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International Journal of Engineering Technology Research & Management
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EFFICIENT DIAGNOSIS OF RICE CROP DISEASE USING MACHINE LEARNING

Dr. VENKAT KRISHNA,
DEAN , CSE , JBIET

[1] D. ANURADHA, [2] C. NISHITHA, [3] A.SRI VARSHA, [4] K. ANUSHA
J.B. Institute of Engineering & Technology, Department of Computer Science & Engineering, Yenkapally, Moinabad Mandal, R.R. Dist-75 (TG), India

ABSTRACT
Rice is a key staple crop, and productivity is highly impacted by numerous diseases. Conventional disease diagnosis approaches are based on manual examination, which is cumbersome and subject to errors. The present work puts forward a framework for rice disease diagnosis using a machine learning technique based on convolutional Neural Networks (CNNs). The model was trained on a database of images of diseased and healthy rice leaves and reached 84.8% classification accuracy. The system is developed to deployed as a web application to aid farmers in the early detection of disease and prescriptive treatment, hence enhancing crop yield. The use of cutting-edge technologies like machine learning(ml) and deep learning (Dl) is capable of addressing these challenges through the early detection of plant diseases.

KEYWORDS:
Rice disease detection, Machine Learning, CNN, Image Processing

INTRODUCTION

Plant life is the foundation of life; no life is ever possible without it, but plant life is plagued by sets of diseases attacking their growth. The need for early identification and diagnosis of disease is crucial in order to prevent possible destruction of ecosystems. Hot weather and moisture promote the spread of disease. Bacteria grow quite easily in the vascular tissues of the plant, leading to an excessive production of slime. It negatively affects the vascular system of the plant. Rice is a key staple crop around the globe, but its yield is severely affected by diseases like Bacterial Leaf Blight, Brown Spot, and farmers to manage crop health effectively. This system allows early detection of rice plant diseases, enabling farmers to take preventive action, improve crop health, and improve agricultural productivity.
The Rice Plant Disease Detection project uses Machine Learning (CNNs) to classify rice leaves as healthy or diseased based on images, automating disease identification for farmers. Built with TensorFlow and Keras, it processes labeled image datasets and trains a custom CNN model with layers like Conv2D, MaxPooling2D, and Dense. The model learns to recognize disease patterns and predicts health conditions of new leaf images.

METHODOLOGY

The proposed system follows a structured approach, leveraging CNN architectures for high-accuracy Disease detection. The methodology includes:

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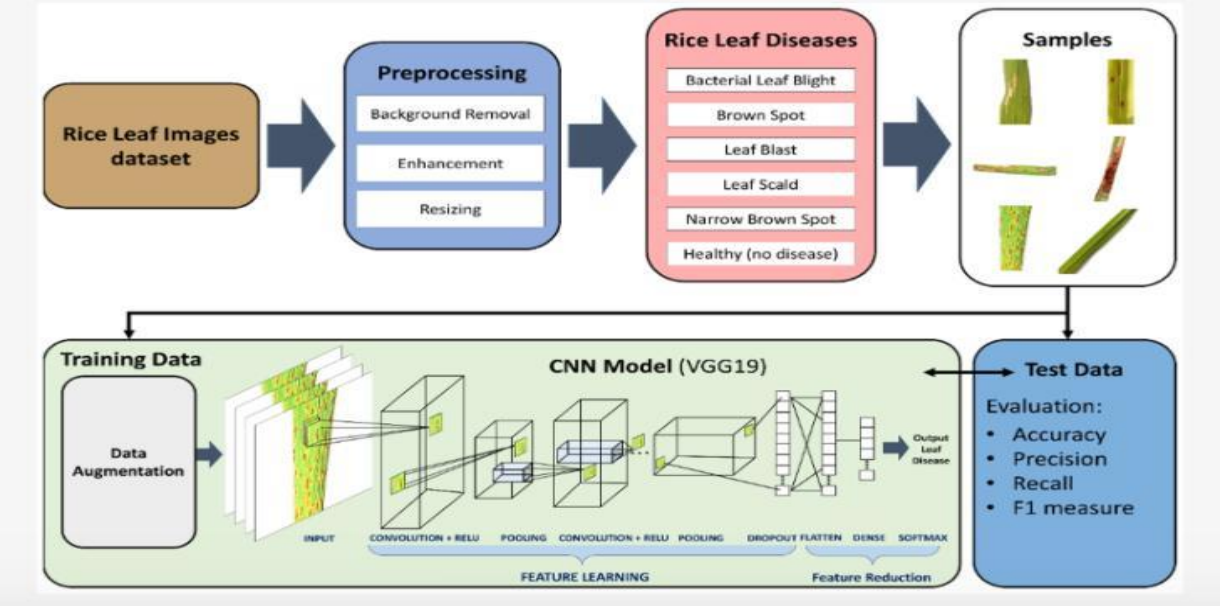

1. Data Collection & Preprocessing

The data set includes images of healthy and unhealthy rice leaves. To improve the model's performance, several preprocessing methods such as background removal, image enhancement, and resizing are applied. These processes ensure that the input data is clean and uniformly standardized, thus making effective feature extraction possible.

