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Multiple Crop Disease Prediction using Machine Learning

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Abstract: *The recognizable proof and discovery of infections of crops are one of the central matters which decide the deficiency of the yield of harvest creation and horticulture. The investigations of cropdiseases are the investigation of any noticeable places in any piece of the crop which assists us with separating between two plants, actually any spots or variety conceals. The manageability of the crop is one of the central issues that is for the agrarian turn of events. The identification of crop diseases is genuinely challenging to get right. The distinguishing proof of the diseases requires loads of work and mastery, heaps of information in the field of plants, and the investigations of the identification of those diseases. Thus, picture handling is utilized for the discovery of crop diseases. The Identification of diseases follows the techniques for Image Collection, Image extraction, Image division, and Image Pre-processing. This article shows how to detect crop diseases using images of leaves. It also describes the use of image extraction and image pre-processing to create this project.*

Keywords*:* Identification, Diseased and Healthy Leaf, Deep Learning, Classification

I. INTRODUCTION

The issue of effective crop diseases security is firmly connected with the issues of reasonable horticulture and environmental change In India, Ranchers have an extraordinary variety of yields. Different micro-organisms are available in the climate which seriously influences the yields and the dirt in which the plant is planted, accordingly influencing the creation of harvests. Different diseases are seen in the crops and harvests. The primary distinguishing proof of the impacted crop or yield is its leaves. The different shaded spots and examples on the leaf are extremely valuable in identifying diseases.

The previous situation for cropdisease location included direct eye perception, recollecting the specific arrangement of diseases according to the environment, season, and so on. These strategies were for sure erroneous and very tedious. The ebb and flow strategies for plant infection recognition included different research center tests, gifted individuals, exceptional labs, and so on.

These things are not accessible wherever particularly in far-off regions. Location of diseases through some programmed procedure is useful on the grounds that it diminishes a curiously large work of watching in gigantic ranches of harvests, and at awfully beginning phase itself it distinguishes the side effects of diseases intends that after they appear to be on crop leaves. There are multiple ways of distinguishing crop pathologies. A few diseases have no apparent side effects, or the impact becomes observable past the point where it is possible to act, and in those circumstances, a refined examination is compulsory. Be that as it may, most diseases create a sign in the noticeable range of some sort or another, so the unaided eye assessment of a prepared proficient is the excellent procedure embraced by and by for crop disease discovery. Varieties of side effects demonstrated by unhealthy crops might prompt an ill-advised conclusion since beginner nursery workers and specialists could have a larger number of challenges deciding it than an expert plant pathologist. A computerized framework intended to assist with recognizing crop diseases by the plant's appearance and visual side effects could be of extraordinary assistance to novices in the cultivating system and furthermore prepared experts as a check framework in disease diagnostics. Progresses in PC vision present a valuable chance to grow and improve the act of exact plant assurance and broaden the market of PC vision applications in the field of accuracy agribusiness.

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II. REQUIREMENTS

2.1 Hardware Components

Mobile Computing Device

Mobile computing devices are portable electronic devices that enable users to access and use computing services while on the go. Lightweight, compact and easy to carry, these devices enable users to perform a variety of tasks such as communication, web browsing, multimedia consumption and productivity functions.

Smartphones are now used in many ways. Smartphones are convenient and have long battery life. Warp-speed processing, crisp displays, great cameras, and more. For this project, I used an Android app that uses your phone's camera and clicks on an image to display information about the plant, such as name and trust level.

Graphics Processing Unit

A graphics processing unit is a specialized electronic circuit designed to quickly manipulate memory to speed up the creation of images in a frame buffer for output to a display device. GPUs are used in embedded systems, mobile phones, personal computers, and workstations. Modern GPUs demonstrate remarkable efficiency when it comes to manipulating computer graphics and performing image processing tasks.

2.2 Software Component

Flask

Flask is a popular web framework used for building web applications and APIs in Python. It provides a simple and lightweight approach to developing web services with a minimalistic yet powerful set of features. Flask follows the model-view-controller (MVC) architectural pattern, allowing developers to create robust and scalable web applications.

