the Third model achieved an accuracy of 84.0% and finally achieved an overall accuracy of 83.66%. Out of all Models, the First model emerged as the best model among various models. Intensity texture features are eliminated to achieve this accuracy. Effect of intensity variations is not a problem because of the elimination of Intensity texture features. Moreover, it reduces the

computational time as texture part of images are taken care of. However, This affected the accuracy of outdoor application, Because of the elimination of intensity. In outdoor lighting, change in ambient lighting is not taken into consideration [2].

Another image processing method includes NN Classification technique, There are many techniques that are presently being utilized to make computer-based vision systems victimization options of plants extracted from pictures as input parameters to varied classifier systems. during this paper, a technique to argument already existing techniques of plant leaves identification system is diagrammatical.this paper, a novel classification model involving neural networks (NN) was used to develop a laptop based vision system for automatic identification of plant species [3].

HSV technique is used in this system which is summarised major image processing used for identification of leaf diseases are k-means clustering, SVM. This methodology will significantly bolster partner degree right discovery of plant ailment. There territory unit five stages for the plant infection recognizable proof that zone unit same to be picture procurement, picture pre-handling, division, include extraction, order. By processing the amount of unwellness blessing inside the leaf, we will utilize an adequate amount of pesticides to successfully to board the bugs progressively the harvest yield will be swelled. We can broaden this methodology by abuse totally unique calculations for division, characterization. By abuse, this thought the unwellness distinguishing proof is finished for a wide range of leaves and moreover, the client will perceive the influenced space of leaf in the offer by trademark the sickness legitimately the client can amend the issue simple and with less expense [4].

An Algorithm for Plant Diseases Detection Based on Color Features, Advanced pictures empowered extraordinary enhancements in a wide range of territories and science and agribusiness are some of them. Plant illnesses location and grouping is extraordinarily imperative assignment and any, increasingly programmed recognition of plant sicknesses is a vital investigation point since it could help in perception of goliath fields of harvests, and consequently, precisely discover the side effects of ailments as right away as they show up on the plant leaves. In this paper, we tend to anticipate AN algorithmic standard for programmed recognition of plant leaf maladies. The proposed technique comprises of a few stages including middle channel, thresholding, and employment of various shading models for the division. Our proposed strategy gives speedier and increasingly exact discovery and order contrasted with other condition of-workmanship. A method supported totally different colour models and Kapur's thresholding for plant diseases detection was planned. Four totally different colour models were tested and compared: RGB, YCbCr, HSI and CIELAB colour model. The best results were obtained once the HSI colour model was used. Component H was used for image segmentation wherever diseases were separated from the leaf. A median filter was applied to a colour transformed image. In the end, disease spots area is determined by applying Kapur's threshold on different colour components. The experimental result shows commotion that is acquainted due with foundation, vein and camera streak makes a minimal issue for HSI shading model. Following this procedure, very surprising infection spots are identified precisely and results don't appear to be disappeared with foundation, kind of leaf, sort of sickness spot and camera. In further work, malady might be grouped by calculative components of illness spot [5].

P colour rework primarily based approach for unwellness spot detection on a plant leaf. In this examination, a calculation for malady spot division utilizing picture preparing procedures in plant leaf is actualized. This is the essential and indispensable segment for programmed location and grouping of plant maladies. Infection spots are diverse in shading yet not in power, in correlation with plant leaf shading. So we will in general shading redesign of RGB picture are regularly utilized for the higher division of sickness spots. In this paper, an examination of the aftereffect of CIELAB, HSI and YCbCr shading space during the time spent illness spot discovery is finished. Middle channel is utilized for picture smoothing. At long last edge might be determined by applying Otsu strategy on the shading part to discover the unwellness spot. A standard that is independent of ground commotion, plant kind and unwellness spot shading was created and tests were dole out on very surprising "Monocot" and "Dicot" family plant leaves with both, clamour free (white) and loud foundation [6].

A PSO model for disease pattern detection on leaf surfaces: The fundamental target of this paper is to fragment the infection influenced bit of a plant leaf and concentrate the half and half highlights for a better arrangement of various ailment designs. Another methodology named as Particle Swarm Optimization (PSO) is proposed for picture division. PSO is a programmed unsupervised proficient calculation which is utilized for better division and better component extraction. Highlights removed after division are critical for ailment order with the goal that the half and half element extraction parts control the exactness of arrangement for various infections. The methodology named as Hybrid Feature Extraction (HFE), which has three parts to be specific shading, surface and shape based highlights. The execution of the preprocessing result was analyzed and the best outcome was taken for picture division utilizing PSO. At that point, the half breed highlight parameters were

extricated from the dark dimension co-event grids of various leaves. The proposed strategy was tried on various pictures of malady influenced leaves, and the trial results display its viability [7].

