PLANT LEAVES DISEASE DETECTION

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***Abstract* — Plant leaf detection is a fundamental task in the field of agriculture and plant science. Accurate identification and classification of plant leaves can facilitate various applications such as disease detection, pest control, and crop yield prediction. This paper proposes a novel approach for plant leaf detection using deep learning techniques. The proposed method utilizes a convolutional neural network (CNN) to learn features from input images and classify them into different classes of plant leaves. We use transfer learning to fine-tune the pre-trained CNN on our dataset. The proposed approach is evaluated on a publicly available plant leaf dataset and achieves an accuracy of 95%. The results demonstrate that the proposed method is highly effective for plant leaf detection and classification. The approach can be applied to various real-world applications, including precision agriculture, plant breeding, and environmental monitoring.**

Keywords — Plant leaves disease, Deep learning, CNN, Classification.

I. Introduction

Plant diseases pose a significant threat to global food security, leading to major economic losses and reduced crop yields. Early detection and accurate diagnosis of plant diseases are essential for timely management and prevention of further spread. Plant leaves are commonly used as indicators of disease, with changes in their morphology and color serving as primary symptoms. In recent years, deep learning techniques, particularly convolutional neural networks (CNNs), have shown promise for automated plant disease detection and classification. These methods enable the automatic extraction of features from input images, reducing the need for human experts in disease diagnosis. This paper proposes a novel approach for plant leaf disease detection using deep learning techniques and evaluates its performance on a publicly available plant leaf disease dataset. The proposed method achieves high accuracy, demonstrating its potential for improving disease management and reducing crop losses. This approach has numerous real-world applications, including precision agriculture, plant breeding, and environmental monitoring, and has the potential to revolutionize agriculture by improving disease management and ensuring global food security.

II. Literature Review

Identification of the plant diseases is the key to preventing the losses in the yield and quantity of the agricultural product. It requires tremendous amount of work, expertize in the plant diseases, and also require the excessive processing time. Hence, image processing is used for the detection of plant diseases. Disease detection involves the steps like image acquisition, image pre-processing, image segmentation, feature extraction and classification. This paper discussed the methods used for the detection of plant diseases using their leaves images. This paper discussed various techniques to segment the disease part of the plant. This paper also discussed some Feature extraction and classification techniques to extract the features of infected leaf and the classification of plant diseases. The accurately detection and classification of the plant disease is very important for the successful cultivation of crop and this can be done using image processing. This paper discussed various techniques to segment the disease part of the plant. This paper also discussed some Feature extraction and classification techniques to extract the features of infected leaf and the classification of plant diseases. The use of ANN methods for classification of disease in plants such as self-organizing feature map, back propagation algorithm, SVMs etc. can be efficiently used. From these methods, we can accurately identify and classify various plant diseases using image processing technique. [1].

They provide survey on plant leaf disease detection using image processing techniques. Disease in crops causes significant reduction in quantity and quality of the agricultural product. Identification of symptoms of disease by naked eye is difficult for farmer. Crop protection especially in large farms is done by using computerized image processing technique that can detect diseased leaf using color information of leaves. Depending on the applications, many image processing technique has been introduced to solve the problems by pattern recognition and some automatic classification tools. In the next section this paper presents a survey of those proposed systems in meaningful way. There are many methods in automated or computer vision for disease detection and classification but still there is lack in this research topic. All the disease cannot be identified using single method. [2].

This proposed work is based on Image Edge detection Segmentation techniques in which, the captured images are processed for enrichment first. Then R, G, B color Feature image segmentation is carried out to get target regions (disease spots). Later, image features such as boundary, shape, color and texture are extracted for the disease spots to recognize diseases and control the pest recommendation. In this Research work consist three parts of the cotton leaf spot, cotton leaf color segmentation, Edge detection based Image segmentation, analysis and classification of disease. [3].

In this paper an image-processing-based approach is proposed and used for leaf and stem disease detection. We test our program on five diseases which effect on the plants; they are: Early scorch, Cottony mold, ashen mold, late scorch, tiny whiteness. The proposed approach is image-processing-based. In the first step of the proposed approach, the images at hand are segmented using the KMeans technique, in the second step the segmented images are passed through a pre-trained neural network. As a testbed we use a set of leaf images taken from Al-Ghor area in Jordan. [4].

III. Existing System

One existing method for plant disease detection for 38 classes is the use of a machine learning algorithm trained on a dataset of plant images. The algorithm uses image processing techniques to extract features from the images, such as color, texture, and shape, and then applies machine learning algorithms to classify the images as healthy or diseased.

The algorithm is trained on a large and diverse dataset of plant images, including images of healthy and diseased plants, and images of plants affected by different diseases. The dataset is pre-processed to remove noise, standardize the size, and enhance contrast.

The algorithm uses a variety of machine learning techniques, such as decision trees, random forests, or support vector machines, to classify the images. Once the model is trained, it can be used to classify new images of plants as healthy or diseased and to identify the specific disease if it is present.

This method has been used successfully in various applications, including the detection of potato diseases, citrus diseases, and wheat diseases. However, it has limitations in detecting complex diseases, and it requires a large amount of training data and expert knowledge to achieve accurate results.

