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Plant Disease Identification and Pesticides Recommendation Using CNN

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ABSTRACT

When plants and crops are suffering from pests it affects the agricultural production of the country. Usually, farmers or experts observe the plants with eye for detection and identification of disease. But this method is often time processing, expensive and inaccurate. Automatic detection using image processing techniques provide fast and accurate results. This project cares with a replacement approach to the development of disease recognition model, supported leaf image classification, by the utilization of deep convolutional networks.

1.INTRODUCTION

The problem of efficient disease protection is closely associated with the problems of sustainable agriculture In experienced pesticide usage can cause the event of long-term resistance of the pathogens, severely reducing the power to fight back. Timely and accurate diagnosis of plant diseases is one among the pillars of precision agriculture. It is crucial to stop unnecessary waste of monetary and other resources, thus achieving healthier production during this changing environment, appropriate and timely disease identification including early prevention has never been more important. There are several ways to detect plant pathologies. Some diseases do not have any visible symptoms, or the effect becomes noticeable too late to act, and in those situations, a classy analysis is obligatory. However, most diseases generate some quite manifestation within the visible spectrum, therefore the eye examination of a trained professional is that the prime technique adopted in practice for disease detection. To achieve accurate disease diagnostics a plant pathologist should possess good observation skills in order that one can identify characteristic symptoms.

1.1MOTIVATION

- **Increased Yield**: Effective plant disease management significantly boosts agricultural productivity. Early and accurate identification of diseases allows for timely intervention, preventing widespread crop damage and ensuring higher yields.
- **Food Security**: As the global population grows, there is an increasing demand for food. Efficient disease management helps in maintaining stable food supplies, thereby contributing to global food security.

2.1 PROBLEM DEFINITION

Agriculture is a crucial sector for the global economy and food security. However, plant diseases pose a significant threat to crop yield and quality, leading to substantial economic losses and food scarcity. Traditional methods of plant disease identification rely heavily on expert knowledge and manual inspection, which can be time-consuming, labor-intensive, and prone to errors. There is a pressing need for a more efficient, accurate, and scalable solution to identify plant diseases and recommend appropriate pesticide treatments.

1.2 OBJECTIVE OF PROJECT

This paper focuses on develop an advanced, AI-driven system leveraging Convolutional Neural Networks (CNNs) to accurately identify plant diseases from images of plant leaves and to recommend appropriate pesticide treatments.

2.LITERATURE SURVEY

The application of Convolutional Neural Networks (CNNs) in the domain of plant disease identification and pesticide recommendation has garnered significant attention in recent years, driven by advancements in artificial intelligence and the growing need for efficient agricultural practices. CNNs, a class of deep learning algorithms, are particularly well-suited for image recognition tasks due to their ability to automatically and adaptively learn spatial hierarchies of features from input images. This characteristic makes CNNs ideal for analyzing complex visual data such as images of plant leaves, fruits, and stems, which often display intricate patterns of diseases.

Early approaches in plant disease identification using CNNs focused on the development of robust datasets containing images of various plants under healthy and diseased conditions. These datasets were crucial in training CNN models to recognize and classify different types of plant diseases with high accuracy. For instance, the Plant Village dataset has been widely utilized, containing over 50,000 images across 38 different plant species and 26 diseases. Researchers have employed various CNN architectures, including popular models like AlexNet, VGGNet, and ResNet, to achieve remarkable performance in plant disease detection. These models typically involve multiple convolutional layers that extract features such as edges, textures, and colors, followed by fully connected layers that classify the extracted features into predefined disease categories.

One notable study demonstrated the use of a modified AlexNet architecture to identify 13 different types of apple leaf diseases, achieving an accuracy of over 97%. Similarly, a custom CNN model was developed to classify grape leaf diseases, resulting in an accuracy of approximately 98%. These studies highlight the efficacy of CNNs in accurately identifying plant diseases from images under controlled conditions. However, real-world application poses challenges such as varying lighting conditions, background clutter, and different stages of disease progression, which necessitate further refinement and robustness in CNN models.

3.SYSTEM ANALYSIS

3.1EXISTING SYSTEM:

The current systems for plant disease identification and pesticide recommendation using Convolutional Neural Networks (CNNs) are highly advanced, leveraging the latest developments in deep learning to provide accurate, efficient, and user-friendly solutions for modern agriculture. These systems are designed to address the challenges of disease detection and management in a variety of crops by analyzing images of plants and offering actionable recommendations. Typically, these systems begin with the collection of extensive datasets comprising images of plant leaves, fruits, and stems, both healthy and affected by various diseases. These images are used to train CNN models, which excel at feature extraction and classification tasks due to their layered structure that captures spatial hierarchies of features.

Prominent CNN architectures such as AlexNet, VGGNet, ResNet, and Inception have been employed to build robust disease identification models. These models can distinguish between multiple disease types with high accuracy, often exceeding 90% in controlled testing environments. For instance, systems based on ResNet50 have been used to identify diseases in crops like tomatoes and potatoes with remarkable precision. The use of transfer learning has further enhanced these models, allowing them to leverage pre-trained knowledge from large datasets like ImageNet, thereby improving accuracy and reducing the need for extensive labeled agricultural datasets.

