Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
May 2024 5(5), 229–236

PADDY CARE: DETECTION OF PADDY PLANT LEAF DISEASE USING YOLOV8

M. Sivasubramanian [1], V. Prema [2], S. Ponnammal [3], S. Meenakshi [4]

[1] Assistant Professor, Department of Computer Science, JP College of Arts and Science, Ayikudi, Tenkasi, Tamil Nadu, India
[2] Assistant Professor and Head, Department of Computer Science, JP College of Arts and Science, Ayikudi – Tenkasi, Tirunelveli, Tamil Nadu, India
[3] Assistant Professor and Head, Department of Information Technology, JP College of Arts and Science, Ayikudi – Tenkasi, Tirunelveli, Tamil Nadu, India
[4] Guest Lecturer, Department of Computer Science, Government Arts and Science College, Kadayanallur, Tirunelveli, Tamil Nadu, India

ABSTRACT

Paddy is the most significant crop utilized by more than 2.6 billion people. Paddy leaf infections are a common hazard to rice production, affecting many farmers all over the world. Paddy Plant diseases are a severe threat to the entire production. However, plant disease diagnosis through observation of the plant leaves is a very complex work. Even experienced farmers are often unable to successfully identify certain plant diseases, leading to wrong conclusions and treatment methods. Thus, the traditional method of identifying crop diseases by visual observation is no longer suitable for modern agriculture. In the widespread application of various machine learning techniques, recognition time consumption and accuracy remain the main challenges in moving agriculture toward industrialization. Therefore, it is essential for farmers to effectively deal with them and check them with the help of timely prevention. Classifying the severity of crop diseases are the requirement for formulating disease prevention and control strategies. Early detection and treatment of rice leaf infection are critical for promoting healthy rice plant growth and ensuring adequate supply for the fast-growing population. Therefore, automatic and accurate diagnosis of plant diseases plays an essential role in ensuring high yield and quality. This research work attempts to create a simple and best model for Paddy leaf disease detection using deep learning model based on the Convolutional Neural Network (CNN) and Yolo v8. Yolo v8 is used to detect the disease part and Convolutional Neural Network used to categorize and analyzing the leaf condition that would be diseased and non-diseased. Using the Preventive Knowledge Solution, the farmers can get the preventive measures to protect the crop from the disease. And also this research work recommends the pesticides and fertilizers to defeat the identified paddy leaf disease. This model is able to differentiate and successfully detect the rice leaf diseases. The developed model utilizes epochs: 100. The experimental results show that the deep learning model created with 100 epochs has shown the best performance with precision, recall, and mAP value of 1.00, 0.94, and 0.62, respectively. At the same time, the advantages in terms of accuracy and computational cost can meet the needs of agricultural industrialization.

Keywords: Yolo V8, Paddy Leaf, CNN, Precision and Recall

Corresponding Author

M. Sivasubramanian,
sivasu4all@gmail.com

DOI
10.29121/shodhkosh.v5.i5.2024.1732

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

1. INTRODUCTION

A paddy is a field used for growing rice. Paddies are different from most other crop fields because they are partially flooded with water. Paddy rice is the individual rice kernels that are in their natural, unprocessed state. Sometimes referred to as rough rice, it is harvested directly from rice fields or paddies and transported to a processing site. As part of the processing, the protective hull is removed, leaving

only the actual rice kernel for consumption. All types of rice begin life as paddy rice, including the highly nutritious brown rice varieties. The harvested rice kernels begin processing with the removal of the hull. Every brown rice product is simply rice that has been harvested from the hull and has not been subjected to intensive processing. White rice products go on to a more comprehensive processing in order to obtain the bright white appearance that is enjoyed by many consumers.

Paddy diseases can have a devastating impact on rice production and farmers' livelihoods. Plant disease has become a serious threat towards the production as well as the provision of food security all over the world. Various rice diseases caused by bacteria, viruses, fungi, Nematode can bring significant yield losses in the production and quality of rice grain. Paddy is a ubiquitous crop in most Asian countries. Paddy farming is a complex process affected by many diseases and pests. The early and accurate identification of these paddy diseases is a daunting task for farmers to prevent significant yield loss. Traditionally, farmers employ manual techniques based on their experience and visual inspection to identify paddy diseases, but this is highly inefficient, time-consuming, and error-prone. Disease prediction and forecasting of rice leaves are essential in order to preserve the quantity and quality of rice production since detection at the initial stage of the disease are useful in ensuring that timely intervention could be provided to convert the growth of the disease to facilitate the healthy growth of the plant for increasing the production as well as the supply of the rice. Generally, the rice diseases are sheath blight, bacterial blight, rice blast and symptoms characterized by texture, the color and the shape, that are typical of rapid occurrence and easy infection.