ResNet

ResNet (Residual Neural Network) is a deep learning architecture that has made significant advancements in the field of computer vision. ResNet addresses the problem of vanishing gradients encountered in very deep neural networks by introducing residual connections. ResNet's fundamental innovation is the introduction of residual blocks. These blocks consist of a series of convolutional layers, batch normalization, and activation functions, along with the addition of the original input. By adding the input to the output of each block, ResNet enables the network to learn residual representations more effectively. The residual connections in ResNet not only alleviate the vanishing gradient problem but also facilitate the training of much deeper networks. As a result, ResNet models have achieved state-of-the-art performance on various computer vision tasks, such as image classification, object detection, and image segmentation.

PyTorch

A graphics processing unit is a specialized electronic circuit designed to quickly manipulate memory to speed up the creation of images in the frame buffer for output to a display device. GPUs are used in embedded systems, mobile phones, personal computers, and workstations. Moreover, PyTorch has gained widespread adoption in the deep learning community and is supported by a large and active community of users. This community-driven approach has led to the development of numerous resources, tutorials, and pre-trained models that can be leveraged to accelerate the development process.

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CNN

Convolutional Neural Networks are complex neural network bind which work to get the elements of a picture from a dataset that is prepared and classified them to get the expected result. It trains the neural networks by utilizing the dataset images and transforming them into mathematical qualities.

The fundamental benefit of CNN contrasted with its ancestors is that it naturally distinguishes the significant highlights with no human supervision. The CNN models are utilized for geological order in different organizations which expect information to be grouped in a fast and secure manner it nearly behaves like a channel eliminating residue and isolating the highlights of the Images.

Classification

Feature classification tool is used for crop disease detection. The unhealthy highlights are eliminated from the crop and grouped with the healthy leaf images. At the point when the leaf is healthy and there is no classification the outcomes are displayed as healthy and when there is a disease which when dark scaled shows dark spots, it groups them so they are displayed as which disease they are and the certainty of the characterization. Grouping happens between two mathematical exhibits. On the off chance that the mathematical exhibits match, it is a healthy or aninfected leaf, contingent on the dataset gave. Grouping is a basic however important system which gives a legitimate outcome and is utilized in crop disease identification.

Flow of System

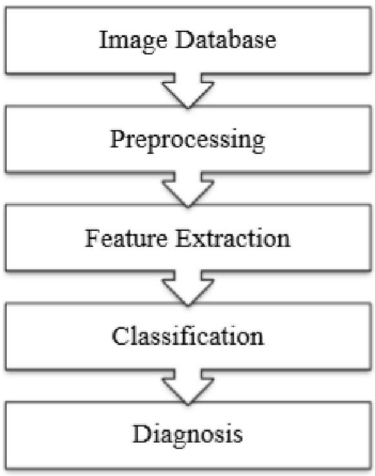

Fig -1: Flow of system

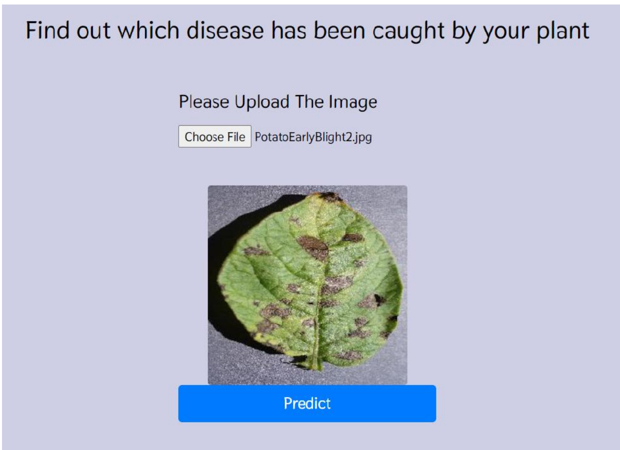

Fig -2: UI for Crop Disease Prediction

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III. IMPLEMENTATION METHODOLOGY

