

Leaf Disease Detection Using Deep Learning for Smart Agriculture

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ABSTRACT: Agriculture plays a vital role in the global economy, and plant diseases significantly affect crop productivity and food security. Early detection of plant diseases can help farmers take preventive measures and reduce crop loss. This paper presents an automated leaf disease detection system using deep learning techniques. The proposed system utilizes image processing and convolutional neural networks (CNN) to identify diseases in plant leaves based on visual symptoms. The system captures images of plant leaves, processes them using a trained deep learning model, and predicts the disease type with high accuracy. The model is trained using a dataset of healthy and diseased leaf images. Experimental results show that the proposed system can effectively detect various plant diseases and assist farmers in taking timely actions. The system can be deployed as a web or mobile application to support smart agriculture and improve crop productivity.

KEYWORDS: Leaf Disease Detection, Deep Learning, Image Processing, Convolutional Neural Network, Smart Agriculture.

I. INTRODUCTION

Agriculture is the backbone of many economies, especially in developing countries. Crop diseases are one of the major factors that reduce agricultural productivity and cause significant financial losses to farmers. Traditional methods of disease detection rely on manual inspection by experts, which is time-consuming and not always accurate.

With the advancement of artificial intelligence and computer vision technologies, automated plant disease detection systems have become possible. Image processing and machine learning techniques can analyse leaf images and identify disease patterns efficiently.

Deep learning models, particularly Convolutional Neural Networks (CNN), have shown excellent performance in image classification tasks. These models can automatically learn complex features from leaf images and accurately classify plant diseases. The proposed system aims to develop an intelligent leaf disease detection system that can identify plant diseases at an early stage using deep learning techniques. This system helps farmers monitor crop health and take necessary preventive measures.

II. LITERATURE SURVEY

Several Several researchers have developed plant disease detection systems using machine learning and image processing techniques.

Mohanty et al. proposed a deep learning approach for plant disease detection using convolutional neural networks and achieved high classification accuracy on plant leaf datasets. Their work demonstrated the effectiveness of deep learning in agricultural disease detection.

Spasojevic et al. developed an automated plant disease recognition system using deep convolutional neural networks. The system was capable of identifying multiple plant diseases from leaf images with good accuracy.

Recent studies have also explored the use of mobile applications for real-time plant disease diagnosis. These systems allow farmers to capture leaf images using smartphones and obtain instant disease predictions.

III. PROPOSED SYSTEM

The proposed system aims to automatically detect plant diseases from leaf images using deep learning algorithms:

- Image Acquisition
- Image Preprocessing
- Feature Extraction
- Disease Classification
- Result Display

In this system, the user uploads an image of a plant leaf through a web interface. The uploaded image is pre-processed to remove noise and improve image quality.

The pre-processed image is then passed to a trained deep learning model, such as a Convolutional Neural Network (CNN), which extracts important features from the image. The proposed system provides an efficient and eco-friendly method for utilizing otherwise wasted mechanical energy in public areas such as sidewalks, shopping malls, and railway stations.

IV. SYSTEM DESIGN AND WORKING PRINCIPLES

1. Image Acquisition:

The first step in the system is capturing images of plant leaves. Images can be obtained using cameras, smartphones, or publicly available datasets such as the Plant Village dataset.

2. Image Preprocessing:

The captured images are processed to remove noise and improve image quality. Techniques such as resizing, normalization, and colour conversion are applied to prepare the images for model training.

3. Feature Extraction:

Feature extraction is performed using deep learning models such as Convolutional Neural Networks. The CNN automatically learns important patterns such as colour, texture, and shape that are associated with plant diseases.

4. Disease Classification:

The trained model classifies the leaf image into different categories such as healthy or diseased. The model predicts the disease type based on learned patterns from the training dataset.

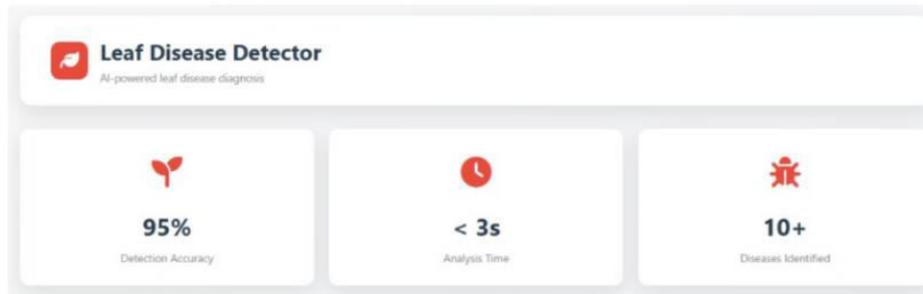
V. RESULTS AND DISCUSSION

The proposed leaf disease detection system was implemented using deep learning algorithms and tested using a dataset of plant leaf images. The dataset contained images of both healthy and diseased leaves.

The model was trained using convolutional neural networks to classify different types of plant diseases. During training, the dataset was divided into training and testing sets to evaluate the model's performance.

Experimental results show that the system can accurately detect plant diseases from leaf images with high accuracy. The use of deep learning significantly improves classification performance compared to traditional machine learning techniques.

The developed system successfully demonstrates the capability of identifying plant diseases automatically and assisting farmers in crop monitoring.



VI. CONCLUSION

This paper presented an automated leaf disease detection system using deep learning techniques. The proposed system uses image processing and convolutional neural networks to identify plant diseases from leaf images.

Experimental results indicate that the system can effectively classify plant diseases and support early detection. The system can be implemented as a mobile or web application to assist farmers in monitoring crop health.

In the future, the system can be improved by integrating additional datasets, improving model accuracy, and developing a real-time mobile application for farmers.

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