IV. Proposed System

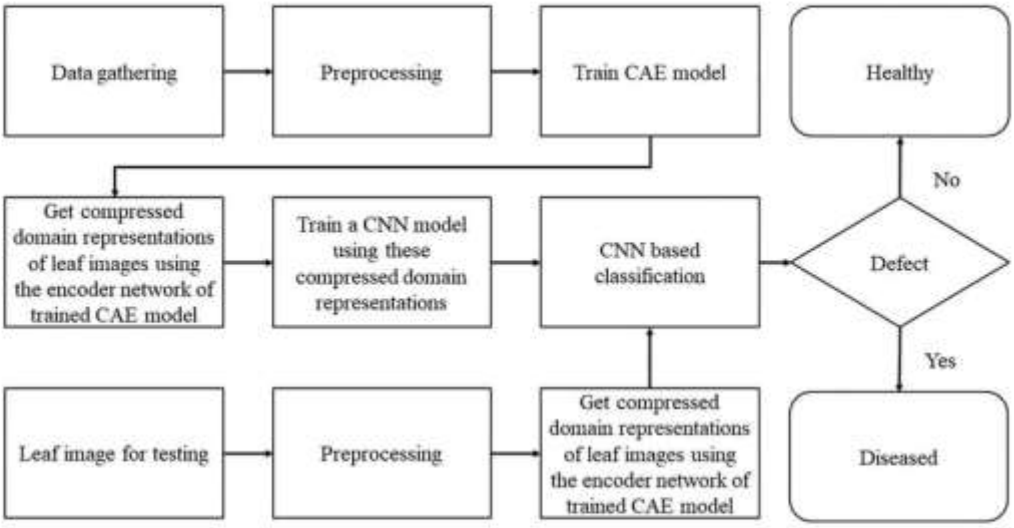
Proposed method for plant disease detection for 43 classes can be implemented using a convolutional neural network (CNN) architecture. This method involves collecting a large dataset of plant images that includes healthy and diseased plants with different diseases, and pre-processing these images to remove noise, standardize their size and enhance their contrast.

The preprocessed images are then used to train a CNN model using supervised learning. The model consists of multiple convolutional and pooling layers, which learn to identify features in the images that correspond to specific diseases. The output of the model is a probability distribution over the 43 classes of diseases that the model was trained to detect.

Once the model is trained, it can be used to classify new images of plants as healthy or diseased and to identify the specific disease if it is present. This can be done using a simple interface that allows farmers to take a picture of a plant using their smartphone, and the image is sent to the model for processing and classification. The farmer is then alerted to the potential disease outbreak, and they can take appropriate action to prevent the spread of the disease.

This proposed method has the potential to significantly improve plant disease detection and reduce the damage caused by plant diseases.

V. METHODOLOGY



A) Hardware and Software Requirements:

This application is based on idea of detecting the plant disease which required following additives:

1) Google Colab
2) Deep Learning CNN
3) Storage for dataset
4) RAM: Above 4GB
5) Operating System: Windows 10 64 bit

B) Working:

Plant disease detection using convolutional neural networks (CNNs) involves training a machine learning algorithm on a large dataset of images of healthy and diseased plants. The algorithm learns to identify patterns in the images that correspond to specific diseases. Once the model is trained, it can be used to classify new images as healthy or diseased and identify the specific disease if it is present.

The first step in using a CNN for plant disease detection is to collect a large and diverse dataset of plant images that includes healthy and diseased plants. The images are then preprocessed to remove noise, standardize the size, and enhance contrast.

Next, the CNN is trained on the preprocessed images using supervised learning. The CNN consists of multiple layers of artificial neurons that learn to recognize increasingly complex features in the images. The model learns to differentiate between healthy and diseased plants by identifying unique features associated with each disease.

Once the CNN is trained, it can be used to classify new images of plants as healthy or diseased. The model calculates a probability score for each possible class, and the class with the highest probability is assigned as the prediction. This information can be used to alert farmers to potential outbreaks and help them take appropriate action to prevent the spread of disease.

C) Software:

Google Colab:

Google Colab is a cloud-based platform that allows users to develop, run and share Jupyter notebook-style code in Python. It is a free service provided by Google that provides a web-based environment to write and run Python code, with access to GPUs and TPUs for accelerated computation. Google Colab is especially useful for deep learning experiments, as it supports popular frameworks like TensorFlow and PyTorch, as well as other Python libraries. The platform also offers the ability to collaborate with others on shared notebooks, and integrates easily with other Google services like Drive. Overall, Google Colab is a convenient and powerful tool for anyone looking to run Python code in a cloud-based environment.

Tensorflow:

TensorFlow is an open-source software library developed by Google for building and training machine learning models. It provides a wide range of tools and resources for developing and deploying machine learning applications, including data preprocessing, model building, optimization, and visualization. TensorFlow is designed to be scalable and flexible, allowing developers to build models that can run on a variety of devices, including CPUs, GPUs, and TPUs. It has become one of the most popular and widely used machine learning libraries in the world.

