



RICE PLANT DISEASE IDENTIFICATION USING ARTIFICIAL INTELLIGENCE APPROACHES

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ABSTRACT

One of the fascinating research areas in agriculture is the identification of illnesses from plant photos, which may be done using machine learning principles from the computer field. The proliferation of plant pests and diseases has accelerated in recent years. Globalization, trade, and climate change have all had an impact, as has the weakening of ongoing systems as a result of many years of agricultural intensification. Plant diseases can injure plant components above or below ground and can be parasitic, bacterial, viral, or nematode-like. It is critical to recognise symptoms and understand when and how to effectively control diseases. In the agricultural field, yield loss is primarily caused by a widespread disease. The majority of the time, illness detection and diagnosis occur when the disease has progressed to a severe level, resulting in a loss of yield, time, and money. For the time being, a quick refresher of the Image Processing techniques and Deep Learning models used to detect rice plant diseases is in order.

Keywords: Agriculture, Rice Plant Disease, Image Processing, Deep Learning, Segmentation, Feature Extraction, Classification

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1. INTRODUCTION

Plant diseases are one of the factors contributing to the decline in the quality and quantity of agriculture crops [1]. A drop in both viewpoints can legitimately affect a country's overall crop creation [2]. The primary issue is the lack of constant monitoring of the plants. Amateur farmers are sometimes unaware of diseases and their occurrence periods. In general, diseases can strike any plant at any time. Persistent surveillance, on the other hand, may help to prevent illness infection. One of the most important study issues in agriculture is the detection of plant disease.

This paper tries to use machine learning and image processing techniques to solve the problem of autonomous disease detection and classification in the rice plant, which is one of India's most important meals. Diseases are caused by bacteria, fungi, and viruses on any plant. Bacterial leaf blight, Brown spot, Leaf filth, Leaf blast, and Sheath blight are the most generally recognised diseases in rice plants [1][3]. Image processing techniques can be used to improve the appearance of sick plants from the outside. Disease signs, on the other hand, differ depending on the plant. Some diseases are brown in hue, while others are yellow in colour. Every disease has its own distinct features. Disease symptoms vary in size, colour, and fit as a fiddle. Some diseases have similar colours but different shapes, whereas others have different colours but similar shapes. Farmers can become perplexed and unable to make appropriate pesticide judgments at times.

One strategy for dealing with crop loss due to disease infection is to capture photos of infected leaves and learn more about the illness [4]. Cameras can be supplied at precise separations on the homestead to capture photographs on a regular basis as an automated remedy to this problem. These photos can be submitted to a focused system for disease analysis; the system will identify the disease and provide information on the disease as well as pesticide options. The automatic recognition of the disease that has developed would be at the heart of such a system.

2. RICE PLANT DISEASES

Listed below are the various forms of rice plant diseases considered:

Bacterial Leaf Blight: The sample image for this type of disease is given in figure1.

- **Components** of a plant where it affects: commonly affects leaves regarding the plant.
- **Symptoms Shape:** Symptoms contain elongated lesions from the leaf tip, lesions are many inches long.
- **Lesion color:** Yellow to White as a result of the effect of bacteria.

Brown Spot: The sample image of this type of disease is given in figure2.

- **Components** of a plant that it affects: generally, affects leaves regarding the plant.
- **Symptoms Models:** Signs and symptoms regarding the disease are round to shape that is oval.
- **Lesion color:** Reddish Colored Brown to Dark Brown.

Leaf Smut: The trial image for these types of disease is presented in figure3.

- **Components** of a plant that it affects: typically, affects leaves regarding the plant.
- **Symptoms Models:** signs and symptoms regarding the disease are small spots scattered for the leaf in non-uniform shape.
- **Lesion color:** Reddish Brown.

