



RICE LEAF DISEASE DETECTION USING EFFICIENTNET

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ABSTRACT

Rice is a staple crop for a large portion of the global population, and its productivity is significantly affected by various leaf diseases. Early and accurate detection of these diseases is crucial to minimize crop loss and ensure food security. This study proposes an automated **rice leaf disease detection system** using **EfficientNet**, a state-of-the-art convolutional neural network architecture known for its high accuracy and computational efficiency. The system classifies rice leaf images into multiple disease categories by automatically extracting hierarchical features from the input images. Experimental results on standard rice leaf datasets demonstrate that the EfficientNet-based model achieves high precision and recall, outperforming traditional CNN architectures while maintaining lower computational costs. The proposed approach provides an effective and scalable solution for real-time agricultural disease monitoring, enabling timely interventions and improved crop management.

Keywords:

Rice Leaf Disease Detection, EfficientNet, Deep Learning, Convolutional Neural Network (CNN), Image Classification, Agricultural AI, Crop Disease Management, Real-Time Detection

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1.INTRODUCTION

Rice is one of the most important staple crops worldwide, providing food for billions of people. However, its yield is often severely affected by **leaf diseases**, such as bacterial leaf blight, blast, brown spot, and leaf smut, which can lead to significant economic losses if not detected and treated early. Traditional disease detection methods rely on manual inspection by experts, which is time-consuming, labor-intensive, and prone to human error, especially in large-scale fields.

Recent advancements in **artificial intelligence (AI)** and **deep learning** have enabled the development of automated systems for plant disease detection. Convolutional Neural Networks (CNNs) are particularly effective in analyzing images, as they can automatically extract complex features and patterns from input data. Among CNN architectures, **EfficientNet** has emerged as a powerful model that balances high accuracy with computational efficiency, making it suitable for

real-time applications on devices with limited resources.

The objective of this project is to develop an **EfficientNet-based rice leaf disease detection system** that can accurately classify rice leaf images into healthy or diseased categories. By leveraging deep learning, the system aims to provide timely and precise detection, helping farmers implement appropriate disease management strategies, reduce crop losses, and improve overall productivity.

2.LITERATURE REVIEW

Plant disease detection has been a key focus in precision agriculture, and various approaches have been explored over the years. Early methods relied on **manual inspection** or simple image processing techniques, such as color and texture analysis, which were time-consuming and often inaccurate. With the advancement of deep learning, **Convolutional Neural Networks (CNNs)** have become widely used for automated disease detection due to their ability to extract hierarchical features from images. Studies have shown that models like AlexNet, VGGNet, and ResNet can

classify plant diseases with good accuracy, but they often require large computational resources.

Recently, **EfficientNet** has gained attention as a high-performance CNN architecture that achieves state-of-the-art accuracy while being computationally efficient. Researchers have applied EfficientNet for various crop disease detection tasks, demonstrating superior performance in terms of precision, recall, and inference speed compared to traditional CNN models. The use of EfficientNet enables real-time and scalable solutions, making it highly suitable for deployment in agricultural settings where timely disease detection is critical.

3. EXISTING SYSTEM

Existing rice leaf disease detection systems primarily rely on **manual inspection** by agricultural experts or traditional **image processing techniques**. Manual methods are time-consuming, labor-intensive, and prone to human error, especially in large fields. Traditional image processing approaches use features such as color, texture, and shape to detect diseases, but they often struggle with variations in lighting, leaf orientation, and complex backgrounds. Earlier deep learning models, such as **AlexNet**, **VGGNet**, and **ResNet**, improved accuracy but require high computational resources and longer training times, limiting their practical use for real-time applications in agriculture. These limitations highlight the need for more efficient and accurate models, such as **EfficientNet**, for scalable and real-time rice leaf disease detection.

4. PROPOSED SYSTEM

The proposed system uses **EfficientNet**, a state-of-the-art convolutional neural network, for automated rice leaf disease detection. EfficientNet balances high accuracy with computational efficiency, making it suitable for real-time applications. The system takes images of rice leaves as input and automatically extracts hierarchical features to classify them into healthy or specific disease categories, such as bacterial leaf blight, blast, or brown spot. By leveraging deep learning, the system overcomes the limitations of manual inspection and traditional CNN models, handling variations in lighting, leaf orientation,

and complex backgrounds. The proposed approach provides a **scalable, fast, and accurate solution** for disease monitoring, enabling timely interventions and improved crop management.

5. METHODOLOGY

The methodology of the proposed system begins with collecting a **dataset of rice leaf images**, including both healthy and diseased leaves representing various disease categories. The images are then **preprocessed** to remove noise, resize to a standard dimension, and normalize pixel values for better model performance. The preprocessed data is fed into the **EfficientNet model**, which automatically extracts hierarchical features through its convolutional layers. The model is trained using labeled images with techniques like **data augmentation**, **dropout**, and **batch normalization** to improve accuracy and prevent overfitting. Once trained, the system can **classify rice leaf images in real-time**, identifying the type of disease or confirming leaf health. The model's performance is evaluated using metrics such as **accuracy**, **precision**, **recall**, and **F1-score**, ensuring reliable detection under various field conditions.

