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A Survey on Identifying and Categorizing of Diseases in Rice Plants

Gayatri Parasa

Department of Computer Science & Engineering, Annamalai University, Tamilnadu.

gayathriparasa20@gmail.com

M. Arulselvi

Department of Computer Science & Engineering, Annamalai University, Tamilnadu.

marulcse.au@gmail.com

Abstract

Utilizing technology to enhance the cultivation of crucial crops for optimal yield and quality is a compelling prospect. The focus on automatic plant disease detection is particularly intriguing, offering the potential for effective monitoring across expansive agricultural fields and the automatic identification of diseases based on symptomatic cues in various plant sections. This research contributes to the field by presenting an automated diagnostic framework for various diseases affecting rice. The methodology integrates image processing, deep learning, machine learning, and meta-heuristic optimization techniques. Key factors considered encompass the size of the image dataset, the number of classes, preprocessing methodologies, classification approaches, and performance analysis. A comprehensive review of research conducted over the past decade is presented, covering diverse rice plant diseases. The survey delves into critical features, shedding light on the array of approaches employed for disease identification in rice plants. Attributes scrutinized in the study include segmentation methods, division technologies, extracted features, author details, dataset sizes, publication years, disease categories, techniques used, accuracy in detection and classification, as well as any associated constraints. Additionally, a proposed model employs a hybrid deep learning technique for the precise identification of specific rice plant diseases such as rice blast, brown spots, leaf smut, tungsten, and sheath blight.

Keywords: Bacterial Leaf Blight, Leaf Smut, Classification, Artificial Intelligence, Deep Learning

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Introduction:

Addressing one of the foremost challenges in the agriculture sector involves the early identification of plant pests and diseases. Particularly significant in India, where the economy heavily relies on agricultural productivity, with rice constituting approximately 70 percent of the total crop and 93 percent of the grain output [1]. Timely diagnosis of rice diseases is crucial for ensuring sustainable rice production, given the vital role rice plays as a staple food in India and its substantial consumption. Rice plants are susceptible to various diseases, including but not limited to Leaf Blast, Sheath Blight, Brown Spot, and Leaf Scald. These diseases, often caused by fungi or bacteria, can significantly impact crop yield, with an estimated 10 to 15 percent reduction in the case of rice in Asia. Identifying and classifying plant pests and diseases pose considerable challenges in the agricultural industry, particularly when considering the intricate structure of crops and their susceptibility to diverse diseases. Recognizing the necessity of detecting diseases in crops, researchers have turned to innovative methods to overcome the limitations of manual detection, where farmers rely on their experience or guidelines. The manual approach is time-consuming and requires careful consideration when selecting insecticides, often resulting in delayed responses to disease outbreaks. Despite the use of pesticides, significant losses in rice yield occur, impacting both quantity and quality. Consequently, the identification of diseases from rice images has become a pivotal area of research, bridging the domains of informatics and agriculture.

Recent research has focused on leveraging digital images for the identification and categorization of rice plant diseases, with an emphasis on computer-aided diagnostic systems utilizing RGB pictures. The integration of colour features and machine learning classification methods has demonstrated promising accuracy in identifying and classifying rice plants afflicted with diseases [2]. Deep learning methods have also gained attention in agricultural applications, contributing to the advancement of disease detection. The effectiveness of machine learning-based classification methods is underscored by their accurate performance in identifying rice plant diseases. Despite these advancements, conventional methods face challenges such as limited picture features, suboptimal classifiers, and challenges associated with shadow effects in captured crop images leading to misclassification. Additionally, the diversity of diseases with similar manifestations and the influence of various rice types and local conditions can pose hurdles for conventional methods. As a result, ongoing research aims

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to enhance the precision and efficiency of disease identification in rice plants through the integration of advanced technologies and methodologies.

Various types of diseases can afflict rice plants, encompassing a spectrum of infections. This section delves into the diverse classifications of rice infections, aiming to furnish insights into the specifics of work configuration [3]. The primary focus is on elucidating the criteria for image selection and structural types conducive to effective performance validation. The prevalent diseases affecting rice plants are elucidated below:

(a)

(b)

(c)

(d)

(e)

(f)

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(g)

Fig.1 Different kinds of rice plant diseases a) Brown Spot (BS), b) Leaf Blast (LB), c) Sheath Blight (SB), d) Leaf scald (LS), e) Bacterial Leaf Blight (BLB), f) Rice Blast (RB) and g) Sheath Rot (SR)

Data Acquisition: The initial step involves collecting images of rice plants along with additional soil and geographical data. In this work, a multimedia sensor, specifically an image sensor, is mounted on a metal pole. An impulse control mechanism is employed to adjust the relative direction of the sensor [4]. Scalar sensors, including those for soil, temperature, moisture, and humidity, are utilized to gather scalar information, which is then synchronized with image data processing. To comprehensively monitor the life cycle of rice plants, both numerical and image data are systematically collected and transmitted to the cloud for storage.

