

Tomato Leaf Diseases Detection using Deep Learning

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Abstract— Tomatoes are among the most basic crops with a significant showcase esteem that get developed in gigantic sums. They are broadly developed and expended not as it were in India but moreover all around the world. The fundamental figure affecting this crop's generation quality and amount is infection. In past considers, as it were the takes off of the plant were considered to distinguish maladies but, in a few infections, it's as it were the natural product that gets influenced whereas the other parts of the plant fair see fine. Recognizing the illness with the bare eye some of the time leads to an wrong forecast, coming about in applying the off-base pesticide, which might ruin the plant. The inaccessibility of specialists in numerous of the areas makes it troublesome for the ranchers to recognize the illness. In spite of specialists being accessible in a few locales, it's a time and cost-consuming handle. Recognizing the illnesses prior would diminish their impact on plants and raise trim efficiency. Subsequently, it is significant to accurately analyze these infections and apply the right pesticide. An mechanized framework can be utilized to illuminate these issues. To address this issue, we have come up with a framework that employs a convolutional neural arrange (CNN) to recognize the infection and recommends a pesticide to offer assistance kill that illness. This framework executes a CNN since it gives the most noteworthy level of precision.

Keywords- CNN, Feature extraction, Pesticide suggestion, Disease detection.

I. INTRODUCTION

Agriculture is a main source of income for a majority of the population in countries like India. Every nation's economy depends on agriculture especially country like india. Over the years, technology has proved to be extremely useful in the agricultural sector and will continue to be so. The fundamental goal of agricultural advancement is to satisfy the expanding population's demand. To thrive in the current climate, agriculture needs to be upgraded. Both fungal and bacterial infections can harm crops. The productivity of farmers is severely

harmed by this. Crops should be in good health for the best yield. Disease detection through visual examination will always be challenging. To achieve this, the farm must be constantly watched. This technique is time-consuming. When the farm is large, this can be very expensive as well. Owing to this complexity, even agricultural professionals struggle to identify the diseases and come up with a fix. The farmers would benefit significantly from an automated system that could detect plant diseases. The farmers may use this system as a tool to alert them at the appropriate time and take the necessary precautions. Plant parts including leaves, fruits, seeds, etc. can be affected by a variety of diseases that impact the plant. Certain plant segments involved are more susceptible to these diseases. The most significant component of a plant is its leaves. If a plant's leaf gets infected, it will directly destroy the life cycle of that well grown plant. Bacterial illnesses, fungal diseases, and other conditions are frequently seen in leaves. Thus, it is important to find plant diseases early.

II. RELATED WORK

Hareem Kibriya, Rimsha Rafique, Wakeel Ahmad, S.M Adnan [1], the authors have implemented a method for detecting the disease using a deep-learning method. Google Net and VGG16 CNN-based models were employed to classify tomato leaf disease. VGG-16 achieved an accuracy rate of 98.00%, while Google Net achieved a higher accuracy rate of 99.23%. The plant town dataset is utilized to recognize the maladies containing 10735 pictures. They have identified the disease on the leaf images for Tomato. Evaluated the performance of the two models by calculating different performance evaluation metrics like TP, TN, FN, and ACC.

Lili Li, Shujuan Zhang, Bin Wang [2], The authors explained how deep learning is being used to recognize plant diseases, which has greatly improved the recognition accuracy of image classification and object detection systems. They provided a detailed analysis of recent research on the use of deep learning to identify plant leaf diseases. To improve the precision of classification, huge datasets with high variability are collected, transfer learning is performed, data is augmented, and CNN activation maps are visualized, as well as the importance

of hyperspectral technologies for detecting the disease.

Deepa, Rashmi N, Chinmai Shetty [3], the authors discussed machine-learning techniques for detecting leaf disease. The identification of diseases involves the use of a supervised machine learning algorithm i.e., the Support Vector Machine (SVM) algorithm. the methodology used in detecting the diseases which involves the basic steps like taking input image, then image pre-processing after pre-processing extracting the useful features which are crucial in the classification of the image, training the model using the infected image and healthy images followed by clustering and classification.