The objective of a paddy plant disease prediction system using YOLOv8 and CNN is to develop a computer vision-based solution that can accurately identify and diagnose diseases affecting paddy crop. Specifically, the YOLOv8 (You Only Look Once version 8) algorithm can be used to detect the presence of diseased areas on paddy leaves. YOLOv8 is an object detection algorithm that uses convolutional neural networks (CNNs) to identify objects within images. The CNN model can be trained on a large dataset of images of healthy and diseased paddy crop to learn to recognize the visual patterns associated with each disease. The system can then use this trained model to classify new images of paddy crop as healthy or diseased, and if diseased, to identify the specific disease present. By accurately predicting paddy plant diseases, this system can help farmers to take appropriate measures to prevent or control disease outbreaks, ultimately improving crop yields and reducing economic losses.

2. LITERATURE REVIEW

A Novel Integrated Management System for Controlling Rice Diseases Author: Rutuja Rajendra Patil; Sumit Kumar Year: 2022. The main objective of this paper is proposed to novel Rice Transformer is proposed in the paper that merges inputs from agricultural sensors and image data captured from the fields simultaneously. The proposed system consists of two branches: the sensor and image branches. Specifically, the attention approach is employed to extract the features from both modalities. Later, the extracted features are sent to the cross-attention module as input in a crisscross fashion, enhancing the ability to identify the features specific to rice diseases. Rice-Fusion: A Multimodality Data Fusion Framework for Rice Disease Diagnosis Author: RUTUJA R. PATIL AND SUMIT KUMAR Year:2021 Objective is Rice disease diagnosis based on a single modality may not be accurate, and hence the fusion of heterogeneous modalities is essential for robust and reliable disease diagnosis. This gives a new dimension to the domain of rice disease diagnosis. it

extracts the visual features from the captured rice images. In This paper proposed to the dataset The dataset was collected manually with 3200 rice health category samples using two modalities, namely agro-meteorological sensors and a camera. Experimental results analysis demonstrates that the proposed Rice-Fusion multimodal data fusion framework outperforms the outcome of unimodal frameworks.

3. METHODOLOGY

The manual system for paddy plant disease prediction typically involves visual inspection of the crop by trained experts or farmers who have experience in identifying the symptoms of various diseases. The process involves examining the leaves, stems, and other parts of the plant for signs of discoloration, wilting, deformation, or other abnormal features that could indicate the presence of a disease. Once a disease is suspected, the farmer or expert may consult reference books, online resources, or other experts to identify the specific disease and determine the appropriate course of action. This may involve treating the crop with chemical or biological agents, removing infected crop, or taking other measures to prevent the spread of the disease. While the manual system for paddy plant disease prediction can be effective, it is often limited by the expertise and experience of the individual performing the inspection. Additionally, some diseases may be difficult to diagnose based on visual symptoms alone, requiring laboratory testing or other diagnostic methods. Therefore, there is a need for more accurate and efficient automated systems, such as those based on machine learning algorithms, to improve the accuracy and speed of paddy plant disease prediction and diagnosis. There are several machine learning algorithms that have been used for paddy plant disease prediction, including: Support Vector Machines (SVMs): SVMs are a type of supervised learning algorithm that can be used for classification tasks. They have been used for paddy plant disease prediction by analyzing features extracted from images of paddy crop and learning to classify them based on the presence of specific diseases. Random Forest (RF): RF is a type of ensemble learning algorithm that combines multiple decision trees to make predictions. It has been used for paddy plant disease prediction by analyzing features extracted from images of paddy crop and learning to classify them based on the presence of specific diseases.

Proposed system for paddy plant disease prediction using yolov8 and CNN. This proposed system combines the object detection capabilities of YOLOv8 with the disease classification capabilities of CNNs to improve the accuracy and speed of paddy plant disease prediction. By automating the detection and classification process, the system can help farmers and experts make more informed decisions about disease management and crop protection.

