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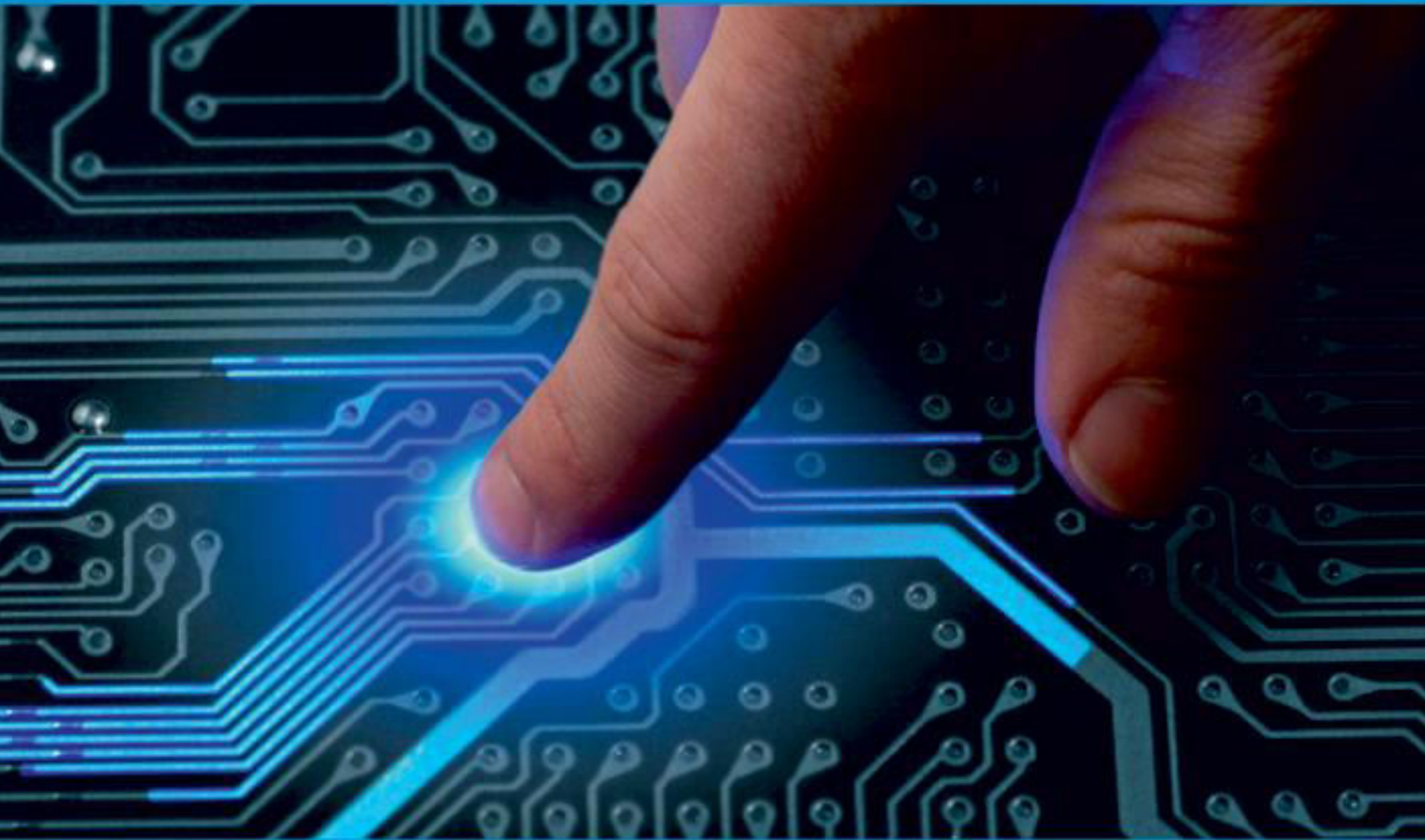

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Plant Leaf Disease Detections Using Deep Learning