Crop anomaly identification with colour filters and convolutional neural networks: Observing harvests is a tedious yet critical assignment to guarantee generation quality. In this paper we present a correlation of convolutional neural system based strategies, assessing model multifaceted nature and execution dependent on various measurements for the paired characterization assignment of portioning trees from the earth. An Unmanned Aerial Vehicle (UAV) is utilized to acquire RGB video of orange harvests in various elevations. Keyframes are removed dependent on automaton direction and speed for preparing and assessment of the models. The impact on the execution of numerous information growth procedures is likewise assessed. The favoured model is then connected to a recreation of an area from various pictures and a shading channel is connected for abnormality discovery. Trial and visual outcomes demonstrate that these strategies can section the earth effectively with no component designing, being a suitable pre-preparing strategy for lessening clamour in malady distinguishing proof applications [8].

III. METHODOLOGY

The Proposed methodology uses deep learning techniques for image classification. There are many architectures on this subject. Out of all, AlexNet Architecture is chosen for this implementation. AlexNet is one of the first and most Convolutional neural networks ever made. AlexNet is composed of five convolutional layers which perform computation on the input image, Three pooling layer and four dense layers. For backend, Computation that is done in the convolutional layer, Technique of Stochastic gradient descent is used.

Data acquisition: For a Neural network to perform with the highest accuracy, amount and variety of data plays a Crucial role. For the collection of images, Various farms have been visited. Along with the live samples, Several Online databases and datasets are combined together to obtain a dataset which is expected to yield the highest accuracy of the neural network Prediction.

Setting up Neural Network: For the implementation of this classifications, models are generated using Keras package, which uses TensorFlow, deep learning framework developed by Google. There are 5 convolutional layers along with 3 pooling layers and 4 dense layers, all of these layers are added to the sequential classifier. Each layer has its own parameters. Dense layers are fully connected layers. Last two dense layers are made not trainable to have appropriate calculations. Neurons in the last layer are determined by the number of classes are required to be classified. For the initial implementation, the Only tomato plant is considered and ten classes of tomato diseases are considered. Hence, neurons in the last layer of the neural network are ten. Classifier with that above layout is compiled with Stochastic gradient descent along with accuracy metric.