A.Rahman et al. [4] This paper reviews IoT technologies for advanced monitoring and control in agriculture, aiming to comprehensively evaluate smart agricultural practices. It explores IoT applications, benefits, challenges, and potential solutions within the agricultural domain. The focus is on optimizing crop yield and efficiency by leveraging existing techniques such as water and pesticide management, irrigation practices, crop monitoring, and fertilizer application.

Melike Sardogan, Adem Tuncer, Yunus Ozen, [5], presents a system for disease classification using a combination of Convolutional Neural Network (CNN) and Learning Vector Quantization (LVQ) algorithm. The system was tested on a dataset consisting of 400 training images and 100 test tomato leaf images, and it was able to classify the data into a predetermined number of classes. It is suitable for solving minor problems.

Sakshi Raina, Dr. Abhishek Gupta, [6] is research on various plant leaf disease detection techniques using leaf Images. Here, the authors have presented different plant disease detection techniques They have given a tabular analysis of several identification, segmentation, and classification algorithms based on diverse datasets, with their advantages, disadvantages, and accuracy. Perceiving essential features without the need for human interference deviating from its models is the benefit of a Multilayered Convolutional Neural Network.

III. PROPOSED SYSTEM

This system focuses on using a convolutional neural network to identify diseases. This model will be deployed as a web application. The dataset utilized in this study consists of a total of 1386 images, encompassing both tomato leaf and fruit images. A total of 13 categories are given in the model, 10 of which are based on tomato leaves, and 3 are based on the fruit. Images of tomato leaves are extracted from the Plant Village dataset and tomato fruits are collected from the internet. Images belonging to the healthy category are 148 including tomato leaves and fruit. The dataset used for training and testing the models consisted of 1240 images for training and

146 images for testing. The images were in JPG format and had a size of 224x224 pixels in terms of width and height.

The framework comprises multiple stages to improve the accuracy of disease identification, as illustrated in the image. Our system operates as follows:

Step 1: Picture preprocessing steps are performed on the dataset. The dataset will be preprocessed involving image rescaling, reshaping, and array format conversion. Resizing images to match the input size of a convolutional neural network (CNN) is a common preprocessing step in image classification tasks.

Step 2: The following step includes developing a CNN show, which is gone before by information preprocessing. CNN is fed the training dataset, and the weights are modified to accurately identify the disease and distinguish one from the other. CNN aims to extract an optimal set of features such as color, shape, and texture from the pixel information from an image collected using convolutions.

Step 3: After training the model, the fully connected layer performs the task of classification to predict the disease based on the features obtained by the preceding layers and their respective filters.

Step 4: Pesticides will be suggested, taken after by a list of the areas of the pesticide sellers.

CNN Consist of Four Component

1. Convolution

Convolution is a fundamental operation in image processing and computer vision that allows the extraction of local features from an image. In other words, the network learns specific patterns within the image and becomes capable of recognizing them universally. Convolution is an element-by-element multiplication. The process involves scanning a section of the image, typically with a size of 3x3, and performing a convolution operation by multiplying it with a filter.

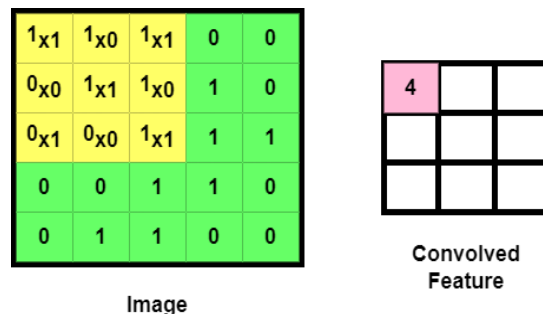


Fig. Convolution on 5x5 image and 3x3 filter

2. Non-Linearity (ReLU)

An activation function is applied to the output after the convolution procedure to accommodate for non-linearity. The Relu is the typical convent activation function. Any

pixels with negative values are substituted with zero.
Model

3. Pooling Operation

The purpose of pooling in convolutional neural networks is to decrease the spatial dimensionality of the input image. The steps are taken to decrease the computational complexity of the operation. By decreasing the dimensionality, the neural network has fewer weights to calculate, thereby reducing the likelihood of overfitting. In the current stage, it is necessary to define both the size and the stride. Utilizing the include map's most extreme esteem is a ordinary strategy of pooling the input image