Gopal Shelke[1], Saurav Wankhade[1], Hrishikesh Tholbare[1], Shankar Shinde[1], Nitin Salunke[1], Gaurav Pundkar[1]

Department of Computer Science & Engineering, Shri Sant Gajanan Maharaj College of Engineering, Shegaon Maharashtra, India

ABSTRACT: Plant diseases pose a significant threat to agricultural productivity and food security. In this research paper, we explore the application of deep learning techniques, particularly Convolutional Neural Networks (CNN), for plant leaf disease detection. The study investigates the use of TensorFlow, a widely adopted deep learning framework, to develop and train CNN models using a diverse dataset of plant leaf images. Experimental results indicate the effectiveness of the proposed approach in accurately identifying and classifying different types of plant diseases. The findings shed light on the potential of deep learning and its ability to enhance early detection and prevention of plant diseases, ultimately leading to improved crop yield and agricultural sustainability.

KEYWORDS: Plant leaf disease detection , Deep learning techniques , Convolutional Neural Networks (CNN) , TensorFlow framework , Agricultural productivity , Food security , Early detection , Prevention , Crop yield.

I. INTRODUCTION

Plant diseases have long been a significant challenge in agricultural systems, causing substantial crop yield losses and threatening global food security. Early detection and timely management of plant leaf diseases are crucial for minimizing these adverse effects. Traditional methods of disease detection often rely on visual inspection by experts, which can be time-consuming and prone to human error. With the advancements in deep learning techniques, particularly Convolutional Neural Networks (CNNs), there is a promising opportunity to develop automated and accurate systems for plant leaf disease detection.In this research paper, we propose a deep learning-based system for automated plant leaf disease detection, leveraging the power of CNNs and the TensorFlow framework. Our study aims to overcome the limitations of traditional detection methods by harnessing the capabilities of deep learning algorithms. By utilizing a large-scale dataset comprising diverse plant leaf images, we train and evaluate our CNN models to accurately identify and classify different types of plant diseases.The main objectives of this study are to improve the accuracy and efficiency of disease detection, enable early intervention measures, and facilitate timely management practices. By providing an automated and reliable tool for plant disease detection, we aim to contribute to the field of precision agriculture, ultimately leading to enhanced crop yield, reduced losses, and sustainable farming practices.Furthermore, the availability of extensive plant leaf image datasets and the computational power of modern hardware make deep learning a promising approach for disease detection. The ability of CNNs to automatically learn relevant features from images, combined with their hierarchical structure, allows them to capture complex patterns and discriminate between different diseases. The TensorFlow framework, renowned for its flexibility and scalability, provides a suitable environment for implementing and training CNN models efficiently.Through this research, we aim to address the challenges in plant leaf disease detection, such as high variability in leaf appearances and the presence of similar symptoms across different diseases. We anticipate that our deep learning-based system will not only offer improved accuracy but also provide a time-efficient and cost-effective solution for plant disease diagnosis and management.This introduction provides an overview of the significance of plant disease detection, highlights the limitations of traditional methods, introduces the potential of deep learning techniques, specifically CNNs and TensorFlow, to address these challenges, and expands on the advantages of deep learning in this context. It also outlines the objectives and expected contributions of the research study. Remember to tailor the introduction to the specifics of your research and include any additional relevant information or context.

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II. PROBLEM STATEMENT

Agriculture plays a vital role in the Indian economy, employing a significant portion of the country's workforce. India holds the distinction of being the largest global producer of pulses, rice, wheat, spices, and spice products. The economic well-being of farmers hinges on the quality of their agricultural output, which is heavily reliant on plant growth and yield. Consequently, disease identification in plants holds immense importance in the agricultural domain. Plant diseases can significantly impede plant development and adversely impact the farmer's livelihood. Early detection of plant diseases through automated techniques brings substantial benefits. Among the various plant parts, such as leaves, diseases often manifest themselves. Manual diagnosis of plant diseases based on leaf photographs is time-consuming. Therefore, there is a need to develop computational methods that automate the process of disease detection and classification using leaf images while ensuring accuracy and efficiency.