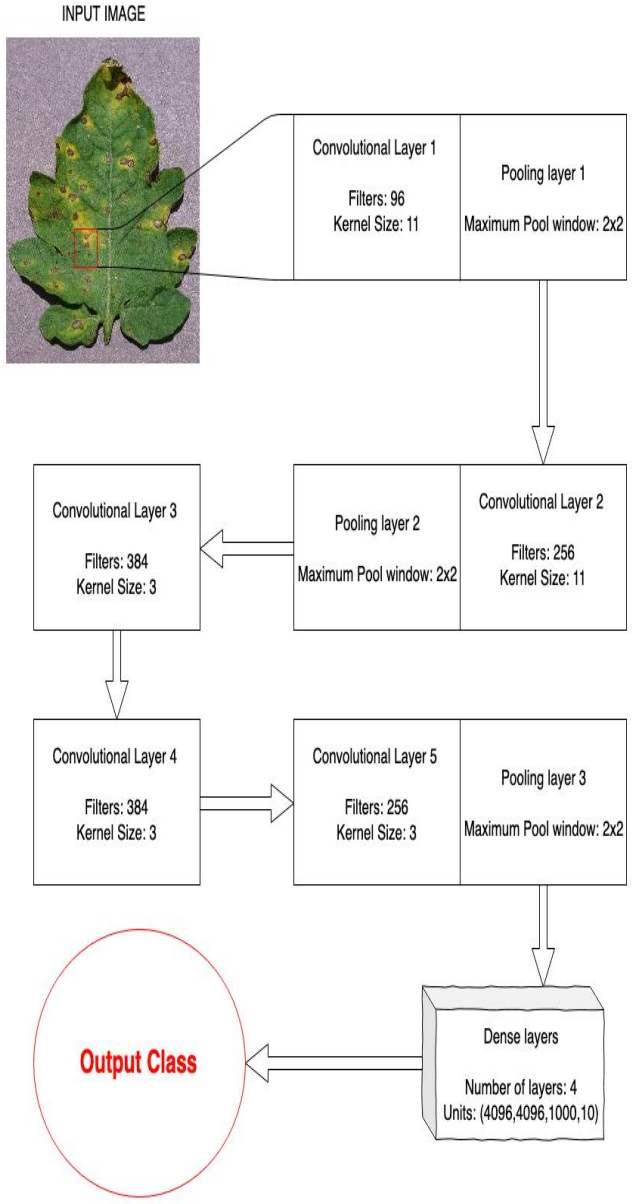

Figure 1. Our Proposed Neural network will and it's Specifications are laid out this Figure. Figure shows five convolutional layer which performs computation on the input image, Three pooling layer and four dense layers. Computation that is done in convolutional layer is Technique of Stochastic gradient descent.

Preprocessing of data: Since images are obtained from various sources online and offline. Preprocessing of data is required. Preprocessing is nothing but changing the data to suit our needs and help with the faster and efficient training of the neural network. All the acquired images are organised into folders with their appropriate classes as the folder names. For instances, all the leaf images of the black rot disease of tomato are placed in a folder called "Tomato__Blackrot". These directors are scanned and their names are taken as the class names in the classification. All images are resized to smaller resolutions for faster computing and reduce the burden on the system running it.

Training: Once Preprocessing of the image is done, Training of the neural networks starts. In this process, Each image is passed through the layers of a neural network to let it interpret the given data in its own words. This process is a black box approach. Where we give input image and get the output as the data model. For implementation, we have used 25 epochs which can be called as iterations to make the model accurate. For each epoch, Neural network will calibrate its weights of the connections between layers. These weights will be fed to the neural network which classifying images. Images are divided into two types which are, training dataset and valid dataset. Images in training dataset are used to calibrate the weights of neural network and Images invalid dataset is used to calculate accuracy.

Predicting: for predicting, the Same initialisation of the neural network is done, Once the image to tested is obtained it is resized to the size of training data image and converted into an Array. Then this image is passed through a neural network with the best weights, whichever neuron the image ends after parsing the neural network is identified as the class of the image. The number of neurons on the final layer of Neural network is the same as number disease classes. That is, When an image is being predicted by the neural network, it is allowed to pass through a neural network and checked which neuron out of ten neurons in the last class, the image has ended with and it is classified as that particular associated class of the neuron.

IV. RESULTS AND DISCUSSION

Data is divided into two sets, one being the training set and other being the validation set. Training set as the name suggests it is used to train the model. Whereas the validation set is used to measure the performance of the model at that point. Below displayed are the achieved maximum accuracy plots of accuracy against epochs. This model is trained several times to get the maximum efficiency out of it.

Figure 2. shown is the accuracy Vs epoch graph of neural network.

Green line represents accuracy of training dataset which varied between 96.71% to 96.92% . Blue lines represent accuracy of validation dataset, the difference between these two plots decides, underfitting or overfitting nature of neural network. in this case, these metrics vary in terms of 0.2% which is neither overfitted nor underfitted. However, this results displayed are for 10 classes in tomato plant diseases. Same method with more data can be used to expand over range of plants and various plant diseases among them.

Figure 3. represents loss of data. Loss represents, average of summation of errors committed by neural network.

This values vary from 0.092 to 0.102, which can be roughly translated to 9.2% to 10.2%. In graph, Redline shows error of validation data and blueline shows loss of training data.

The proposed algorithm has displayed similar results to the majority of the images tested. One of the limitation observed is, if the input leaf with background of green shade, it would confuse the neural network to get the accurate location of leaf to be tested which affected prediction. If leaf is placed

on some sort of distinguished background, this method gives optimal results

V. CONCLUSION AND FUTURE SCOPE

The proposed algorithm has displayed similar results to the majority of the images tested. One of the limitation observed is, if the input leaf with background of green shade, it would confuse the neural network to get the accurate location of leaf to be tested which affected prediction. If leaf is placed on some sort of distinguished background, this method gives optimal results.Future work on this topic included, working on implementation of more number of predictions that algorithm can make, this is done via feeding more data to the neural network and retouch the training process, to increase the accuracy of generated pre processed models.

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