Pre-processing: The collected images may exhibit variations in quality, necessitating pre-processing. In this stage, RGB-colored images are preferred over HSV due to their clarity, even though the transformation from RGB to HSV may require some processing time. Additionally, feature extraction is performed to provide relevant information to the classifier, ensuring a more effective analysis of the images.

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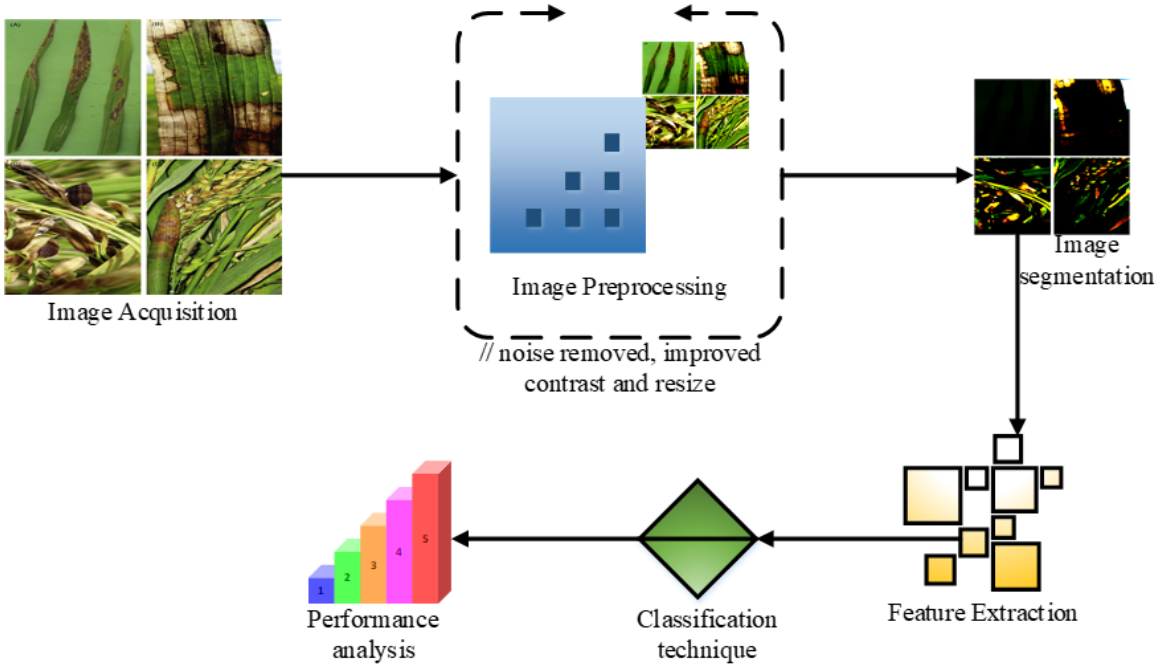

Fig 1.3: General Procedure for Rice Plant Disease Identification

Segmentation: The proposed method employs a watershed clustering-based segmentation technique to segment the images effectively.

Feature Extraction: A novel approach utilizing heap-coupled jellyfish optimization is applied to extract features from the segmented images. This technique proves instrumental in distinguishing between various diseases.

Classification: The study introduces the Generative Fuzzy-based Deep Belief Neural System (GFDBS) classifier to determine the contamination status of leaves and subsequently identify specific diseases. Python-based computer vision and machine-learning tools such as NumPy, pandas, and TensorFlow are employed for data processing and disease identification. The GFDBS model demonstrates exceptional accuracy in classifying major diseases like rice blight, rice blow, smut of leaves, brown spots, and sheath blight.

Conclusion:

Plant diseases pose a significant threat to agriculture, potentially leading to substantial losses if not promptly addressed. Leveraging computer and communication technologies, the development of an automated system becomes feasible, offering early disease notifications.

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This survey explores recent advancements in the detection and classification of diseases in rice plants. A comprehensive examination of numerous papers has been conducted, evaluating research outcomes related to various rice plant diseases against essential benchmarks. The survey specifically focuses on recent studies pertaining to the detection of diverse types of rice plant diseases. Upon scrutinizing these research articles, it is evident that numerous researchers have made noteworthy contributions, particularly in the realm of deep learning for the detection of rice diseases in agriculture. However, some literature reviews indicate a limitation in data availability. To address this, a proposed solution involves the introduction of a hybrid deep learning-based algorithm. This innovative approach aims to enhance classification accuracy, thereby improving the reliability and robustness of rice disease diagnostic systems. By augmenting the dataset with more images and fine-tuning the parameters of the deep learning model, the proposed algorithm holds the potential to further elevate classification accuracy.

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