3. BACKGROUND STUDY ON IMAGE PROCESSING TECHNIQUES

Image processing is the study and control of a digitalized image with the goal of improving image processing quality. Diagnostic image examination, Surgical arranging, Object detection, and Matching, Background subtraction in video, Localization of tumours, Measuring tissue volumes, Locate objects in satellite images (streets, woodlands, and so on.), Traffic control systems, Locate objects in face recognition, iris recognition, agricultural imaging, and medical imaging are just some of the fields where the DIP technique can be used. To improve the degraded image, Digital Image Processing (DIP) addresses obstacles and issues such as image quality degradation. A wellspring of image data, a processing component, and a goal for the

managed outcomes make up the image processing system. A camera, a sensor, a satellite, a scanner, a mathematical equation, statistical data, the Web, a SONAR system, and so on could all be sources of picture data. A computer is the processing component, the aim is the planned outcome, and the processing yield is a display monitor [5][6][7][8].

Image Concept: An image is a method of communication that conveys visual information to a human being; there are two sorts of images: analogue and digital. A true picture and a digital image are two-dimensional images with a limited arrangement of digital values, called picture components or pixels. An analogue image is persistent and rash, whereas a true picture and a digital image are two-dimensional images with a limited arrangement of digital values, called picture components or pixels. The digital image is made up of discrete pixels or groups of pixels, each with a different whole number brightness value, known as Gray-level.

Acquisition of Image: It could be anything as basic as being given a digital image. The major task entails:

- Scaling
- Conversion of Colour (RGB to Gray or vice-versa)

Enhancement Image It is also utilized to retrieve some hidden details from an image and is subjective. It is one of the simplest and most engaging in areas of Image Processing.

Restoration of Image: It also has to do with the attractiveness of an image, although it is objective (Restoration is based on mathematical or probabilistic model or image degradation).

Colour Image Processing: It covers pseudo-color and full-color image processing, as well as colour models for digital image processing.

Processing of Colour Image: It relates to full colour and pseudo-colour image processing colour designs can be applied to digital image processing.

Processing of Multi-resolution and Wavelets: it really is first step toward presenting images in several degrees.

Image Compression: It requires in growing certain functions to execute this activity. It primarily deals with image resolution or size.

Morphological Processing: It relates to tools for getting image elements which can be beneficial in the description & representation of shape.

Segmentation: It contains division a graphic into its parts that are constituent objects. Independent segmentation is one of task that is difficult Image Processing.

Presentation and Description: It uses result of segmentation phase, finding a interpretation is just the section of solution for transforming data that are raw processed data.

Object Detection and Recognition: it really is an ongoing process that adds a tag to an object dependent on its form.

4. PLANT DISEASE DETECTION USING IMAGE PROCESSING TECHNIQUES

At this time, various researchers work complete detection of plant disease Image that is using Processing Deep Learning and Machine Learning models.

Chung, Chia-Lin, et al. [9] proposed employing machine vision to nondestructively identify sick and healthy seedlings at 3 years old weeks. Flatbed scanners were used to capture images of infected and control seedlings in order to measure their morphological and colour characteristics. In order to distinguish between infected and healthy seedlings, support vector machine (SVM) classifiers were created. The fundamental attributes and optimum model parameters for the SVM classifiers were chosen using a hereditary computation.

Raut, Sandesh, and Amit Fulsunge [10] familiarised with a contemporary technique for detecting disease in both leaves and natural products. The creators used a digital image processing technology for quick and exact disease identification of the plant to overcome the drawbacks of the traditional eye watching technique. The designers of the suggested work combined a k-means clustering calculation with a multi SVM calculation in MATLAB software to identify and classify diseases.

Sethy, Prabira Kumar, et al. [11] offered an approach in which a cell phone mounted on a selfie stick was used to capture planthopper photos on rice stems, and the population thickness of RBPH was scaled using image processing techniques. For segmentation, picture enhancement, median filtering, and k-means clustering were used.

Bansod, VishakhaLahu [12] devoted to research on rice plant diseases, as well as other plants and organic goods. The authors looked at a few different articles based on a few key characteristics. These factors include the size of the picture dataset, the number of classes (diseases), preprocessing, segmentation approaches, classifier types, classifier precision, and so on. The creators advocated research on rice drop illness detection and classification.

Joshi, Amrita An., and B. D. Jadhav [13] Another method for diagnosing and classifying rice illnesses has been proposed. Rice bacterial blight, rice blast, brown rice spot, and rice sheath spoil are four illnesses that have been identified and characterised. By constructing a calculation, several features such as form and the colour of a diseased part of the leaf were isolated. The diseases were categorised using the Minimum Distance Classifier (MDC) and k-Nearest Neighbor classifier, and all the eliminated features were consolidated according to the diseases (k-NN).