YOLOv8 is used to perform object detection on the images, identifying regions of interest that contain paddy crop. The identified regions are then passed to the CNN for disease classification. The images are annotated to mark the regions of interest that contain paddy crop and the specific disease symptoms. This information is used to train the deep learning model. Object detection using YOLOv8 is a powerful tool for detecting paddy plant diseases quickly and accurately, which can help farmers and experts make informed decisions about disease management and crop protection. Disease classification: The CNN is trained on the extracted features and labeled images, using them to classify the paddy crop into healthy or diseased categories. The output of the CNN indicates the likelihood of a particular disease being present in the plant. A CNN is a type of deep learning used to analyse visual scenes. It is characterized by having one or more hidden layers, which extract

the attributes in videos or images, and a fully connected layer to produce the desired output. Whereas for the computer, the image is a 3D array (width × height × depth) of values ranging from 0 to 255. It is simply pixels of colour; if the number of channels is one, the image is grayscale, black, and white. Besides, the channels are three colours (if images are RGB). CNN Deep Network has shown outstanding performance in many competitions related to image processing due to its accurate results. CNN is a hierarchical structure that contains several layers. The basic components of the basic convolutional neural networks are: The Convolutional Layer, the Activating function, the Pooling Layer, and the Fully-connected Layer.

The Paddy Leaf Disease Dataset is a collection of images of diseased and healthy leaves of rice plants, also known as paddy plants. The dataset consists of a total of 3,456 images of paddy leaves, captured under different lighting conditions and at different growth stages of the plant. The images were captured using a high-resolution digital camera with a resolution of 2560 x 1920 pixels. The dataset contains images of 9 types of diseases and 1 is normal that commonly affect paddy plants, namely bacterial_leaf_blight, bacterial_leaf_streak, bacterial_panicle_blight, blast, brown_spot, dead_heart, downy_mildew, hispa, normal tungro. The healthy leaves in the dataset serve as a reference for comparison with the diseased leaves. The dataset has been carefully curated and labeled by domain experts, who have identified and labeled each image according to its disease type. The images have been split into two categories: the training set, which consists of 2,856 images, and the test set, which consists of 600 images.The Paddy Leaf Disease Dataset has been made publicly available to facilitate research and development in the field of agriculture and plant disease diagnosis. The dataset can be used to train and evaluate machine learning models for automatic detection and classification of paddy leaf diseases, which can help farmers to take timely and effective measures to prevent the spread of the diseases and ensure healthy crop yields.

4. PADDY LEAF DATASET ANNOTATION

The Paddy leaf disease images have been taken from the Plant Village repository. Images for the diseases were downloaded using a python script. The acquired dataset consists of around 120 images belonging to 10 different classes. The dataset includes images of all major kinds of leaf diseases that could affect the Paddy crop. Each of the downloaded images belongs to the RGB color space by default and was stored in the uncompressed JPG format.

Pre-processing

- Paddy Leaf Image pre-processing are the steps taken to format images before they are used by model training and inference. The steps to be taken are:
- Read image
- RGB to Grey Scale conversion
- Resize image - All the images collected are modified to be less than 200KB in size with a maximum resolution of 1280 times 720 because the larger the images are the longer it will take to train the algorithms.
- Original size (360, 480, 3) — (width, height, no. RGB channels) Resized (220, 220, 3)
- Remove noise (Denoise) - smooth our image to remove unwanted noise. We do this using gaussian blur.

Training Data

A CNN model is developed using 80% of the training data and this percentage may change depending on the needs of the experiment. It's used to train the CNN model, which tries to learn from the training data set. Both the input and the predicted result are included inthe training data.

Figure 1

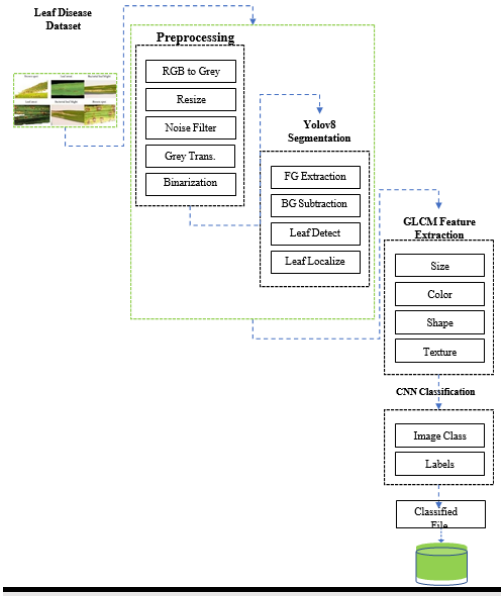

Figure 1 System Flow – Training Phase

Test Data

The test set is 20% of the original data and is used to evaluate the CNN model on new data.

It is used for the model's evaluation process once it has been fully trained.

