Rice Leaf Disease Classification Using Deep Learning

1. Project Overview

This project focuses on automated classification of rice leaf diseases using Convolutional Neural Networks. Early detection of crop diseases helps farmers improve yield and reduce losses. The system classifies rice leaf images into disease and healthy categories.

2. Dataset Description

- Labeled rice leaf images covering multiple disease classes and healthy leaves
- Dataset is clean, well-structured, and free from corrupted files
- Images vary in lighting, orientation, background, and resolution
- Minor class imbalance handled using data augmentation

3. Data Preprocessing & Augmentation

- Images resized to match CNN input dimensions
- Pixel normalization applied for faster convergence
- Data augmentation using rotation, flipping, zooming, and shifting
- Dataset split into training, validation, and testing sets

4. Exploratory Data Analysis

- Class distribution analysis performed to detect imbalance
- Visual inspection revealed texture and color differences between diseases
- Some disease classes show similar visual patterns, increasing classification complexity

5. Models Used

- MobileNetV2 – Lightweight and efficient, suitable for real-time deployment
- ResNet50 – Deep residual network capable of extracting complex features
- EfficientNet – Scaled architecture balancing accuracy and efficiency

6. Model Training & Evaluation

- Transfer learning used with pretrained ImageNet weights
- Models evaluated using accuracy, loss, precision, recall, and F1-score
- Validation performance monitored to detect overfitting
- EfficientNet achieved the best overall performance

7. Results & Insights

- CNN models successfully learned spatial features from leaf images
- EfficientNet showed superior generalization and stable validation accuracy
- MobileNetV2 provided fast inference with acceptable accuracy
- ResNet50 delivered strong feature extraction but required higher computation

8. Challenges & Limitations

- Visual similarity between certain disease classes
- Minor class imbalance affecting prediction confidence
- Performance dependent on image quality and lighting conditions

9. Conclusion

The project demonstrates the effectiveness of deep learning for agricultural disease detection. EfficientNet proved to be the most balanced model, while MobileNetV2 is recommended for deployment scenarios.

10. Future Scope

- Increase dataset size with more disease samples
- Deploy model as a mobile or web application
- Incorporate explainable AI techniques for better interpretability