IDENTIFYING AND CLASSIFYING THE DISEASE OF COTTON LEAF BY USING CONVOLUTIONAL NEURAL NETWORK

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Abstract -Agriculture is an area that has a high impact on human life and economic status in many countries including India. In India, the main source of revenue for a population of about 58 percent is in agriculture. The existence of all organisms on Earth is dependent mostly on the plants. The financial system in India is mostly sustained by agriculture production, so it is foremost important to ensure that measures are taken to identify and reduce any diseases on plants. Cotton leaf diseases are the root cause of the reduction in the productivity of cotton. For human eyes, it is very hard to detect the sort of disease precisely which occurs on the leaf of the cotton plant. So, there is a requirement for a system that can automatically identify the diseases and help in surveying huge sectors of crops, and then plant leaves can be taken cure promptly after identifying a disease. This project includes a Convolutional Neural Network technology that can access the image of the leaf of a plant and detect the diseases. The main approach of this project is to recognize the distinct types of diseases by implementing the CNN technique, which performs an image pre-processing procedure to operate on the leaf image and employs automated feature extraction to help in the categorization of the given input image into respective disease classes. This proposed CNN model achieves good accuracy for detecting the cotton leaf diseases and classifying it based on the category of disease thereby showing the practicability of its management in real-time implementations.

Keywords: Convolution neural network, Cotton leaf disease, Classification,

I. INTRODUCTION

Plant disease has long been a compelling threat to agriculture production, as it significantly decreases crop yield and undermines its consistency. Correct and accurate diagnosis of illnesses has been a big problem. Traditionally, the diagnosis of plant diseases was based on human annotation through visual examination. There are numerous diseases that impede the growth of crops in the region, which can lead to a huge loss in the quality of goods. Nowadays image processing is commonly used to diagnose certain diseases, pests such as germs, fungi and microorganisms are the major cause of disease in crops due to lack of excellence and development.

Crops are affected by a number of environmental anomalies, such as fungi, water shortage, insects and weeds. There are some types of problems that enable farmers to take preventive steps to improve production. This research helps to establish on the visually targeted consistency of cotton. Image classification been all over for a quite long time and has also been a common area of study. In fact, it's been introduced in the majority of the big applications. In this paper, the same thing has been implemented to solve the issue of plant disease detection by studying the plant leaf using the Convolutional Neural Networks (CNN).

We decided to utilize a neural organization for this division task. With enough preparing material nearby, one can let a neural organization train the ideal blend of the three shading groups. The intensity of a neural organization lies in the strength to varieties of conditions (for example change of light, varieties of shading). In the event that the neural organization is prepared on an informational index which contains pictures of a wide range of conditions, it will have the option to confront these conditions. In similar to applications, for example, skin shading division, neural organizations have demonstrated their latent capacity.

We utilize neural organizations to have any kind of effect between plant pixels and foundation pixels, freely of the shades of the plants/foundation. We need to prepare the neural organization once for each sort of information (pictures in the visual range, pictures of the NIR-range and pictures on the fringe between these two). The neural organization we utilized has 2 layers, with in the primary layer, the 3 RGB-estimations of a pixel as contribution to every neuron. Each info esteem is duplicated by a weight esteem that is relegated to the information sign of a neuron. The yields of the neurons in this layer are sent to the neuron in the yield layer. The actuation capacity of the neurons is a sigmoid capacity and the preparation strategy is back-propagation. The back-propagation procedures utilize determine of the initiation capacity to change the weight estimations of the neural organization, so we need to utilize an actuation work that is differentiable. To make the preparation information, we utilize a cover which chooses the plant-pixels and foundation pixels. The contribution of the organization are the 3 RGB-values, the yield is subject to the kind of pixel. For a foundation pixel we utilized an estimation of 0.1 for a plant-pixel we utilized an estimation of 0.9. Digital image processing is the utilization of PC calculations to perform picture handling on computerized pictures. As a subfield of advanced sign preparing, computerized picture handling has numerous preferences over simple picture preparing. It permits and a lot more extensive scope of calculations to be applied to the info information — the point of computerized picture handling is to improve the picture information (highlights) by smothering undesirable bends or potentially upgrade of some significant picture includes so our AI-Computer Vision models can profit by this improved information to take a shot at.

The aim of this paper is to establish a method for the recognition of crop diseases. We have developed a technique that uses deep learning to evaluate, detect, and classify any disease that may have infected a plant by taking a photo of the leaf. In that the user needs to send an image to the network, the image processing begins with the digitalized color image of the infected leaf. Finally, with the use of CNN plant disease may be detected. The analysis finalized during this part of the research is to suggest a solution consisting of three key steps: data collection, pre-processing and classification for the identification of plant diseases. It also helps to solve these problems and produces good crop growth.