Our proposed framework is a Web application-based programming. TheImage is sent through a Convolutional NeuralNetwork which encodes this image into a mathematical exhibit and characterizes it with the other mathematical clusters in the model. The model is a Torchvision model which is made into a Torchvision light model due to the enormous size of the typical model. This model characterizes the transferred image's mathematical worth to the dataset values. At the point when a mathematical cluster matches it computes the certainty and presents the worth which has the most elevated certainty. Along these lines, we can guarantee that we generally have the most elevated certainty esteem appearing in the outcomes. The proposed methodology is as follows:

Dataset:

The Plant Town dataset contains 13,309,56 images of leaves of various plants classified into 38 classes. The dataset contains both strongly cropped and weakly cropped images. The pictures cover 21species types including:

Apples, blueberries, cherries, grapes, oranges, peaches, peppers, potatoes, raspberries, soybeans, pumpkins, strawberries, tomatoes. Each class contains his two fields, such as the name of the plant and the name of the disease. All photos are resized and split for pre-processing and further requests.

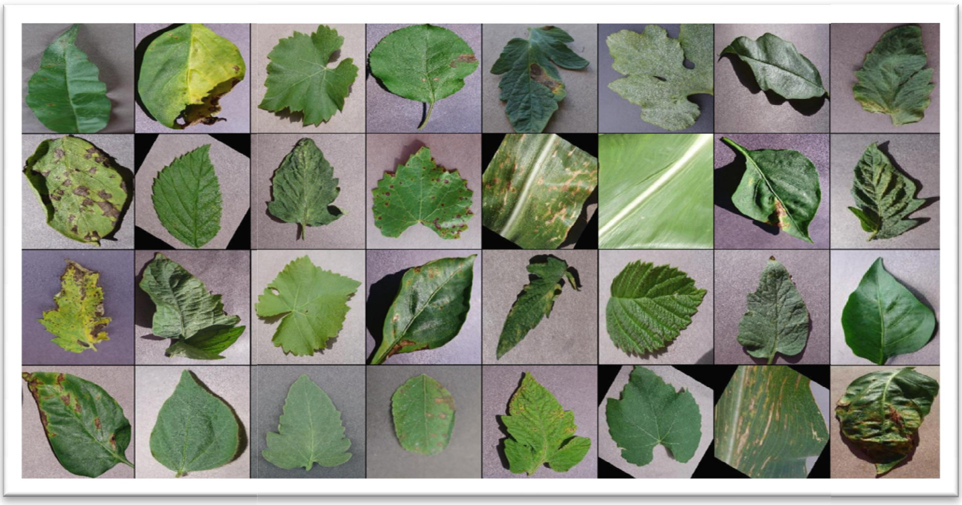

Fig -3: leaf images of some crops from dataset

Pre-processing of the Images:

Data pre-processing is an important task in computer vision-based systems. The figure shows the pre-processing steps for each image. For accurate results, the background noise should be removed prior to feature extraction. The RGB image is first converted to grayscale and then the image is smoothed using a Gaussian filter. Next, binarize the image by implementing Otsu's threshold algorithm. A morphological transformation is then applied to the binarized image to close small holes in the foreground. After foreground detection, a bitwise AND operation is performed on the binarized image and the original color image to obtain the RGB image of the segmented leaves. After image segmentation, shape, texture, and color features are extracted from the image. Leaf area and leaf perimeter are calculated using contour lines. An outline is a line that connects all points along the edge of an object of the same color or intensity. The mean and standard deviation of each channel of the RGB image are also estimated. To get the amount of green in the image, first convert the image to the HSV color space and calculate the ratio of the number of pixels with pixel intensity between 30 and 70 to the total number of pixels in the hue channel (H). Number of pixels in the channel. The non-green portion of the image is calculated by subtracting the green component from 1.