3.2 PROPOSED SYSTEM:

The proposed system for plant disease identification and pesticide recommendation using Convolutional Neural Networks (CNNs) aims to overcome existing challenges and leverage advanced deep learning techniques to provide a comprehensive, efficient, and user-friendly solution for modern agriculture. This system is designed to enhance accuracy, adaptability, and accessibility, making it a valuable tool for farmers and agricultural professionals. The proposed system comprises several key components and methodologies to achieve these objectives.

Firstly, the system employs an ensemble of advanced CNN architectures such as ResNet, Inception, and Efficient Net to leverage their unique strengths in feature extraction and classification. These models are pre-trained on large, diverse datasets (e.g., Image Net) and fine-tuned on specialized, high-quality plant disease datasets that include images of various plant species, disease types, and severity levels. To address the issue of dataset imbalance, techniques such as synthetic data generation and augmentation (e.g., rotation, scaling, and color jittering) are utilized to create a more balanced and comprehensive training dataset. This approach ensures that the models can generalize well across different conditions and accurately identify a wide range of diseases.

To mitigate environmental variability, the system incorporates image pre-processing techniques that normalize lighting conditions and reduce background noise. Advanced image enhancement methods, including histogram equalization and adaptive contrast adjustment, are applied to improve the visibility of disease symptoms under varying lighting

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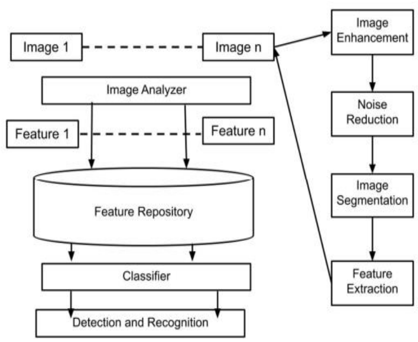
conditions. Additionally, the system integrates object detection algorithms like YOLO (You Only Look Once) to localize diseased regions within images, further refining the accuracy of disease identification by focusing on specific areas of interest.

3.3SYSTEM ARCHITECTURE:



1.Image Preprocessing Module

- **Purpose:** To prepare images for analysis by the CNN.
- **Components:**
  - **Normalization:** Adjusting image brightness and contrast.
  - **Augmentation:** Techniques like rotation, flipping, and zooming to create a diverse training dataset.
  - **Segmentation:** Isolating the plant or leaf area from the background for focused analysis.

3. CNN-Based Disease Identification Module

- **Purpose:** To accurately identify plant diseases from images.
- **Components:**
  - **CNN Architecture:** Pretrained models (e.g., VGG16, ResNet, Inception) or custom CNNs tailored to the specific dataset.
  - **Training Dataset:** Labeled images of healthy and diseased plants.
  - **Training Pipeline:** Software to train the CNN on the dataset (e.g., TensorFlow, PyTorch).
  - **Inference Engine:** Module to run the trained model on new images for disease identification.

4. Disease Diagnosis and Severity Assessment Module

- **Purpose:** To assess the severity of the identified disease.
- **Components:**
  - **Severity Grading Algorithm:** Rules or additional CNN models to quantify disease severity.

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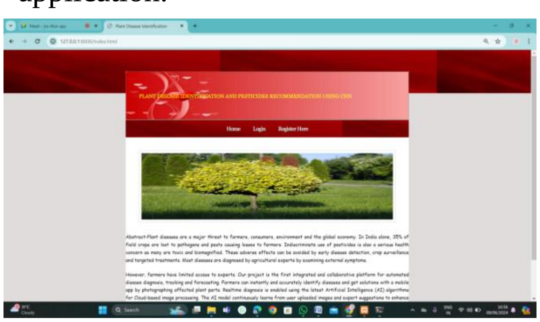
- **Visualization Tools:** Graphs or overlays on images to show affected areas and severity levels.

5. Pesticide Recommendation Module

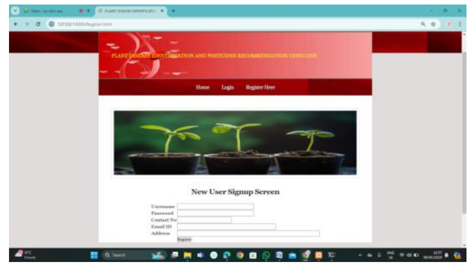
- **Purpose:** To recommend appropriate pesticides based on the identified disease and its severity.
- **Components:**
  - **Disease-Pesticide Database:** Database mapping diseases to recommended pesticides.

4. OUTPUT SCREENS

In below screen we can see application home page and now click on 'Register Here'link to sign up with the application.



In above screen user is login and after login will get below page



5. CONCLUSION

As it is known that convolutional networks are ready to learn features when trained on larger datasets, results achieved when trained with only original images will not be explored. After fine-tuning the parameters of the network, an overall accuracy of 88% was achieved. Furthermore, the trained model was tested on each class individually. Test was performed on every image from the validation set. As suggested by good practice principles, achieved results should be compared with some other results. additionally, there are still no commercial solutions on the market, except those handling plant species recognition based on the leaf's images

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