II. LITERATURE SURVEY

Notwithstanding different difficulties, plant infection discovery is as yet a functioning region of exploration. Various methodologies have been proposed throughout the long term. In conventional frameworks approach for discovery and separation of plant infections can be accomplished utilizing Support Vector Machine calculations. Another methodology depends on leaf pictures and utilizing ANNs based strategy to identify and arrange the ailments in plants.

Baqueroet al. utilized a methodology dependent on shading structure descriptors and closest neighbors. Irregular conditions like chlorosis, dirty hills and early scourge could be arranged utilizing this methodology. Molina et al. evaluated the soundness of tomato crop utilizing AI approach by planning a convention to develop the informational collection for impromptu gained pictures. Nieuwenhuizen contributed his postulation towards the advancement of a computerized framework for the location and control of undesirable potatoes inside sugar beet fields. Smedtet al. proposed an application for rural applications. The framework pictures division effortlessly. The framework identifies and orders the weeds by picture division. Low-cost NIR channels with neural organizations were utilized to get the necessary outcomes. Brivot and Marchant committed their work to discover the precise measure of herbicide or pesticide required on weeds or plants. The proposed technique utilized the division close to the infrared area to separate plants, weeds, and soil. Tellaecheet al. utilized a crossover approach of Support Vector Machines and the Fuzzy k-Means techniques. These two methodologies were consolidated through the fluffy collection hypothesis to effectively decide the measure of herbicides expected to the yields. Weyrich et al. utilized a machine vision framework to distinguish the area of weed and yields. At that point the nature of plant is determined through the territory secured by leaves, regardless of whether the leaves are covered.

In this section, we discussed about the related works done by using image processing and CNN in agricultural applications. Prior to the introduction of deep learning, image recognition and machine learning methods have been used to identify various plant diseases. Most of these structures typically follow the following steps: Initially, images are taken with a digital camera. Image processing methods, such as image enhancement, segmentation, color space conversion, and filtering, are then applied to make the images appropriate for the next steps. Important features are then extracted from the image and used as a classifier input.

The overall accuracy of the classification is also based on the method of image processing and the extraction techniques used. However, recent studies have shown that state-of-the-art efficiency can be achieved by networks trained using standardized data. CNN's are multi-layer supervised networks that can dynamically learn features from datasets. Over the last few years, CNNs have attained state-of-the-art success in almost all major classification tasks.

III. SYSTEM DESIGN AND ARCHITECTURE

The primary goal of farming is to grow good crops without any disease present. The health of the cotton leaf is quite difficult to explicitly presume. In order to solve this problem, a neural network-based technique is required that can assess the picture of the leaf of the plant and identify the disease and quality of the cotton plant using a deep learning method.

The following below figure illustrates the structural architecture of the proposed structure. The system used an image processing method for the identification of diseases. We submit an input image of the cotton plant leaf. First, system will pre-process the submitted image and then use the CNN technique. Using the CNN methodology method, the image can be examined with a qualified dataset and the characteristics can be extracted.

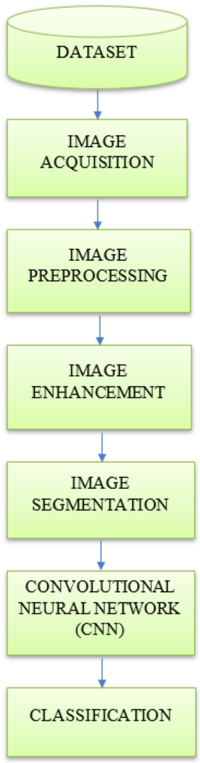

Fig 1: System Architecture

The proposed system consists of the following mentioned modules.

1. INPUT IMAGE

Take an input image from a dataset that has several images collected from cameras, the internet and various other sources. These pictures are taken in no direction of sunlight as it will impact the image. In this module, we select an input image of the cotton plant from our dataset and is used for testing.

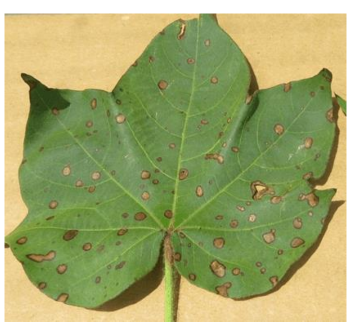

Fig 2: Input image

2. IMAGE PREPROCESSING

The acquired dataset consisted of cotton leaf images with minimal noise and thus noise reduction was not a necessary pre-processing step. The cotton leaf images in the dataset have been resized to uniform resolution in order to optimize the training process and make the training model computationally feasible. This process is performed so that it may be used in the process of back propagation of Neural Network.

