Tomato Leaf Disease Detection Using Convolutional Neural Network

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Abstract- *Tomato leaf disease is a serious issue that can cause significant yield loss and affect the quality of the crop. In recent years, deep learning techniques have been applied to detect plant diseases using images of affected leaves. This study proposes a method for tomato leaf disease detection using a convolutional neural network (CNN). The proposed method involves pre- processing the leaf images, followed by training the CNN model using a large dataset of tomato leaf images. The trained model is then used to classify the leaf images as healthy or diseased. This approach can be used as a reliable and efficient tool for early detection and management of tomato leaf diseases, ultimately leading to improved crop yields and quality.*

Keywords- Convolutional Neural Network (CNN) , Leaf Disease Detection , Neural Network.

I. INTRODUCTION

The Tomato Leaf Disease Detection using CNN is a project that involves the use of convolutional neural networks (CNNs) to detect diseases in tomato leaves. The project utilizes a dataset of images of tomato leaves, which are labelled with their corresponding diseases. The CNN is trained on the dataset using the TensorFlow library in Python. The trained model is then integrated into a web application that allows users to upload images of tomato leaves and receive a diagnosis of the disease present in the image The web application is developed using HTML, CSS, and JavaScript, with the Flask web framework used for the backend. The application provides a user-friendly interface that allows users to easily upload and diagnose images of tomato leaves. The project aims to provide a fast and accurate way of detecting diseases in tomato leaves, which can help farmers to identify and treat diseased leaves early, thus improving crop yield and reducing losses.

II. PROBLEM STATEMENT

To create a user-friendly web application that can accurately detect and classify different diseases present in tomato leaves using a CNN model. The web application should be able to process user-uploaded images of tomato leaves and provide a quick and accurate name of the disease present. The key challenges in this problem statement include developing a robust and accurate CNN model for disease detection, integrating the model with a user-friendly web interface, and ensuring that the web application can handle large volumes of user requests without compromising on performance. The goal of this project is to create a tool that can help farmers and researchers quickly identify diseases in tomato leaves, allowing them to take appropriate measures to prevent the spread of the disease and minimize crop losses. The project can also contribute to the development of more advanced and accurate methods for leaf disease detection and management.

III. EXISTING SYSTEM

Machine Learning Algorithms are applied in Various Fields. Deep Neural Networks significantly increases the Image Classification accuracy. Various Deep Learning techniques are being used by the Researches for Plant Disease Identification. Performance of Various CNN for Plant Disease Identification depends on Various Factors namely,

1) Availability of Limited Number of Annotated
2) Poor Representation of Disease Symptoms
3) Image Background and Capturing Conditions
4) Limited Variations in Disease Symptoms

IV. PROPOSED SYSTEM

The Proposed System for Tomato Leaf Disease Detection using Convolutional Neural Network (CNN) includes some important stages namely:

1) Image Acquisition
2) Image Pre-processing
3) Image Segmentation
4) Feature Extractions in Image
5) Detection and Classification of Leaf Disease

1) Image Acquisition

The First Stage of any Vision System is the Image Acquisition. Image Acquisition involves the steps to obtain the plant leaf and captured the high- quality images through the Camera. Images are acquired from the Internet (or) Agriculture Field. The Datasets are trained for the 10 different Classification of Tomato leaves.

2) Image Pre-processing

Image Pre-processing involves the steps of image enhancements. Image Enhancement is carried out for the purpose of increasing the Contrast. The Images which are present in the datasets are resized to the appropriate resolution in order to speed up the Training process and make the model training computationally feasible.

3) Image Segmentation

Image Segmentation is the process of partitioning of Image into various parts of same features or having some similarities. The Images are arranged and classified under the appropriate class Names.

4) Feature Extractions in Image

The convolutional layers of the network act each as a feature extractor. CNN is a Neural Network that extracts the Input image features and another neural network classifies the Image Features. The Input image is used by the feature extraction network. The Extracted Feature Signals are Utilized by the Neural network for Classification.