III. PROPOSED SOLUTION

This study aims to address the identification of plant diseases through the utilization of segmentation, feature extraction, and classification techniques. In this research, photographs of leaves from different plant species are captured using a digital camera or a similar device, and these images are employed to classify the affected regions on the leaves. To accomplish the task of plant disease detection, a framework is proposed that incorporates Convolutional Neural Networks (CNN) and Deep Neural Networks (DNN). The framework leverages low-cost and open-source software, ensuring cost-effectiveness and accessibility in reliably detecting plant diseases.

IV. LIST OF MODULES

- Image acquisition.
- Image pre-processing.
- Image enhancement.
- Image segmentation.
- Image analysis
- Feature extraction.
- Disease classification

4.1 Image Acquisition:

The initial step involves data collection from publicly accessible repositories. The gathered data consists of images that serve as the input for subsequent processing. To ensure compatibility with various image formats such as .bmp, .jpg, and .gif, we have considered the most common image domains. Real-time images are directly obtained through a camera feed. To facilitate accurate segmentation, a white background is provided for enhanced visibility and convenient image analysis, considering that leaf colors typically range from red to green. In the case of cotton images, an image capturing system is utilized to capture images while ensuring minimal distortion. Care is taken to avoid direct sunlight during the image capturing process to prevent picture distortion.

4.2 Image Pre-processing:

Image pre-processing refers to the application of computer algorithms on digital images to perform necessary adjustments and enhancements. In the context of plant detection, a specific algorithm is employed to analyze the image and identify the presence of plants. Similar image processing and detection approaches are utilized, leveraging specific algorithms tailored for this purpose. It is important to note that the quality of the image plays a crucial role in this process. If the image lacks clarity or sufficient quality, the algorithm may not be effective, highlighting the significance of using clear and high-quality images for accurate plant detection.

4.3 Image Enhancement:

Image enhancement refers to the process of modifying digital images to achieve more suitable effects for display or subsequent image processing. Several techniques can be employed to improve the quality and visual characteristics of an image, including:

1. Histogram Equalization: This technique adjusts the distribution of pixel intensities in an image to enhance contrast and improve overall image quality.

2. Noise removal using filters: Various filtering methods, such as median filtering or Gaussian filtering, can be

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applied to remove noise from the image, resulting in a cleaner and more visually pleasing output.

3. Unsharp mask filtering: This technique involves sharpening the image by subtracting a blurred version of the image from the original, enhancing edge details and improving overall clarity.

4. Decorrelation stretch: Decorrelation stretch is a method used to enhance the color and contrast in remote sensing images by stretching the color information along the principal components.

These are just a few examples of image enhancement techniques that can be employed to improve the quality, clarity, and visual appeal of digital images. The selection of the appropriate technique depends on the specific requirements and characteristics of the image being processed.

4.4 Image Segmentations:

Image segmentation refers to the process of dividing a digital image into multiple segments or sets of pixels, often referred to as image objects. The primary goal of image segmentation is to simplify image identification and analysis by partitioning the image into distinct segments, allowing for individual analysis of each segment. Various characteristics such as color, texture, and intensity are commonly utilized in segmenting the image. By analyzing each segment separately, image segmentation enables more focused and accurate analysis, facilitating tasks such as object recognition, tracking, and measurement.

4.5 Image analysis

In this particular step, image segmentation is employed to identify and locate the region of interest within the image. Region-based segmentation is the chosen technique, wherein the color of the leaf is utilized as a differentiating factor to distinguish between healthy and diseased regions of the plant leaf. By analyzing the color properties of the leaf, the segmentation algorithm can accurately separate the healthy and diseased regions, enabling further analysis and classification of the plant disease.