3. IMAGE ENHANCEMENT

The process of image enhancement is finished by the technique for noise cancellation. Noise cancellation is the technique for remedying the pixel esteems that do not mirror the genuine forces of the genuine scene. The foundation of the picture is taken out and is isolated to the dark foundation. The RGB (red, green and blue) segments of the image are taken out first, at that point it is then changed into HSV image.

4. IMAGE SEGMENTATION

Image segmentation is the process where the parallel picture of the abandoned leaf is separated. In this cycle a high contrast picture is shaped. The abandoned aspect of the picture is white and the foundation picture is in dark tone. The distortion in the picture is appeared as little white pixel which is spread around the abandoned region.

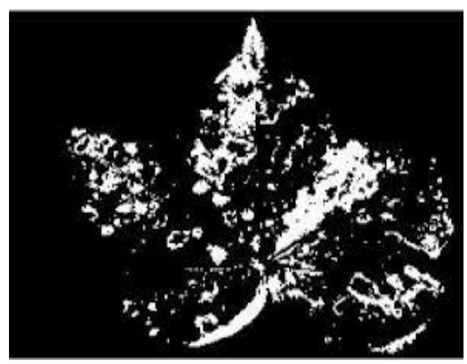

Fig 3: Segmentation of the image

5. CLASSIFICATION

Convolution Neural Network (CNN):

CNN may be used to construct a statistical model that operates on unstructured image inputs and transforms them to corresponding classification output marks. They come under the group of multi-layer neural networks that can be programmed to learn the features needed for classification purposes. They execute automatic feature extraction that gives better results. They are then classified in the group of diseases named on the basis of the type of disease.

IV. IMPLEMENTATION

The technique used here is Convolutional Neural Network method. Convolution Neural Networks are designed for accurate research. Unsupervised Learning classification is used when the input image is undefined and new to the algorithm. Many real-time implementations require unsupervised learning data since the content is still unpredictable to the algorithm.

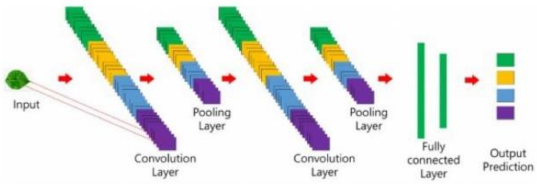

Fig 4: illustration of CNN layers

This is implemented in python. To build and train the CNN model, Keras and numpy library is used which works on top of Tensorflow. Implementation steps are as follows:

Step 1- Input image is taken and pre-processing is done.
Step 2- After pre-processing steps, we pass an information picture to the first convolutional layer. The network will perform arrangement of convolutions and pooling activities during which the highlights are identified. The convolution layers extricate highlights from the info.
Step 3- Convolution is performed on input image using a filter. This filter slides over input image one pixel from top to bottom at a time.
Step 4- The convoluted output is obtained as that of an activation map. The channels applied in the convolution layer removes pertinent highlights from the information picture to transferred further.
Step 5- After a convolution layer once you get the component maps, it is entirely anticipated to include a pooling and perhaps a sub-testing layer in CNN layers. Each filter shall have a different feature to help predict the correct class. In case we need to maintain the size of the image, we use the same padding (zero padding), else valid padding is used so it helps to minimize the number of features.
Step 6- Pooling layers are therefore added to additionally lessen the quantity of boundaries.
Step 7- Until the prediction is made, multiple convolution and pooling layers are inserted. Convolutional layer deals in extracting features. When we move further into the network, more specific features are extracted as compared to a shallow network where the extracted features are more generic.
Step 8- This output layer within CNN is a fully connected layer, where the input from the other layers is flattened and then sent so as to transform the output into the variety of classes as requested by the network.
Step 9- We then apply the linear transformation and activation function to this data.
Step 10- The output would then be produced from its output layer and compared to an output layer for fault generation. The loss function is specified in the fully connected output layer to measure the mean square loss. The error gradient is then determined. The mistake is being backpropagated to refresh the filter(weights) and the bias values.
Step 11- The results are produced from the output layer and use them to classify the input image into its class.

V. RESULTS

The purpose of this model is to establish a platform that notices crop diseases and shows the results as identified diseases to the user, and whenever a user uploads a file, the image processing begins with a digitized color image of the diseased cotton leaf. Finally, by the use of CNN cotton plant leaf disease can be expected.

Fig 5: Input Image

This above figure shows the input cotton leaf image we selected for the purpose of testing of disease detection. And is further used for the image processing and convolution process.