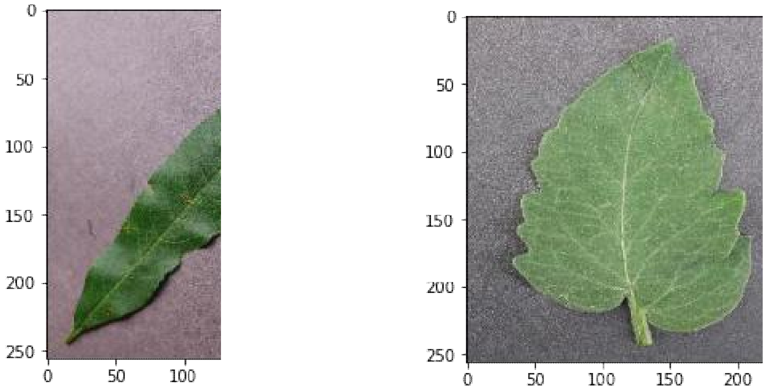

Fig-4: leaf images Analysis

Features Extraction:

As we get the greyscale pictures from the past step, we take the picture and convert it into decreased factors. Essentially every pixel of the pictures is taken and are changed over into framework for performing convolutions. The interaction stumbles into every one of the pixels where the convolution lattice is essentially duplicated with every pixel grid. Likewise, we notice the quantity of steps which alludes to the moving of pixel lattice.

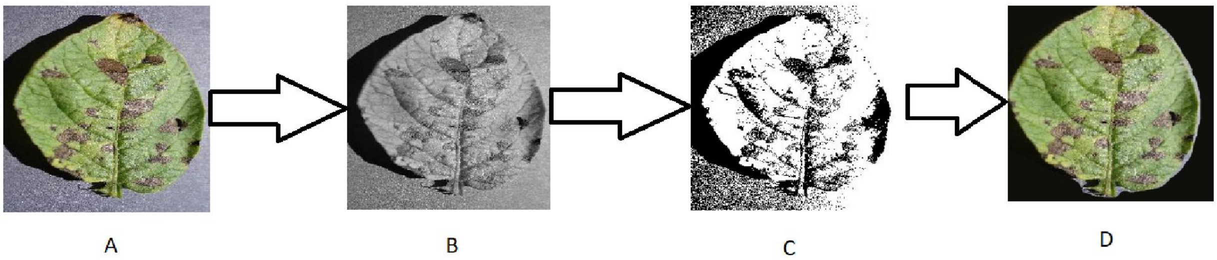

Fig-5: Images from the from different versions of used in various experimental configurations.
A. Leaf color, **B.**Leaf grayscale, **C.** Leaf Threshold, **D.** Leaf segmented

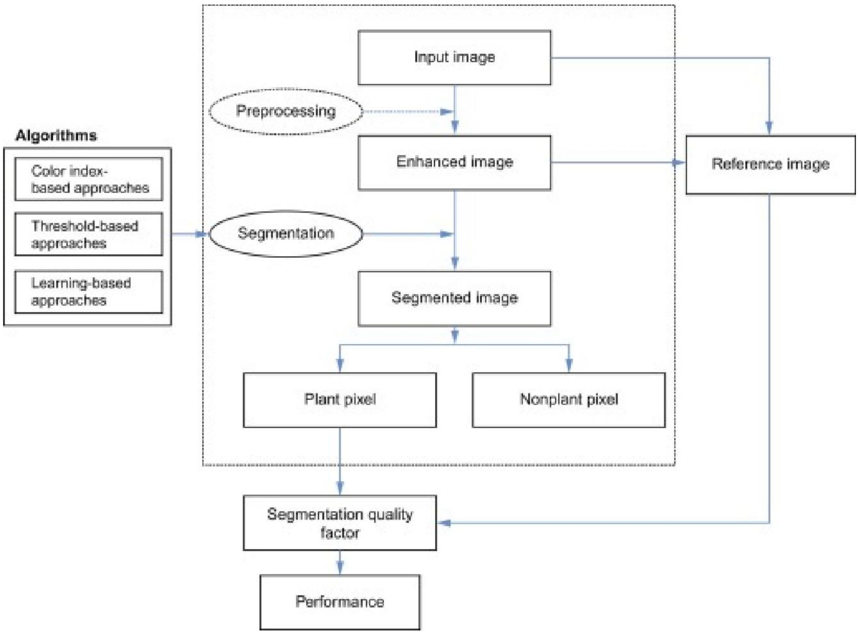

Fig-4: Flow

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When every one of the qualities are gotten by increase, we then perform Pooling on the network. Here we are utilizing Max pooling for our framework for better exactness and extraction of highlights. Both the interaction for example Convolution and Pooling structure an age. Presently to further develop the framework precision we play out various ages however this might cause to increment in the quantity of boundaries. Consequently, through following these means we get to remove extraordinary highlights from the pictures. These novel elements are then sent for additional cycles.