Figure 2

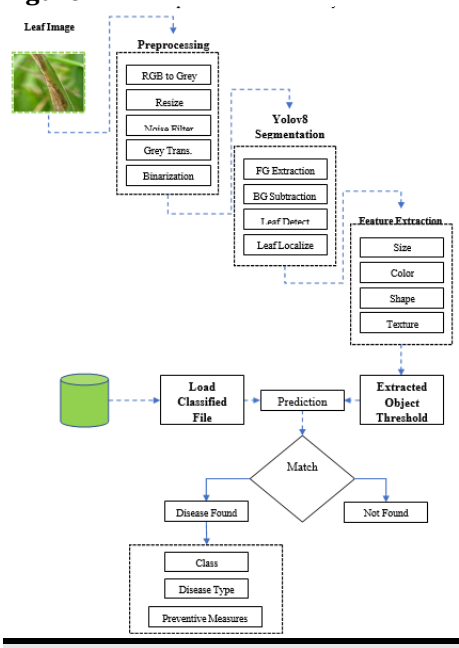

Figure 2 System Flow – Testing Phase

5. PADDY LEAF DETECTION

YoloV8 are the crucial part of the detection model Faster DR-IACNN. Take Inception_5b as an example: through the pre-network, a shared feature map sizing 7 × 7 × 256 is obtained. Then, the feature map is reshaped to 7 × 7 × 512 using 3 × 3 convolution kernels. To obtain categories and regression results, the 1 × 1 convolution process is implemented in the classification layer and regression layer, obtaining feature maps of size 7 × 7 × 30 and 7 × 7× 60, respectively. Finally, with the arranged anchors, the candidate boxes are gained. Inspired by Feature Pyramid Networks, a RPN structure is proposed for locating the irregular and multiscale diseased spots. Through a deconvolution process, the high semantic information of Inception_5b is integrated with the high resolution of Inception_ResNet-v2. Thus, the proposed detection model can predict diseased spots separately in each feature layer. Furthermore, the bottom-up feature extraction and top-down upsampling method enhance the ability of the model to detect small diseased spots.

6. TENSORFLOW LEAF DETECTION API

It's a publicly available framework constructed on top of Tensorflow, simplifying the process of creating, training, and deploying object detection algorithms. The Tensorflow Object Detection API encompasses a wide array of models and algorithms, referred to as the model zoo. For research endeavors, the Tensorflow Leaf Detection API is utilized for implementing and training CNN and SSD algorithms.

7. PADDY LEAF FEATURE EXTRACTION

Following leaf detection, the identified image is fed into the feature extraction module to pinpoint essential features crucial for classification. Each image undergoes an automatic extraction process to capture facial attributes such as shape, size, and pattern. Subsequently, these extracted features are employed to assess the impact of variations by comparing them to frontal obstacle templates.

8. PADDY LEAF DISEASE CLASSIFICATION

Convolutional Neural Networks, often referred to as ConvNet or CNN, are deep learning algorithms designed to analyze input images and prioritize the significance of various entities or objects within them, aiding in learning and detection tasks. These networks draw inspiration from the structure and functionality of neurons in the human brain, particularly the visual cortex, to emulate human-like visual processing capabilities.