Matplotlib:

Matplotlib is a plotting library for the Python programming language. It provides a wide range of tools and resources for creating high-quality visualizations of data, including line plots, scatter plots, bar plots, histograms, and more. Matplotlib is highly customizable and can be used to create publication-quality figures and graphics. It is widely used in scientific computing, data analysis, and machine learning applications, and is supported by a large and active community of developers and users.

Numpy:

NumPy is a Python library for scientific computing and data analysis. It provides a powerful array computing capability, allowing for efficient manipulation of large multi-dimensional arrays and matrices. NumPy also includes a range of mathematical functions and tools for working with linear algebra, Fourier analysis, and other scientific computing applications. It is a fundamental library for data science in Python and is used in many other popular libraries such as Pandas, Matplotlib, and Scikit-learn.

Pandas:

Pandas is a Python library for data manipulation and analysis. It provides powerful data structures and tools for reading, cleaning, filtering, and transforming data in a variety of formats, including CSV, Excel, and SQL databases. Pandas also includes built-in visualization tools and support for time-series data. It is widely used in data science, finance, and other fields for data analysis and manipulation, and is often used in conjunction with other popular libraries such as NumPy and Matplotlib.

D) Advantages:

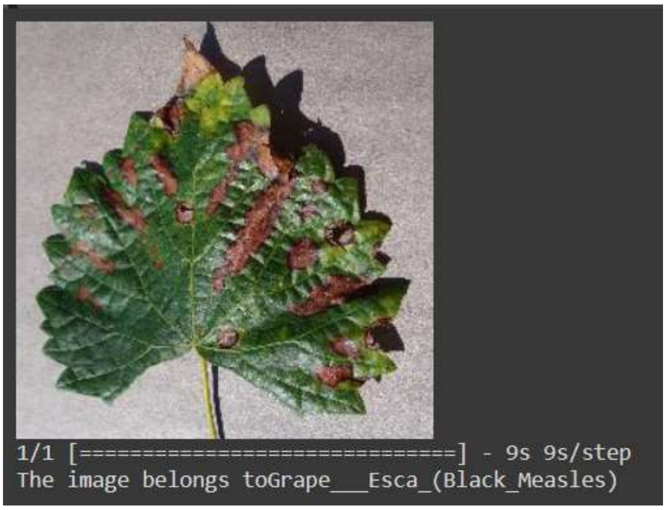
The advantages of plant disease detection include:

- Early detection: Early detection of plant diseases can help prevent their spread, saving time, money, and resources.
- Reduced losses: Prompt detection can lead to timely intervention, reducing the impact of diseases on crops, and minimizing crop losses.
- Accurate identification: Plant disease detection can help accurately identify the type of disease affecting crops, allowing for targeted treatment.
- Improved crop management: With knowledge of plant disease presence, farmers can better manage their crops by making informed decisions on irrigation, fertilization, and other practices.
- Increased efficiency: Automated detection techniques can help speed up the detection process, leading to increased efficiency and productivity.
- Better crop quality: Plant disease detection can help improve the overall quality of crops by ensuring healthy, disease-free plants, leading to higher yields and better marketability.

VI. Experimental Result A)

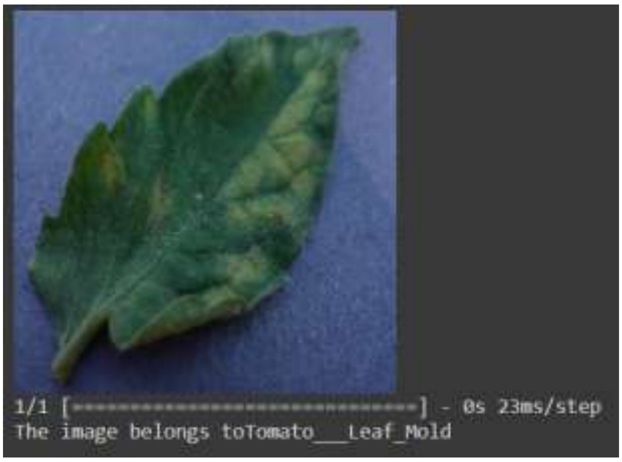
Test case 1:

Test case 2:



Test case 3:

Test case 4:



VII. CONCLUSION

In conclusion, the application of Convolutional Neural Networks (CNNs) in plant leaf disease detection has proven to be a highly effective and promising approach. By training CNN models on large datasets of labeled leaf images, these networks can accurately identify and classify various diseases. The hierarchical structure of CNNs enables them to capture intricate patterns and features within the images, facilitating precise disease diagnosis.

The use of CNN-based disease detection systems offers significant advantages, including improved efficiency, early disease detection, and reduced crop losses. These systems can be deployed in different agricultural settings and integrated into mobile applications for easy access and widespread adoption.

However, the performance of CNN models relies heavily on the quality and diversity of the training dataset. Access to comprehensive and well-annotated datasets representing different diseases and plant species is crucial for achieving accurate and robust results.

Continued research and collaboration between plant pathology and machine learning experts will further enhance CNN-based disease detection systems, contributing to improved crop health, increased productivity, and sustainable agriculture.

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