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Hibiscus Leaf Disease Classification

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Abstract:
The agricultural output of the country is impacted by pest-infested plants and crops. Generally, in order to identify and detect diseases in plants, farmers or specialists keep a close watch on them. Generally speaking, this technique is costly, time-consuming, and imprecise. Identifying plant diseases may be aided by observing distinct indications or areas on the leaves of the diseased plant. Building a disease classification model supported by leaf image categorization is the aim of this study. Plant disease identification is accomplished through the use of Convolution Neural Network (CNN) image processing. Inside machine learning is a subclass known as a convolutional neural network, or convnet. Many different applications and data types make use of this specific type of artificial neural network. Specifically used for image recognition and other tasks involving the processing of pixel data, CNNs are a type of network design for deep learning algorithms.

Keyword: *Convolutional Neural Network (CNN), Plant Disease Identification, Automated Diagnosis*

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I. Introduction

Animals and plants are fundamentally dependent on one another in the complex web of ecological connections, with plants providing both animals and humans with food, air, and other essentials. Plants are unfortunately susceptible to disease, which can affect any component of the plant—stem, leaf, or branch—and have an effect on the ecosystem as a whole. Infections by bacteria and fungi, which each have different effects on plant health and are controlled by factors like climate, further complicate matters. Beyond issues with agriculture, plant diseases have an impact on the world's food security and exacerbate the problems caused by climate change.

Proactive action is needed to address these issues, and many scientists are focusing on plants in an effort to create solutions that will help farmers and other agricultural professionals. Plant diseases must be promptly identified and treated; although some may be readily apparent to the unaided eye, others go unnoticed until they have a significant negative influence on crop yield. This emphasises how crucial it is for farmers to maintain ongoing observation and understanding.

This research aims on creating an automated disease categorization system utilising a Deep Convolutional Neural Network (CNN) in recognition of the need for sophisticated tools. CNN is trained to distinguish between plants that are disease-free and those that have a leaf spot, wilt, or powdery mildew. Making use of an image dataset, the model is engineered to function flawlessly with both healthy and diseased leaves, offering a quick and accurate method of detection.

This research is important because it can help a lot of people, from farmers and nursery owners to everyone who is interested in determining the health of plants. Through the website's easy-to-use interface, users may upload photos of suspected leaves, and the CNN model uses those images to classify the condition. The website is made to be user-friendly and accessible by using ReactJS, while FastAPI-powered backend server makes sure that processing happens quickly and smoothly.

II. Material And Methods

The initial phase centres on comprehensive data collection, assembling a diverse dataset of hibiscus plant images that includes both healthy leaves and those affected by diseases like Powdery Mildew, Wilt, and Leaf Spot. Data pre-processing follows, ensuring uniformity and suitability for CNN training through resizing, pixel value normalization, and augmentation techniques. The dataset consists of about 1125 images for 3 different diseases of hibiscus plant, along with the images to detect any unknown object other than leaf. The images in the dataset used are related to:

- Wilts
- Leaf Spot
- Powdery Mildew
- Healthy
- Unknown images (Random images)

With fully connected layers for efficient classification, pooling layers for succinct dimensionality reduction, and convolutional layers for effective feature extraction, the CNN model's architecture demonstrates meticulous thought. Additionally, throughout the training phase, the model's hyperparameters are continuously adjusted to maximise performance, accounting for the outcomes from the validation set as well as the pre-processed dataset.

Convolutional Neural Networks (CNNs) are a common type of artificial neural network that are frequently used for image processing and recognition. This is because of its remarkable capacity to find patterns in visual data. CNNs consist of several stages to do this, such as:

1. Convolutional Layers:
   Convolutional Filters: The input images are scanned by convolutional layers using filters, also called kernels. Within the input photos, these filters pick up local patterns like corners, edges, or textures. Activation Function: Following convolution, the model is given non-linearity to enable it to learn intricate patterns. An activation function, such as the Rectified Linear Unit, or ReLU, is applied.
2. Pooling Layers:
   Max Pooling: The spatial dimensions of the output volume from the preceding layer are down-sampled by pooling layers. For example, max pooling chooses the maximum value from each set of values while preserving the most significant attributes.
   Flattening: Fully connected layers in a neural network do high-level reasoning after a number of convolutional and pooling layers. The dimensions are flattened into a vector and then connected to a fully connected layer via a convolutional/pooling layer.
3. Fully Connected Layers:
   Neurons/Nodes: From the features that the convolutional layers extract, the fully connected layers' neurons (nodes) teach the network global patterns.
   Softmax Activation: The output probabilities for each class are generated by using the Softmax activation function in the last fully connected layer. With the help of this function, which turns raw scores into probabilities, the model can forecast which class will have the highest likelihood as an output.