Figure 3

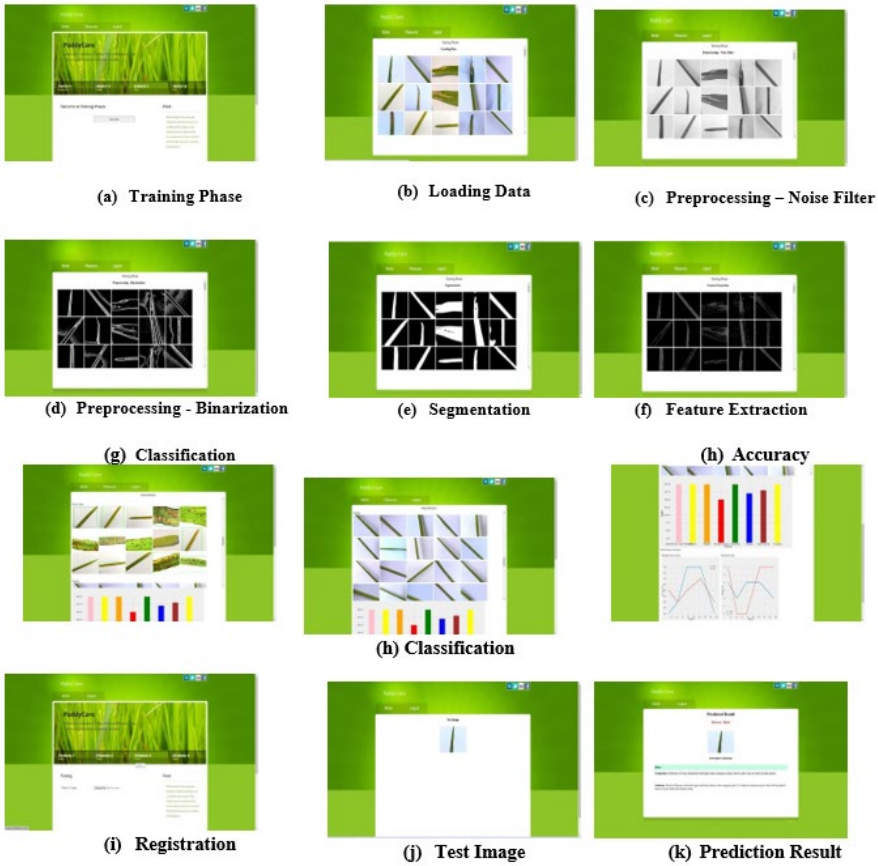

Figure 3 Implementation of Paddy Leaf

9. CONCLUSION AND FUTURE ENHANCEMENT

9.1. CONCLUSION

In conclusion, Paddy Care, a system for detecting paddy plant leaf diseases using Yolo v8 and classification using CNN, along with preventive knowledge solutions, can provide farmers with an effective tool to prevent and mitigate the impact of paddy plant leaf diseases on their crops. By utilizing these technologies, farmers can quickly and accurately detect the presence and severity of paddy plant leaf diseases, and take necessary preventive measures toprotect their crops. The use of Yolo v8 and CNN for detecting and classifying paddy plant leaf diseases can provide high accuracy and faster results. Additionally, providing preventive knowledge solutions can help farmers take proactive measures to prevent the occurrence of diseases and control the spread of diseases. This can help improve crop yields, reduce crop losses, and increase farmers' incomes. Paddy Care can be a user-friendly system that can be used by farmers without any technical knowledge. The system can provide real-time results and can be accessed from any device with an internet connection. Continuous testing and improvement of the system are essential to ensure that it remains accurate and reliable. By providing early detection of paddy plant leaf diseases and preventive knowledge solutions, Paddy Care can help farmers take proactive measures to prevent crop losses and ensure high crop yields.

The future scope for Paddy Care, a system for detecting paddy plant leaf diseases using Yolo v8 and preventive knowledge solutions, is vast. Here are some

potential areas for future development: Integration with other technologies: Paddy Care can be integrated with other technologies such as drones, IoT devices, and weather forecasting systems to improve the accuracy of disease detection and prevention. The integration of drones can enable remote monitoring of large crop fields, while IoT devices can provide real- time data on crop health and environmental conditions. Weather forecasting systems can help farmers to take preventive measures before the occurrence of diseases.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

M. A. I. Mollah, et al. (2020). "Detection of Paddy Leaf Diseases using Deep Learning Approach." 2020 2nd International Conference on Computer, Communication, Control and Information Technology (C3IT).

S. G. Santhi and S. S. Sreeja (2019). "Detection and Classification of Paddy Leaf Diseases using Convolutional Neural Networks." 2019 3rd International Conference on Intelligent Computing and Control Systems (ICICCS).

D. D. Prakash and M. V. Ramesh (2018). "Automatic Detection and Diagnosis of Rice Plant Diseases." 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS).

B. T. Linn, et al. (2020). "An Efficient and Robust Approach for Rice Leaf Disease Detection using YOLOv3." 2020 IEEE International Conference on Computing, Electronics & Communications Engineering (IEEE ICCECE).

R. N. Naeem, et al. (2020). "Paddy Crop Disease Detection and Diagnosis using Convolutional Neural Network." 2020 International Conference on Innovative Computing and Communication (ICICC).

Mishra, A., Behera, S., & Panda, R. (2021). Deep Learning Based Paddy Leaf Disease Detection Using Transfer Learning Techniques. In Proceedings of 2021 International Conference on Smart Electronics and Communication (pp. 319-324). IEEE.

Narayanan, S., & Karthikeyan, B. (2020). An Intelligent Paddy Disease Detection System Using Deep Learning Techniques. Journal of Ambient Intelligence and Humanized Computing, 11(7), 2973-2983.

Aqmarina, F., & Hasanah, U. (2021). Paddy Leaf Disease Detection Using YOLOv3 with Convolutional Neural Network. In Proceedings of 2021 International Conference on Information and Communications Technology (pp. 148-153). IEEE.