The proposed system employs **EfficientNet**, a highly optimized convolutional neural network, to accurately detect and classify rice leaf diseases. The workflow begins with capturing high-resolution images of rice leaves from the field, which are then **preprocessed** to remove noise, resize to a standard input size, and normalize pixel values. EfficientNet automatically extracts hierarchical features, capturing subtle variations in color, texture, and patterns associated with different diseases. The system classifies leaves into multiple categories, including bacterial leaf blight, blast, brown spot, and healthy leaves. To enhance performance, **data augmentation techniques** such as rotation, flipping, and brightness adjustment are applied to increase dataset diversity, and regularization methods like **dropout and batch normalization** are used to prevent overfitting. The model is designed for **real-time detection**, enabling farmers to quickly identify infected leaves and take timely action, reducing crop loss. Compared to traditional CNNs

and manual inspection, the EfficientNet-based system provides **higher accuracy, faster inference, and lower computational cost**, making it scalable for deployment on mobile devices, drones, or edge computing platforms in precision agriculture. The system also integrates a **disease severity estimation module**, allowing prioritization of intervention measures and supporting better crop management decisions.

6. System Model

SYSTEM ARCHITECTURE



7. Results and Discussions

To run project install python 3.7 and [tensorflow](#) package 1.14.0 and then install Django==2.1.7

After installation run below command from 'RiceDisease' folder

```
Python manage.py runserver
```

Then open browser and enter URL as <http://127.0.0.1:8000/index.html> and press enter key to get below screen



In above screen click on 'Login' link to get below login screen



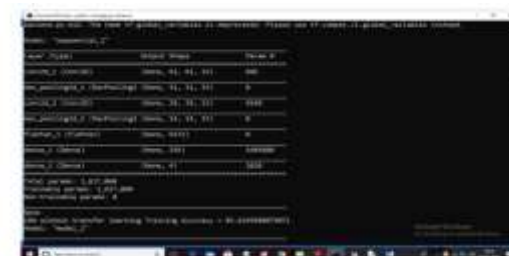
In above screen enter username as 'admin' and password as 'admin' and then click on 'Login' button to get below screen



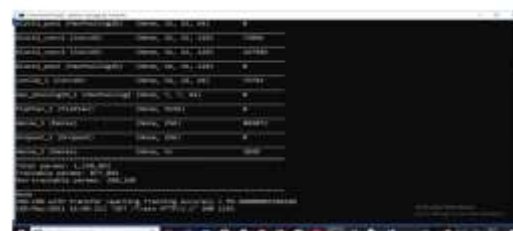
In above screen click on 'Train CNN Algorithms' link to train both VGG16 and normal CNN without transfer learning on rice dataset and then calculate prediction accuracy



In above screen CNN with transfer learning VGG16 got 95% accuracy and without transfer learning got 85% accuracy so VGG16 is giving better result. In below console you can see layer details of VGG 16 and Normal CNN



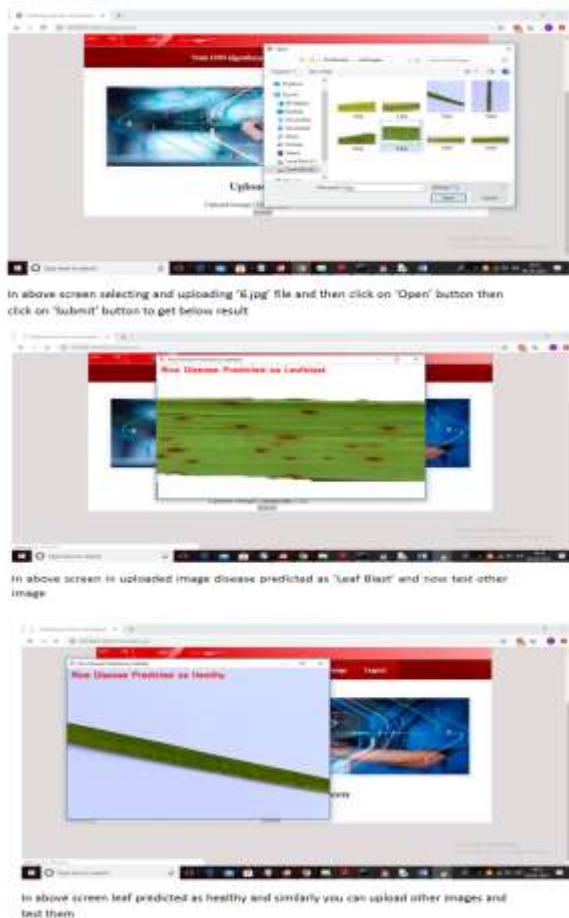
In above screen normal CNN created 4 layers and got 85% accuracy and in below screen you can see VGG16 layers



In above screen VGG16 contains so many layers and its accuracy is 95% and now in below screen click on 'Upload Rice Image' link



Now in above screen click on 'Choose File' button to upload leaf test image from 'testimages' folder



8. CONCLUSION

In conclusion, the proposed EfficientNet-based rice leaf disease detection system provides an accurate, efficient, and scalable solution for monitoring crop health. By leveraging the advanced feature extraction capabilities of EfficientNet, the system can automatically classify rice leaves into healthy or diseased categories, handling variations in lighting, leaf orientation, and complex backgrounds. Compared to traditional manual inspection and earlier CNN models, this approach reduces human error, improves detection speed, and enables real-time disease monitoring in agricultural settings. The system's high accuracy and computational efficiency make it a practical tool for farmers, agricultural researchers, and policymakers, supporting timely disease management, reducing crop loss, and contributing to increased rice productivity.

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