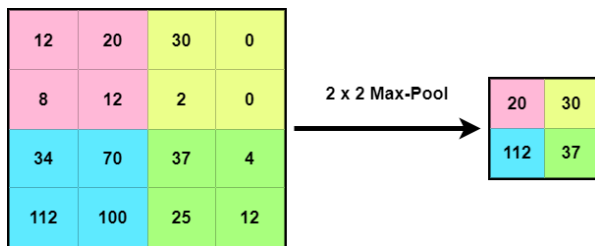


Fig. 2x2 Max pooling

4. Fully Connected Layers

The final stage involves constructing a conventional artificial neural network. Connecting all the neurons of the previous layer to the next layer is a common method used in neural networks for image classification tasks. The softmax activation function is applied to enable the network to classify input images.

CNN (Convolution Neural Network)

Convolutional neural networks, or CNNs, are network architectures for deep learning. They can consist of multiple layers, sometimes reaching tens or even hundreds of layers. Each layer within a CNN is designed to learn and detect distinct features or patterns in an image. In the training process of convolutional neural networks (CNNs), various resolution filters are applied to each input image. The coming about convolved pictures are at that point passed as input to ensuing layers. These filters initially detect basic features such as brightness and edges and progressively learn more complex features that help in uniquely defining the objects being classified. Errands like scene categorization, question acknowledgment, division, and picture preparing can be instructed to a CNN. The process involves scanning a section of the image, typically with a size of 3x3, and performing a convolution operation by multiplying it with a filter

The proposed methodology detects tomato plant diseases. The classification of whether a leaf or plant is infected with a disease is done by considering the images of a leaf, using image processing techniques, feature extraction, and lastly model development. Once the model is trained, it is evaluated on a separate set of images to ensure its accuracy and reliability

Dataset Collection

The data set utilized for training was gathered from the software and comprised pictures of both healthy leaves and plants with various illnesses. The dataset used in the experiment consists of 1386 images, comprising both tomato leaves and tomato fruit.

Dataset Pre-processing

The pre-processing method is used to minimize noise and improve image characteristics. Contrast enhancement is applied before processing the images. By translating input intensity to a new value, it enhances visual characteristics.

Model Building

During the training process, pre-processed images are fed into the CNN model to classify various plant diseases.

Feature extraction

The classification of images depends on this phase. We only extract features from the affected area rather than choosing the entire image. In the image processing technique, feature extraction is a crucial phase that offers an appropriate platform and the most beneficial constraints. Examining the attributes of a leaf image, such as shape, color, pattern, and size, efficiently is crucial in feature extraction.

Fertilizer Recommendation

Develop a fertilizer recommendation system that considers factors such as crop type, soil conditions, growth stages, and predictions. This system should generate data-driven fertilizer recommendations for farmers.

User Interface for Farmers

Create a user-friendly interface for farmers, which provide access to real-time data, diseases predictions, and fertilizer recommendations. This interface can be accessed through a web application or a mobile app.

Testing and Validation

Thoroughly test the entire system by collecting data over an extended period, making real-world predictions, and comparing them to actual outcomes. Validate the accuracy and effectiveness of the algorithm and fertilizer recommendations.