5) Detection and Classification of Leaf Disease

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V. METHODOLOGY

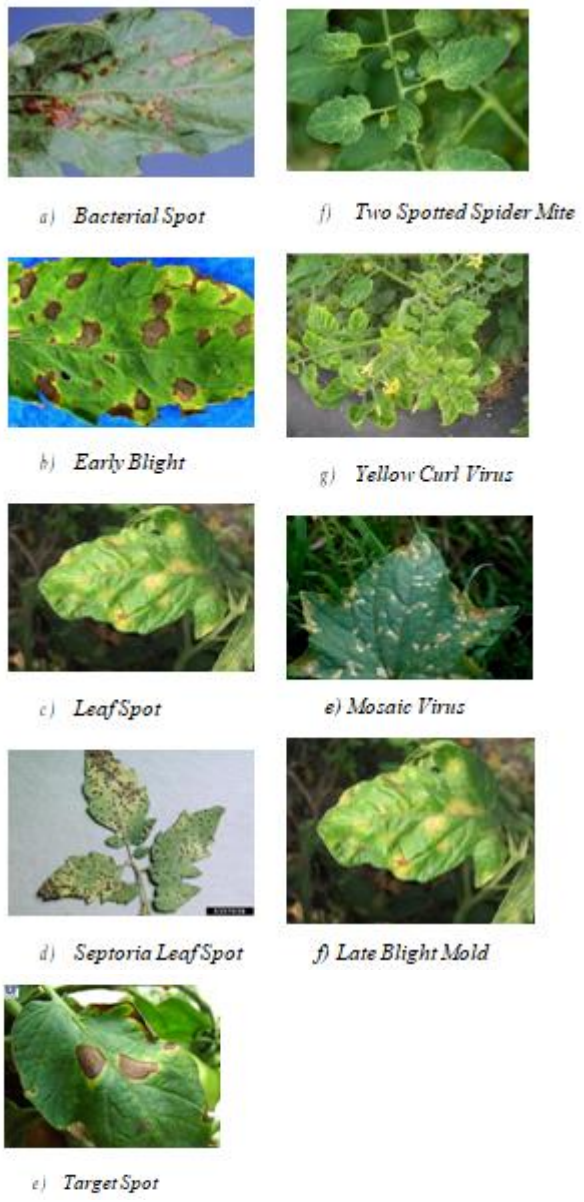
The methodology for the Tomato Leaf Disease Detection using CNN is summarized as follows:

1) Data Collection: A dataset of tomato leaf images is collected, consisting of images of healthy leaves and leaves with different types of diseases.
2) Data Pre-processing: The collected dataset is pre-processed by resizing the images to a standard size,normalizing the pixel values, and splitting the dataset into training and validation sets.
3) Convolutional Neural Network (CNN) Architecture: A CNN architecture is designed for the detection of tomato leaf diseases. The architecture consists of convolutional layers, pooling layers, and fully connected layers.
4) Model Training: The designed CNN architecture is trained on the pre- processed dataset using the TensorFlow library in Python. The model is trained using a stochastic gradient descent optimizer and categorical cross-entropy loss function.
5) Model Evaluation: The trained model is evaluated using the validation set and metrics such as accuracy, precision, recall, and F1- score.
6) Web Application Development: A web application is developed using HTML, CSS, and JavaScript, with Flask web framework used for the backend. The web application allows users to upload images of tomato leaves and receive a diagnosis of the disease present in the image.
7) Integration of CNN Model: The trained CNN model is integratedinto the web application to enable automatic detection of tomato leaf diseases.
8) Testing: The web application is tested using sample tomato leaf images to ensure that it provides accurate diagnoses of tomato leaf diseases.

Overall, the methodology involves collecting and pre-processing data, designing, and training a CNN model, developing a web application, and integrating the CNN model into the web application to provide accurate and efficient detection of tomato leaf diseases.

VI. DATASET

In this Tomato Leaf Disease Detection using Convolutional Neural Network, 10 Different types of leaves is been trained , where 9 Leaves are considered to be as Unhealthy Leaves and the remaining one leaf is Healthy. The Name of the 10 Different Tomato Leaves is as Follows,



VII. APPLICATIONS

1) Deep Learning Techniques are effective methods for the classification of plant diseases.
2) CNN, which comprises of different layers are used for predicting the type of disease.
3) The Primary Focus of this Project is to find the type of Diseases which will reduce the Crops loss and to Increase the Efficiency of Production.
4) The Disease is recognized at the right time which results in the Huge Profit in the Agriculture Production.
5) The Detection of Plant Diseases at an Early Stages for Global Health and Wellbeing.
6) It Provides Benefits in Monitoring the Large Crop Fields and helps in detecting the type of the disease when they are found on the leaves.
7) The Proposed System helps in Identification of plant disease and provides remedies that can be used as defence mechanism against the disease.

VIII. OUTPUT

a) *This Image Represents the Basic look of the Web page.*

b) *The Image of the Leaf is Uploaded by clicking Select an Image Button*

c) *The Name of the Disease is displayed when a user clicks predict Button.*

IX. CONCLUSION AND FUTURE WORKS

In conclusion, tomato leaf disease detection using CNN has shown great promise in accurately detecting and classifying various diseases that affect tomato leaves. With the increasing demand for efficient and effective agricultural practices, automated disease detection using deep learning techniques like CNNs can provide farmers with an early warning system to prevent crop loss and increase yield. The development of a web-based application further enhances the accessibility and usability of the system, making it easy for farmers to access and utilize the technology. In terms of future works, there is still room for improvement in the accuracy of disease detection and classification. One possible avenue is to incorporate more advanced CNN architectures and transfer learning techniques to improve model performance. Another area of interest is the development of a mobile application that can be used in the field, providing real-time disease detection and diagnosis. Finally, the integration of other sensing technologies such as hyperspectral imaging and drone- based imaging can provide more comprehensive and accurate data for disease detection and classification

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