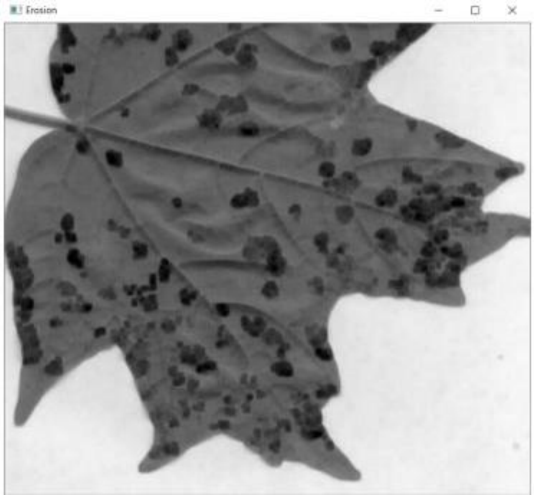

Fig 6: Erosion

Fig 7: Dilation

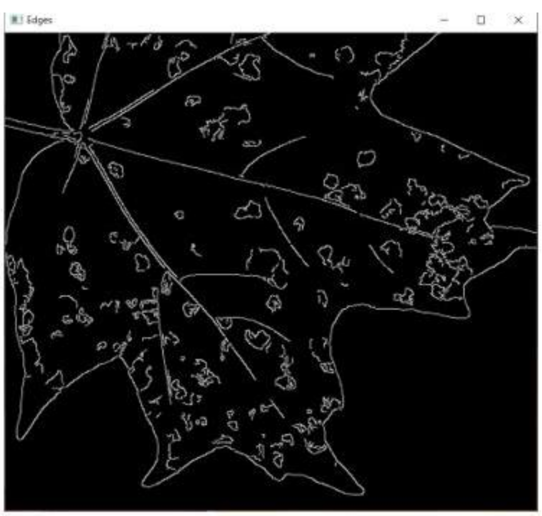

Fig 8: Edges

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IPython 7.9.0 -- An enhanced Interactive Python.

In [1]: runfile('E:/Major/CODE/Plant-Leaf-Disease-Detection/script.py', wdir='E:/
Major/CODE/Plant-Leaf-Disease-Detection')
curses is not supported on this machine (please install/reinstall curses for an
optimal experience)
E:/Major/CODE/Plant-Leaf-Disease-Detection/train/image1.jpg
Model loaded successfully.
Status: Unhealthy.
Disease: Lateblight.

In [2]: runfile('E:/Major/CODE/Plant-Leaf-Disease-Detection/script.py', wdir='E:/
Major/CODE/Plant-Leaf-Disease-Detection')
E:/Major/CODE/Plant-Leaf-Disease-Detection/train/51a03694-82cd-43a5-9877-
ddce42c1a5ad___RS_HL 1779.JPG
Model loaded successfully.
Status: Unhealthy.
Disease: Bacterial.

In [3]: runfile('E:/Major/CODE/Plant-Leaf-Disease-Detection/script.py', wdir='E:/
Major/CODE/Plant-Leaf-Disease-Detection')
E:/Major/CODE/Plant-Leaf-Disease-Detection/train/image25h.jpg
Model loaded successfully.
Status: Healthy.
```

Fig 9: Status of Disease Detection

This above figure shows the actual status of the disease that is obtained and classification of the disease to which it belongs.

```
=================================================================
Total params: 58,292,296
Trainable params: 58,289,416
Non-trainable params: 2,880
_________________________________________________________________
None
Accuracy: 84.6523
```

Fig 10: Calculating Model Accuracy

This above figure indicates the accuracy obtained for the dataset we used for cotton plant leaf disease detection.

VI. CONCLUSION AND FUTURE SCOPE

In this paper, it focuses on identifying diseases from the cotton plant via the images of its leaves. Here, a deep learning inspired strategy is used to identify and classify whether the leaf is diseased or healthy by implementing the Convolutional Neural Network technique. The complete procedure was described, respectively from collecting images from various available internet and other sources in our dataset and then running image processing steps and classifying its type of disease with help of the CNN model. Now, whenever an image path is supplied, all one needs to do is run the code and then system will be capable of predicting the class of disease. CNN model is highly suitable for automated disease identification and diagnosis of cotton plant diseases by examining simple leaf images. This model achieves substantial-good accuracy in our results. This systematically high accuracy shows that CNN works nicely for disease classification and should surpass expert’s eyes with little computational effort.

Hereafter, the work can be made more scalable by making the addition of more major crops and diseases. The dataset here used is a drawback, only limited collected crops and similar backgrounds with the stimulated setup is used. It can be extended to the real-world scenario where the model can be developed extensively. With the increasing demand for mobile computing and steadfast mobile-platform neural processing units, the work can be extended to portable Innovations.

In addition, such insight will help one to gather data on the go and to test it on multiple real-world samples at the same time. Based on the images of leaves captured by the camera, an application for smartphones with features such as viewing recognized diseases in fruits, vegetables, and various other plants can be created. In the future, the system could be made to work on even wide areas. A warning setup can be included such that the mobile application can give an alert message according to plants condition through the leaf. An automated pesticide prescription feature for the diagnosed disease could be included in the future.

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