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Plant Disease Detection Using Deep Learning (CNN) for Smart Agriculture

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Abstract

Plant diseases are a major threat to agricultural productivity and food security. Early detection of plant diseases helps farmers take timely action and reduce crop loss. This paper proposes a deep learning-based approach using Convolutional Neural Networks (CNN) to detect and classify plant diseases from leaf images. The model is trained on a plant leaf dataset and achieves high accuracy. The proposed system provides a fast, cost-effective, and automated solution for disease detection in agriculture.

Keywords

Plant Disease Detection, CNN, Deep Learning, Image Processing, Smart Agriculture

1. Introduction

Agriculture plays a vital role in the economy and food supply. Plant diseases can significantly reduce crop quality and yield, causing economic loss to farmers. Traditional methods of disease detection require expert knowledge and are time-consuming.

With the advancement of Artificial Intelligence (AI), automatic plant disease detection has become possible. Deep learning techniques, especially Convolutional Neural Networks (CNN), are highly effective in analyzing images and identifying diseases accurately.

2. Literature Review

Various techniques have been developed for plant disease detection.

Traditional methods involve image processing and manual feature extraction, which are less accurate. Recent studies show that deep learning models, particularly CNN, provide better performance and higher accuracy.

Researchers have demonstrated that CNN-based models can successfully classify plant diseases using leaf images. These models reduce human effort and improve efficiency in agricultural practices.

3. Methodology

3.1 Dataset

The dataset used is the PlantVillage dataset, which contains images of healthy and diseased plant leaves.

3.2 Preprocessing

- Image resizing
- Noise removal
- Data augmentation (rotation, flipping)

3.3 Model Architecture

The proposed system uses a Convolutional Neural Network (CNN) consisting of:

- Convolution layers
- ReLU activation function
- Pooling layers
- Fully connected layers

3.4 Working Process

1. Input leaf image
2. Image preprocessing
3. Feature extraction using CNN
4. Disease classification
5. Display result

4. Results

The CNN model achieves an accuracy of approximately 95% to 98%, depending on the dataset and training conditions. The model performs better than traditional machine learning techniques and provides fast and reliable results.

5. Advantages

- Fast and automatic detection
- High accuracy
- Reduces manual effort
- Helps in early disease identification
- Improves crop productivity

6. Conclusion

This research shows that CNN-based plant disease detection systems are efficient and reliable. The system can assist farmers in identifying diseases early and taking necessary actions. It can be further enhanced by integrating with mobile applications for real-time detection.

7. Future Scope

- Development of mobile-based applications
- Real-time detection using camera
- Integration with IoT systems
- Expansion to detect multiple crop diseases

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