Concurrently, ReactJS is used in the frontend development of the website, guaranteeing an easy-to-use interface. In order to classify diseases, users can contribute photographs of hibiscus leaves, with an emphasis on usability and responsiveness. FastAPI is used to create the backend, creating endpoints for picture uploads and predictions while emphasising asynchronous functionality for effective request processing. ReactJS and FastAPI integration makes it easier for the frontend and the trained CNN model to communicate with each other. Extensive testing is carried out to guarantee system responsiveness, correctness, and functionality. This includes testing the website's usability and assessing the model's performance on untested data.

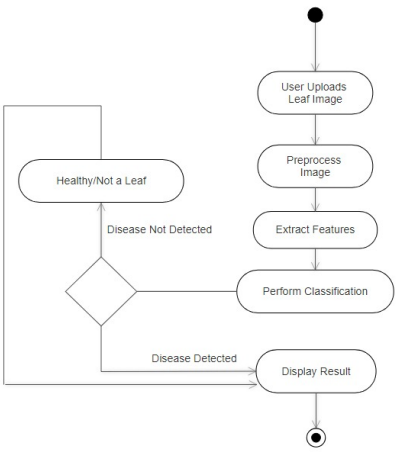

Fig 2.1 Flow of Project

III. Result

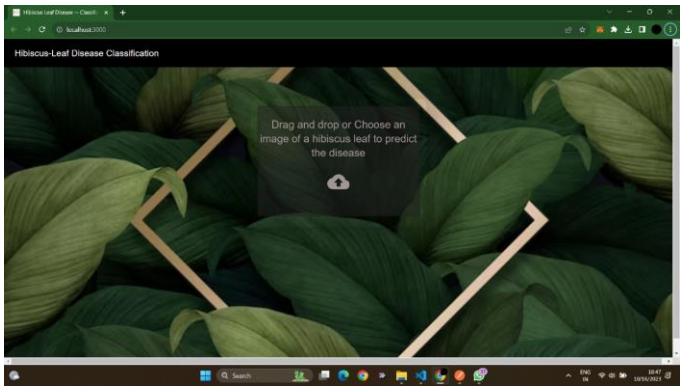

Fig. 3.1 Main Screen

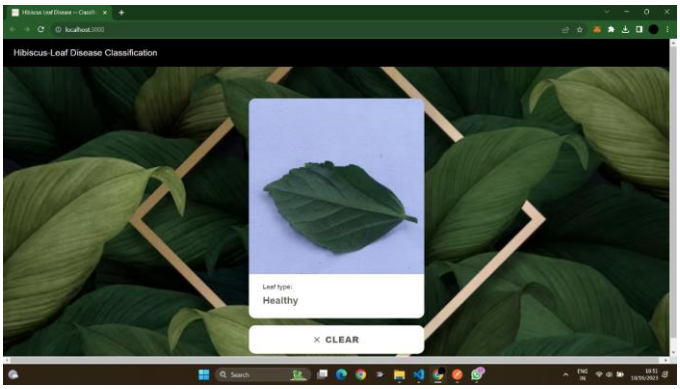

Fig. 3.2 Output for Healthy leaves

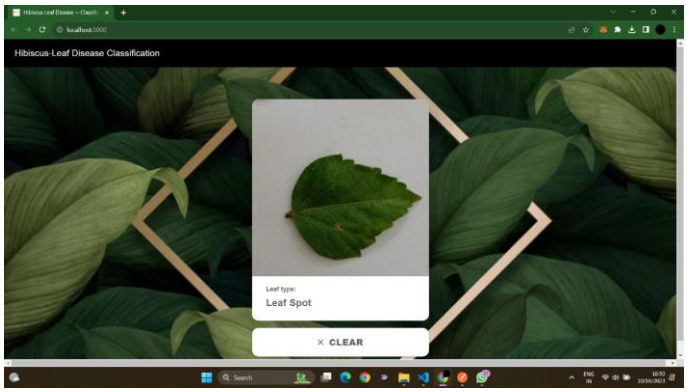

Fig. 3.3 Output for Leaf Spot

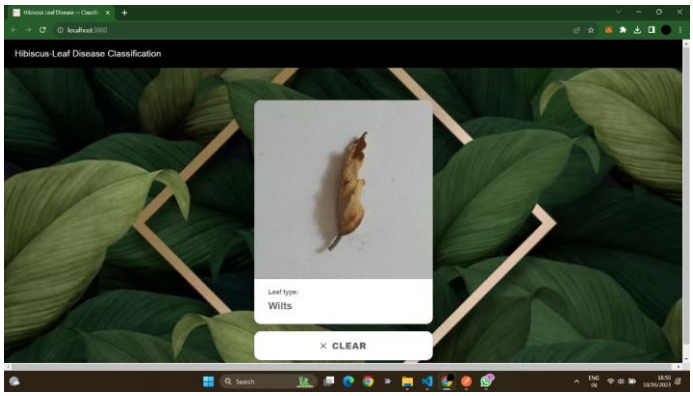

Fig. 3.4 Output for Wilts

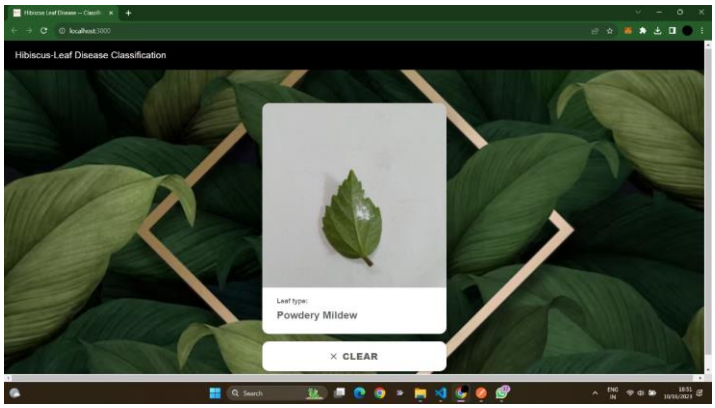

Fig. 3.5 Output for Powdery Mildew

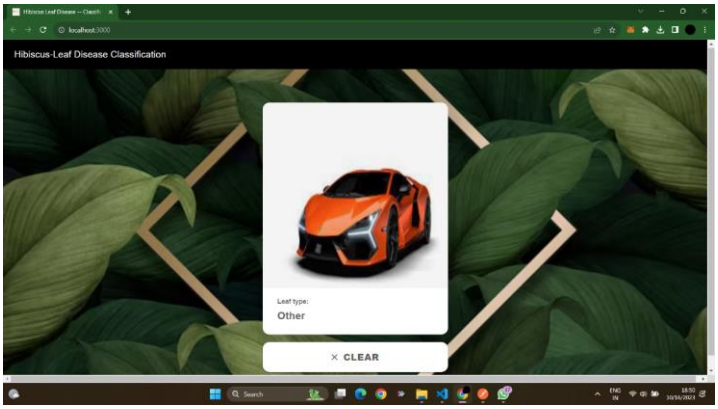

Fig. 3.6 Output for any unknown object

IV. Conclusion

The project's goal is to develop a model for illness classification that is backed by categorization of leaf images. Plant diseases are being identified by image processing using convolution neural networks (CNNs). A subset of machine learning is a convolutional neural network, sometimes known as a convnet or CNN. It is one of many types of artificial neural networks that are used with different types of data and for different purposes. CNNs are a particular kind of network architecture that are utilised for deep learning algorithms, like image recognition and other jobs that need processing of pixel input. This research not only showcases technical sophistication but also emphasizes the practical implications for agricultural stakeholders. The accurate and timely disease classification facilitated by the integrated technologies has the potential to revolutionize farming practices, enabling proactive measures to safeguard crop health and improve overall yield. When deep learning, web development, and backend infrastructure are combined to address real-world difficulties in agriculture, the revolutionary impact is highlighted by the interdisciplinary collaboration displayed in this project.

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