IV. METHODOLOGY

V. SYSTEM ARCHITECTURE

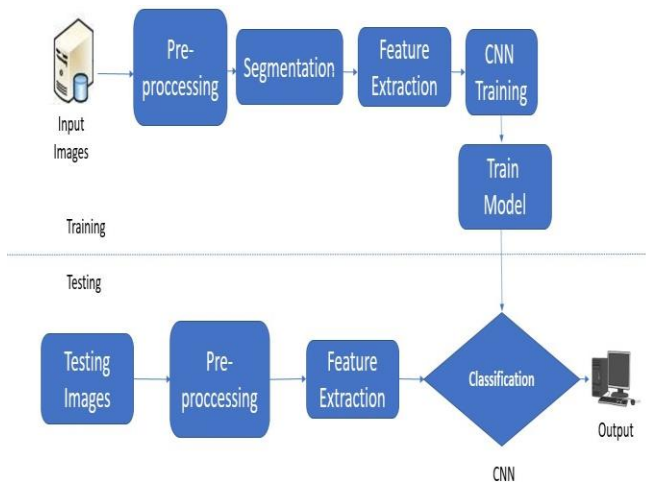


Fig. Architecture Diagram of Tomato Leaf Diseases Detection using Deep Learning

This Tomato Leaf Diseases Detection using Deep learning to empower farmers. The system just required the image of leaf which having diseases. By analyzing this data using a machine learning model, the system can predict crop diseases and recommend the most suitable fertilizer for specific conditions. This information is then presented to the user through a user interface, enabling farmers to make informed decisions for better agricultural outcomes

VI. RESULTS

A Tomato Leaf Diseases Detection using Deep learning provides real-time, data-driven guidance for applying the right amount of fertilizer to crops. It optimizes fertilization by considering soil conditions, crop type, and environmental factors. The result increased crop yields, reduced fertilizer waste, and improved resource efficiency.

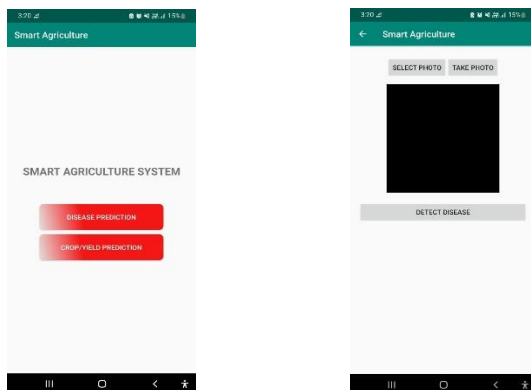


Fig Capturing .Image of Tomato leaf

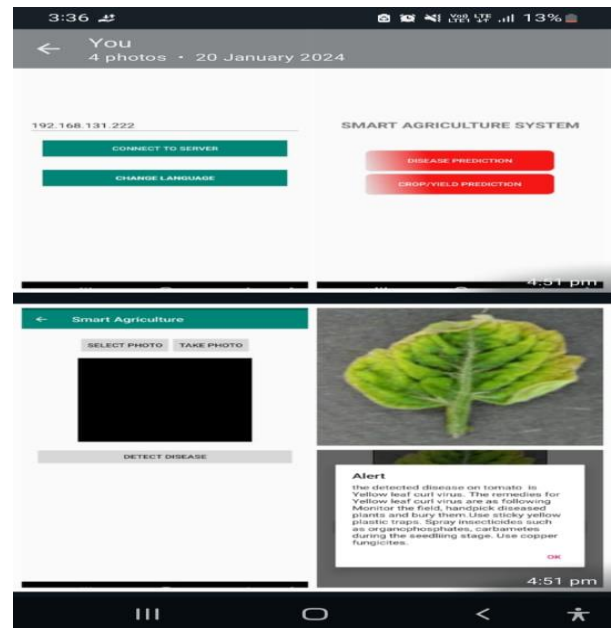


Fig. Diseases Deyection based on different environmental factors

VII. CONCLUSION

The agrarian division is a exceptionally critical segment that incredibly impacts the society. It is not only a necessity but also important for the economy of the country. Tomato being an important crop must be grown with utmost care. Sometimes the fruits of the plant are affected with no visible damage to the leaves. Exposed eye perceptions can be wrong and can lead to utilizing the off-base cures. Seeking help from an expert can be costly as well as time-consuming. Convolution Neural Systems are best suited for picture acknowledgment due to their exactness. Subsequently. Hence, we have used it to make this tool that will help lessen the time and cost consumed during manual prediction. It gives momentous precision in recognizing 13 illnesses. It classifies diseases based on the fruit as well as leaves as sometimes only the fruit is damaged. It along with predicting the disease, suggests the name of the pesticide.

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