4.6 Feature Extraction:

Feature extraction is a fundamental step in machine learning, specifically in dimensionality reduction. It involves dividing and transforming a large set of raw data into smaller, more manageable classes. This process becomes crucial when dealing with large datasets, as it helps minimize resource requirements while minimizing errors.The objective of feature extraction is to extract the most informative features from the dataset by selecting and combining variables into meaningful functions. By doing so, it reduces the dimensionality of the data while preserving the essential information necessary for accurate modeling and analysis. This reduction in dimensionality not only improves computational efficiency but also helps prevent overfitting and improves the generalization capabilities of the machine learning models.By extracting relevant features from the raw data, feature extraction simplifies the subsequent stages of data analysis, model training, and decision-making processes. It enables the machine learning algorithms to focus on the most relevant and discriminative aspects of the data, leading to improved performance and better insights.

4.7 Disease Classifications:

In this approach, a trained deep learning model is utilized for plant disease recognition. The process involves capturing an image of the affected plant's leaf using a digital camera or a similar system. The captured image is then subjected to image scanning using OpenCV, a popular computer vision library. The first step is to determine the type of plant based on the scanned image. Once the plant type is identified, the next step is to analyze the image further to determine the specific disease affecting the plant. This analysis is performed using the trained deep learning model, which classifies the disease based on the patterns and characteristics observed in the leaf image. By leveraging deep learning techniques and image analysis, this method enables accurate and automated identification of both the plant type and the specific disease, facilitating timely and targeted interventions for plant health management.

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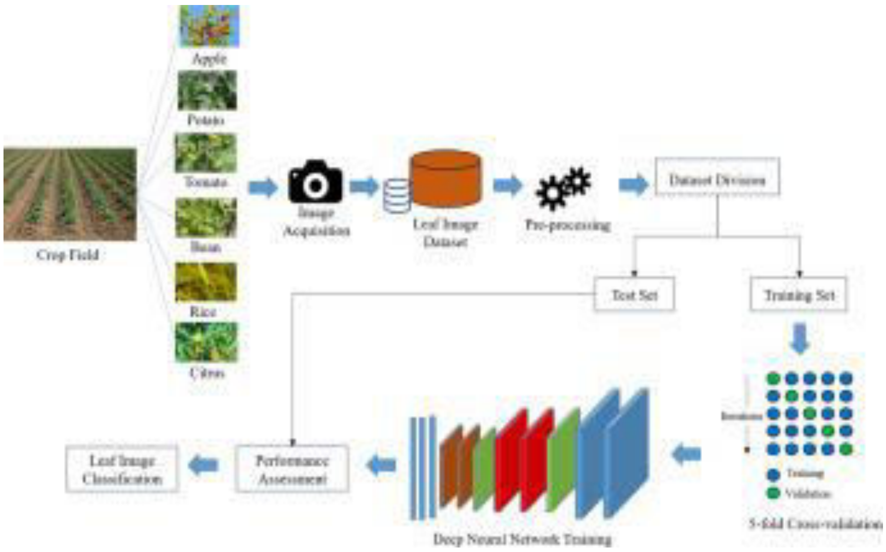

Fig.2. CNN Working

V. CONCLUSIONS

The proposed system is designed to monitor cultivated fields regularly and employ CNN and DNN algorithms to detect crop diseases at an early stage. Machine learning methods are utilized to train the model, enabling accurate disease diagnosis. To address infected crops, farmers are advised to use pesticides as a remedy. Furthermore, future expansions of the proposed system could include additional features such as nearby government markets, pesticide price lists, and information about nearby open markets.This research paper provides a comprehensive review of various disease classification strategies for crop disease detection. It also presents an algorithm for image segmentation that can be employed for automated detection and classification of plant leaf diseases in the future. The algorithm's evaluation encompasses several crops, including banana, beans, jackfruit, lemon, mango, potato, tomato, and sapota, targeting similar diseases affecting these plants. The results demonstrate high accuracy with minimal computational effort, highlighting the effectiveness of the proposed algorithm in recognizing and classifying crop diseases. One of the key advantages of this approach is its ability to detect plant diseases at an early stage or even at the initial onset. Furthermore, the utilization of Convolutional Neural Network (CNN) and Deep Neural Network (DNN) algorithms can further enhance the recognition rates in the disease classification process.

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