Disease detection and classification:

Location of disease is acted in two stages for example recognition of the kind of harvest and discovery of sort of illness. This happens with the assistance of CNN. We will utilize Move Learning for building the Model. It is a strategy where the related models are utilized to make ongoing models. Classification likewise goes about as completely associated classifiers which are shaped utilizing different learnings done by the model.

We do the accompanying by straightening of pictures which converts the pooled pictures to single aspect vectors. When the pictures are switched over completely to the vectors it gets very simple to arrange the pictures. Through the prepared model we get specific mathematical qualities concerning different classes. At the point when the leaf is healthy and there is no classification, the outcomes are displayed as healthy and when there is an infection which when dim scaled shows dark spots, it groups them so they are displayed as which sickness they are, and the certainty of the characterization. Grouping happens between two mathematical exhibits. On the off chance that the mathematical exhibits match, it is a healthy or an unhealthy leaf, contingent on the dataset given. Order is a basic yet important system that gives a legitimate outcome and is utilized in crop disease detection.

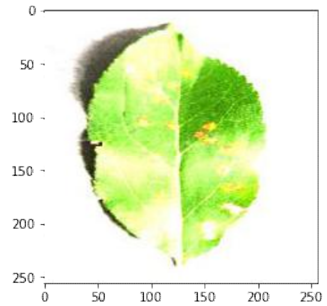

Fig-4: leaf images Analysis

Crop Recommendation

The Crop Recommendation System is designed to assist users in determining suitable crops based on the nutrient values of their soil, as well as the state and city they are located. To utilize this system, users are required to provide the corresponding nutrient values of their soil, specifically the ratio of N-P-K (Nitrogen-Phosphorous-Potassium). Additionally, users should refer to a specific website for more detailed information.

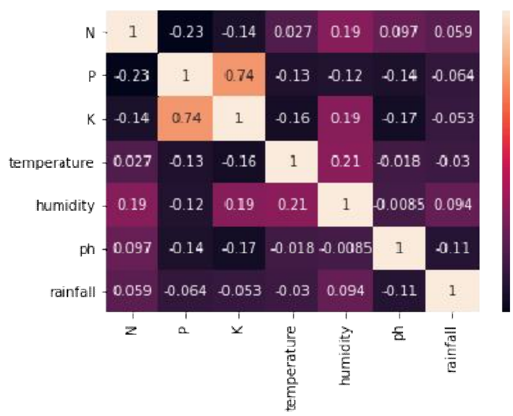

Fig 4: Correlation plot of conditions

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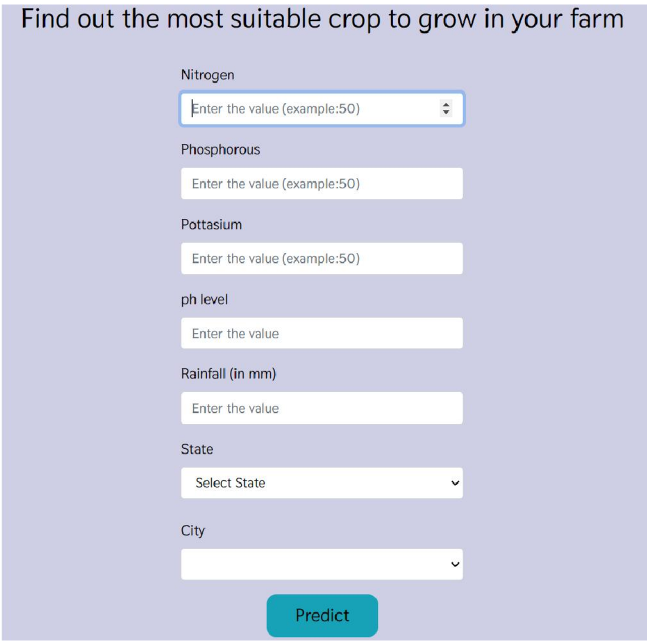

