

KIET Group of Institutions, Ghaziabad

Bachelor of Technology

(CSE)



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Synopsis of Major Project

on

“Rice Leaf Disease Identification using Attention Net”

under the supervision of

Prof. Upendra Mishra

Submitted by :

Umang Rathi (2000290100176)

Shreyash Gupta (2000290100151)

Utkarsh Gautam (2000290100178)

Problem Statement

Rice is a staple food for a significant portion of the world's population, particularly in Asia. However, rice crops are susceptible to various diseases that can severely impact yield and quality. Identifying and classifying rice leaf diseases promptly and accurately is crucial for effective disease management and prevention. Traditional methods of disease identification are time-consuming and often require expert knowledge, making them impractical for large-scale application. This project aims to develop an automated system for detecting and classifying rice leaf diseases using deep learning techniques, providing a more efficient and scalable solution. By leveraging advanced image processing and neural networks, the system can help farmers mitigate crop losses and improve food security. Additionally, this approach can be integrated into existing agricultural practices, enhancing overall productivity.

Objective

The primary objective of this project is to design and implement a deep learning model capable of accurately identifying and classifying diseases in rice leaves. Specifically, the project aims to:

1. Utilize transfer learning with the ResNet152V2 model to leverage pre-trained knowledge and fine-tune it for rice leaf disease classification.
2. Incorporate an attention layer to enhance the model's focus on crucial parts of the image, improving classification accuracy.
3. Train the model on a dataset of approximately 2600 images covering six different disease classes.
4. Evaluate the model's performance and validate its effectiveness in classifying rice leaf diseases into the specified categories.

Introduction

Rice is one of the most vital crops worldwide, providing sustenance to over half of the global population. Its significance is particularly pronounced in Asia, where it forms the cornerstone of daily diets for billions of people. The high caloric and nutritional value of rice makes it an essential food source, playing a critical role in combating food insecurity and supporting the livelihoods of millions of farmers and their communities. Given its global importance, ensuring the health and productivity of rice crops is crucial for maintaining food security and economic stability.

Challenges Posed by Rice Plant Diseases

Despite its critical importance, rice cultivation faces significant challenges due to its susceptibility to a variety of diseases. These diseases can lead to substantial losses in both yield and quality, directly impacting food supply and economic outcomes. Among the most common and destructive rice diseases are:

Brown Spot: Characterized by brown lesions on leaves, this disease can severely affect grain quality and yield.

Leaf Blast: Identified by spindle-shaped lesions with a grey center, leaf blast can lead to the destruction of entire plants.

Bacterial Leaf Blight: This disease causes yellowing and wilting of leaves, significantly reducing photosynthetic capacity and yield.

Leaf Scald: Marked by large, brown, water-soaked lesions, leaf scald can lead to premature leaf death.

Narrow Brown Spot: Identified by narrow brown lesions on leaves, this disease affects plant vigor and grain production.

Early and accurate identification of these diseases is essential for effective management and control, preventing widespread damage and ensuring crop productivity.

Traditionally, diagnosing rice leaf diseases involves manual inspection by trained agricultural experts. While effective, this method is labor-intensive, time-consuming, and often impractical for large-scale applications. Additionally, manual inspection is subject to human error, which can lead to misdiagnosis and inappropriate management strategies. The need for more efficient and scalable diagnostic methods is evident, especially in the context of large agricultural operations.

Advancements in Technology: Deep Learning for Disease Detection

Recent advancements in technology, particularly in the field of artificial intelligence (AI), present a promising solution to these challenges. Deep learning, a subset of machine learning, has demonstrated exceptional capabilities in image recognition tasks. By leveraging these advancements, it is possible to develop automated systems that can assist in the early detection and accurate classification of rice leaf diseases.

This project aims to develop a deep learning model to identify and classify rice leaf diseases using computer vision techniques. Specifically, the project will utilize transfer learning with the ResNet152V2 model, a pre-trained neural network known for its deep architecture and robust performance in image classification tasks. Transfer learning allows the model to leverage knowledge gained from large, diverse datasets and adapt it for the specific task of rice leaf disease classification.

To further enhance the model's performance, an attention layer will be incorporated. This layer will enable the model to focus on the most relevant parts of the images, thereby improving its ability to accurately classify different disease types. The dataset used for training and testing the model comprises approximately 2600 images, categorized into six classes: Healthy, Brown Spot, Leaf Blast, Bacterial Leaf Blight, Leaf Scald, and Narrow Brown Spot.

The primary objective of this project is to develop an efficient and accurate automated system for rice leaf disease identification. By implementing a deep learning approach, the project aims to:

- Reduce the Time and Labor: Required for disease diagnosis.
- Improve Diagnostic Accuracy: By minimizing human error.
- Enable Large-Scale Application: Of disease management practices.

Ultimately, this system will support farmers in mitigating crop losses, improving yield quality, and enhancing overall food security. Additionally, the integration of such technology into existing agricultural practices holds the potential to revolutionize disease management and productivity in rice cultivation.

Proposed Methodology

1. Data Collection and Preprocessing:

- Gather a dataset of approximately 2600 images of rice leaves, each labeled with one of the six classes: Healthy, Brown spot, Leaf blast, Bacterial leaf blight, Leaf scald, and Narrow brown spot.
- Preprocess the images by resizing, normalizing, and augmenting them to enhance the diversity of the training set and improve model generalization.

2. Model Selection and Training:

- Utilize the ResNet152V2 architecture, a powerful deep learning model pre-trained on large image datasets.
- Implement transfer learning to fine-tune the ResNet152V2 model on the rice leaf disease dataset.
- Incorporate an attention layer to enable the model to focus on the most significant parts of the images, improving classification accuracy.

3. Model Evaluation:

- Evaluate the trained model using standard metrics such as accuracy, precision, recall, and F1-score.
- Perform cross-validation to ensure the model's robustness and generalizability.

4. Deployment:

- Develop a user-friendly interface or application that allows users to upload images of rice leaves and receive real-time predictions of the disease class.
- Integrate the model into a mobile or web-based platform to facilitate easy access for farmers and agricultural experts.

Applications

1. **Agriculture:** The primary application of this project is in the agricultural sector, where it can be used by farmers and agronomists to identify and manage rice leaf diseases effectively.
2. **Research:** The model can assist researchers in studying the prevalence and impact of different rice leaf diseases, aiding in the development of better disease management strategies.
3. **Education:** Educational institutions can use the system as a teaching tool to help students learn about plant pathology and the application of deep learning in agriculture.
4. **Extension Services:** Agricultural extension services can leverage the system to provide timely and accurate disease diagnosis support to farmers, improving crop management practices.