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Early Detection and Classification of Tomato Leaf Diseases Using Powerful Deep Neural Networks

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Abstract: Tomatoes are one of the most important and consumable crops in the world. Tomatoes have a different amount of pieces depending on the fertilization method. Leaf diseases are a major factor affecting the quantity and quality of crop yields. Therefore, it is important to properly diagnose and classify these disorders. Various types of diseases affect tomato production. Early identification of these diseases reduces their impact on tomato plants and improves good yields. Various innovative methods for identifying and classifying specific diseases are widely used. The motivation for this work is to enable farmers to accurately identify diseases early and inform them about these diseases. A convolutional neural network (CNN) is used to effectively define and classify tomato diseases. Using Google Colab, we performed a full experiment on a dataset containing 3000 images of 9 different diseased tomato leaves and 1 healthy leaf. I will walk you through the whole process. First, the input image is preprocessed to segment the target regions of images from the original image. Second, the images are further processed using various hyper parameters of the CNN model. Finally, CNN extracts other features such as colors, textures and edges from his images. The results show that the predictions of his proposed model are 98.49% accurate.

Index Terms **- Artificial Intelligence, Image Processing, Convolution Neural Network, Deep Learning.**

I. INTRODUCTION

Plants are essential to our lives as they produce food and protect us from dangerous radiation. Life cannot be imagined without plants. They protect the ozone layer, which sustains all life on Earth and filters ultraviolet radiation. Tomatoes are nutritious plants and widely cultivated edible vegetables. About 160 million tons of tomatoes are consumed worldwide annually. Tomatoes, which contribute significantly to poverty reduction, are seen as a source of income for farmers. Tomatoes are one of the most nutritious crops on the planet, and their cultivation and production have a significant impact on the agricultural economy. Tomatoes are not only rich in nutrients, but also have pharmacological properties that protect against diseases such as hypertension, hepatitis, and bleeding gums. With the prevalence of tomatoes, the demand is also increasing. According to statistics, small farmers produce more than of him, which is 80% of agricultural output. About 50% of crops are lost to disease and pests. Diseases and parasites are important factors affecting tomato growth, and the diagnosis of diseases in field crops should be investigated. Manual identification of pests and pathogens is inefficient and costly. Therefore, there is a need to provide farmers with automated image-based AI solutions. Images are used and accepted as a reliable means of identifying disease in image-based computer vision applications due to the availability of suitable software packages and tools. Process images using image processing, an intelligent image identification technology that increases image recognition efficiency, reduces costs, and improves recognition accuracy.

II. RELATED RESEARCH

Various researchers have built automated disease detection systems using state-of-the-art techniques such as machine learning and neural network architectures such as Inception V3 net, VGG 16 net and SqueezeNet. These identify his plant diseases on tomato leaves using high-precision methods. In addition, the researcher has proposed a number of deep learning-based his solutions for disease detection and classification, as discussed in [1–30] below. Pre-trained network models have been proposed for detecting and classifying tomato diseases, with accuracies of 94–95% [1, 2]. A tree classification model and segmentation is used to detect and classify six types of tomato leaf diseases using a dataset of 300 images [3]. A method has been proposed to detect and classify plant leaf diseases with an accuracy of 93.75% [4]. Image processing techniques and classification algorithms detect and classify plant leaf diseases with better quality [5]. Here, an 8-megapixel smartphone camera is used to collect sample data and classify it into categories that are 50% healthy and 50% unhealthy. The image processing procedure includes three elements: contrast enhancement, segmentation, and feature extraction. The classification process is performed through an artificial neural network using multi-layer feed forward neural networks and two different network structures are compared. The results were superior to those of multilayer perceptron (MLP) and radial basis function (RBF) networks. This quest divides Plant Blade images into healthy and unhealthy. Unrecognizable form of disease. Authors used leaf disease to identify and achieve his 87.2% classification accuracy through color space analysis, color time, histogram and color coherence [6]. We used AlexNet and the VGG 19 model to

diagnose diseases affecting tomato plants using a frame size of 13,262. This model is used to achieve an accuracy of 97.49% [7]. Using transfer learning and a CNN model, accurately detects diseases that infect dairy crops, reaching 95% [26]. Using transfer learning as an AlexNet-based deep learning mechanism, a neural network for determining and classifying tomato leaf states achieved an accuracy of 95.75% [9, 10]. Resnet-50 is designed to identify 1000 tomato leaf diseases. A total of 3000 images named for spot blight, late blight and yellow leaf curl. Changed network activation function for comparison to Leaky-ReLU and updated kernel size of first convolutional layer to 11×11. Model predicts disease classes with 98.30% accuracy and shows 98.0% accuracy after replications [11]. A simplified 8-layer CNN model has been proposed to detect and classify tomato leaf diseases [12]. In this article, the author used his Plant Village dataset [13], which contains various plant datasets.

III. METHODS AND MATERIALS

This part uses state-of-the-art methods, models and datasets to generate results,

3.1 Dataset

The sample had 10 unique disease classes. Nine type tomato leaves were infected and one class was resistant. We identified dataset class using reference pictures and disease names.

3.2 Image Pre-processing and Labelling

Before training the model, we used image preprocessing to modify or enhance raw images that needed to be processed by the CNN classifier. Building a successful model requires analysis of both the network design and the format of the input data. We preprocessed the dataset so that the proposed model could extract the appropriate features from the images. The first step was to normalize the size of the image and change it to 256x256 pixels. The image was then converted to gray. This level of preprocessing means that a significant amount of training data is required to explicitly learn the features of the training data. The next step was to group the tomato leaf images by type and tag all images with the correct acronym for the disease.

3.3 Training dataset

Preparing the record was the first step in working with existing records. The Convolutional Neural Network process was used as the image data input in this step, and the finally formed the model to evaluate its performance.

3.4 Convolutional Neural Network

CNN is a neural network technology widely used today for processing or training data in images. The matrix form of convolution is used for image filtering. Data training uses all layers of a convolutional neural network. It contains layers including an input layer, a combo layer, a fully connected layer pooling layer, a dropout layer to build the CNN and finally link the record classification layer. A set of computations can be mapped to each layer's input test set.

IV. CONCLUSION

This article described a deep neural network model that detects and classifies diseases of tomato leaves into predefined categories. We also took into account morphological features such as plant color, texture, and leaf margins. This article introduced his standard for deep learning models, including variants. This article covers biological diseases caused by fungal and bacterial pathogens, specifically tomato leaf blight, blast and browning. The proposed detection rate for the model was 98.49% accurate. Using the same dataset, the proposed model was compared with the VGG and ResNet versions. After analyzing the results, the proposed model outperformed the other models. The approach proposed to identify tomato diseases is a breakthrough idea. In the future, we plan to extend the model to include specific abiotic diseases due to lack of nutritional value in cultured leaves. Our long-term goal is to expand our collection of unique data and collect a huge data sets on various plant diseases. Going forward, we will apply the following technologies to improve accuracy.

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