Fig 4:UI for Crop Recommendation

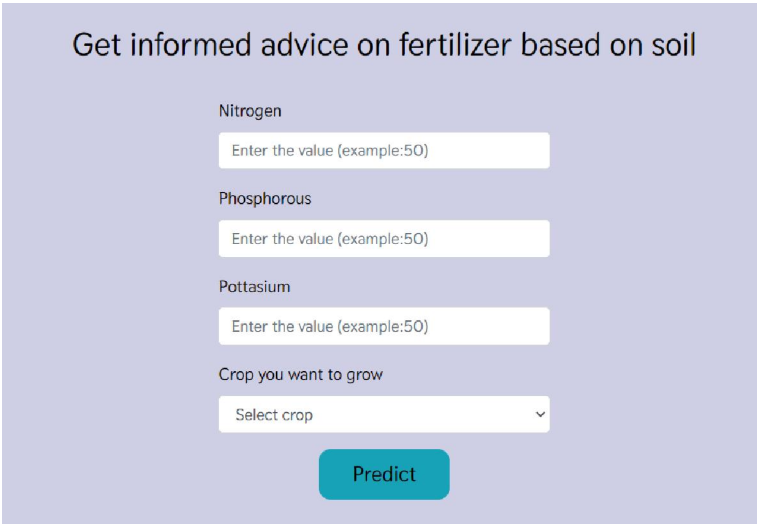

Fig 5:UI for Fertilizer suggestion

IV. ACQUIRED RESULTS

The results obtained are categorized into two distinct groups. These categories include the extracted features from the network outputs, and the layer outputs obtained during the classification of these features. These results are obtained at different stages within the system. Initially, the numerical array is acquired from the neural network, followed by the extraction of image features, and finally, the acquisition of layer outputs during the feature classification process.

Features:

The elements of the plants range from variety, shape and disease type. This can make 1,000,000 odd diseases which the model needs to describe and place in the framework. As the highlights are placed into different classes the pictures are decoded to obtain the following outcome, which is the layered result.

Layer Outputs:

The layer yields are various layers of the discovery of the illness. These can be the grayscale pictures and the RGB of the pictures. These assistance in isolating different hued elements of the leaves and ensure they are ordered into various classifications. It additionally ensures that the client can comprehend where the sickness is found and the mathematical worth can without much of a stretch make the white and dark pictures into 1 and 0.

Crop Recommendation System provides a valuable tool for farmers and agricultural practitioners to make informed decisions regarding suitable crop choices based on soil nutrient values, location, and specific crop requirements. It provides 95% of accuracy and by leveraging advanced algorithms and data analysis, this system assists in optimizing crop selection, maximizing yields, and promoting sustainable agriculture practices.

The Fertilizer Suggestion System is aimed at providing recommendations for buying fertilizers based on the nutrient contents of the user's soil and the specific crop they intend to grow. This system assists users in optimizing the nutrient balance of their soil for successful crop cultivation.

V. FUTURE SCOPE

Since at present the framework is prepared utilizing Plant Town dataset, the model is prepared to recognize just 26 sorts of plant sicknesses. We propose to prepare the framework with considerably more information of different plants and sicknesses to additional increment the extent of the framework. By adding pictures of numerous different plants, it will help in separating a lot more highlights of the plants which surely help in working on the exactness of the framework.

The clients utilizing the framework may likewise add to the framework by catching various kinds of plant pictures which can be added to the dataset. This dataset can be additionally used to fabricate better models Likewise the might be worked on regarding precision by execution of better calculations in the approaching future. We likewise propose to give specific solutions for the yield sicknesses to the client by examining the infections. This will surely assist the clients with staying away from such illnesses later on. Additionally, the cures will assist the client with disposing of the infections consequently, working on their yield.

VI. CONCLUSION

The research paper leverages the power of Convolutional Neural Networks (CNNs), a type of Deep Learning algorithm, for the accurate detection of crop diseases. The model is essentially tried on certain kinds of crop species for certain sorts of crop infections. The model was made utilizing TensorFlow and PyTorch structures and the framework is executed. The general framework results show that the model works better when contrasted with different models and gives better exactness in identifying the diseases. In addition, the number of classes of plants and their diseases will be expanded.

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