2. **Model Development and Training**

A machine learning-based CNN model is utilized for classifying the disease. Rotation and brightness adjustment techniques of data augmentation are utilized for the data while training in order to enhance generalization. Stacked convolutional layers are utilized for feature extraction and classification with fully connected layers. The Adam optimizer and categorical cross-entropy loss are utilized for model optimization.

3. Model Evalution

The performance of the model is measured in terms of accuracy, precision, recall and F1-score. All these measures tell us how well the model can differentiate between various categories of diseases. The performance confirms that the model makes sense when it is applied to unseen images.

4. Deployment

A web application is created to upload images of rice leaves for real-time disease prediction. The system scans the image, diagnoses the disease, and gives results in real-time. The application increases accessibility for farmers and agricultural specialists, allowing them to diagnose diseases early and better manage crops.

Metric	Value
Accuracy	84.8%
Precision	90.2%
Recall	89.7%
F1-Score	89.9%
Training Loss	0.23
Validation Loss	0.28

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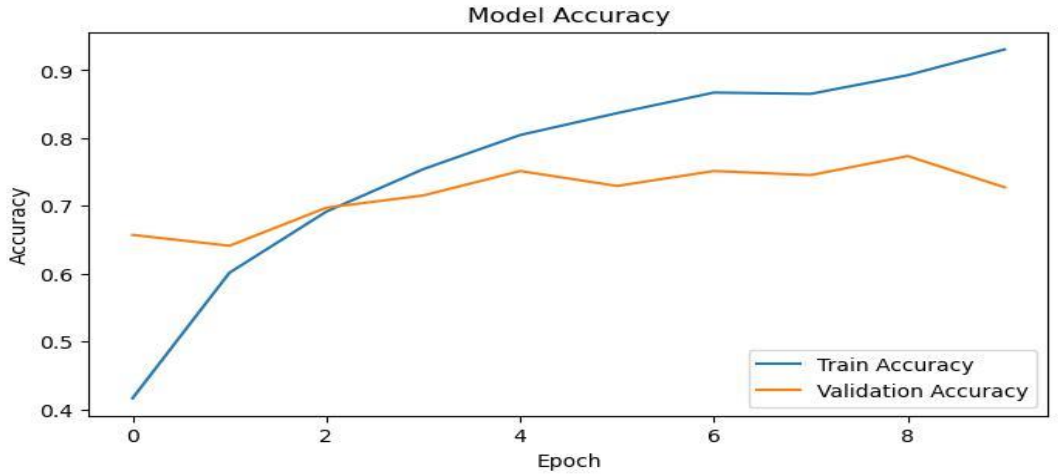
(Table 1: Performance Metrics of CNN Model)

System	Accuracy	Training Time	Feature Extraction
Existing ML Methods	78%	High	Manual
Proposed CNN Model	84.8%	Optimized	Automated

RESULTS AND DISCUSSION



(Fig: Accuracy of the Rice leaf disease)

The accuracy graph depicts model performance across various training epochs. The blue line is for training accuracy, which begins low and increases slowly, showing the model learning from training data. The orange line is for validation accuracy, which begins to get better but then fluctuates, showing signs of overfitting. By increasing the number of epochs, training accuracy continues to increase, over 90%, whereas validation accuracy becomes volatile and is incapable of showing the same increasing trend. This increasing gap between validation and training accuracy shows that the model may be memorizing training data rather than learning to generalize to new data well. To prevent overfitting and enhance the model's capacity for generalization, methods such as regularization, dropout, or early stopping may be employed.

CONCLUSION

The rice plant leaf disease diagnosis system accurately identifies leaf diseases with a CNN model . Preprocessing and data augmentation ensure the model is very accurate despite minimal overfitting. Metrics for evaluation confirm its accuracy. The system benefits farmers by identifying disease early, enhancing crop health. The system can be improved in the future by increasing the dataset as well as running the model as a user-friendly application.

ACKNOWLEDGEMENT

We extend our sincere gratitude to **Dr. Venkata Krishna** for his invaluable guidance and support throughout this research. His expertise and insights have been instrumental in shaping the development of this **Rice crop Disease Detection** project.

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We also thank the faculty members of the **Department of Computer Science and Engineering, J.B. Institute of Engineering & Technology**, for their encouragement and valuable suggestions, which have greatly contributed to the successful completion of this work.
Finally, we acknowledge the contributions of our peers, open-source communities, and the creators of essential datasets and tools that made this research possible.

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