Tichkule, Shivani K., and Dhanashri H. Gawali [14] introduced a discussion of how to distinguish different plant diseases using image processing techniques. Image processing provides more effective methods for identifying diseases caused by organisms, bacteria, or viruses on plants. Minor perceptions of diseases through the eyes are not exact. When pesticides are used in excess, they induce chronic ailments in humans if they are not cleansed properly. In addition, excessive use degrades the nutritional quality of the plant. The rancher suffers a massive loss of creativity as a result of this. As a result, image processing techniques can be used to distinguish and classify diseases in agricultural applications.

Abdullah, Siti Norul Huda Sheik, et al. [15] The Research method begins with a camera modification based on separation against a predetermined rectangle intrigue location. Picture capture with portable and continuous devices, image segmentation with a proposed bi-level limit, system extraction based on image texture evaluation, and rice anomaly detection with a creation rule technique are all discussed. Each captured image detects irregularity based on the form and colour of the lesion. Blast Disease, Brown Spot Disease, Narrow Brown Spot Disease, and Sheath Blast Disease are the four types of rice variants that were studied, with standard leaves serving as the test control.

Mai, Xiaochun, and Max Q-H. Meng [16] developed a superpixel segmentation and irregular woods classifier-based automatic lesion segmentation technique. The proposed technique's means are represented as follows. To begin with, scaling and colour modification techniques are used to preprocess field pictures. Second, using the SLIC superpixel calculation, preprocessed images are portioned. Third, each superpixel has 32 local features deleted, including colour features, shape features, and texture features. The arbitrary woodland classifier classifies superpixels of a picture according on these properties. The segmentation of a picture is complete when all of the superpixels have been correctly classified.

Mondal, Dhiman, and Dipak Kumar Kole [17] Using image processing, a harsh set, and fuzzy c-means, a time-effective technique for detecting the presence of leaf rust disease in wheat leaves was developed. The proposed technique was tested on 100 standard sick and non-

diseased wheat leaf images and achieved a 95 and 94 percent accuracy rate using the most three overwhelmed characteristics and the single most ruled feature, Ratio of Infected Leaf Area, respectively (RILA). The Pearson relationship coefficient selects three of the most ruled features and one of the most commanded features from a total of 10 features.

Lu, Yang, et al. [18] A novel rice disease detection system based on deep convolutional neural networks (CNNs) techniques has been suggested. CNNs are trained to recognise 10 common rice diseases using a dataset of 500 real photos of damaged and healthy rice leaves and stems collected from the rice trial field.

Islam, Monzurul, et al. [19] proposed an approach for diagnosing diseases from leaf photos that combines image processing and machine learning. This algorithm uses an openly accessible plant picture collection named 'Plant Village' to classify illnesses (or their absence) on potato plants. The segmentation method was developed using Support Vector Machine, and the proposed strategy paves the way for automated plant disease diagnosis on a large scale.

Prajapati, Harshadkumar B., Jitesh P. Shah, and Vipul K. Dabhi [20] proposed a prototype system based on photographs of infected rice plants for the detection and categorization of rice illnesses. After an itemised test analysis of numerous methodologies used in image processing tasks, this prototype system was constructed. The authors take into account three rice plant diseases: Bacterial leaf blight, Brown spot, and Leaf muck. Using a digital camera, the creators capture photographs of sick rice plants in a rice field. Four strategies for background removal and three techniques for segmentation are observed and evaluated by the developers. To aid with the precise extraction of characteristics, the creators advocated using centroid-based K-means clustering for disease segmentation from a leaf image. By deleting green pixels from the illness part, the authors improve the output of K-means clustering. Color, shape, and texture are the three categories from which the writers derive various features. For multi-class classification, the authors employed Support Vector Machine (SVM).

Yuan, Yuan, et al. [21] To diagnosis crop leaf diseases, another image recovery approach based on the improvement of the altered list was developed. First and foremost, the illness photos in the info crop were pre-processed, including compression, denoising, augmentation, and so on. The disease's features were then eliminated from the overall image. Meanwhile, the Hash approach was used to outline altered list feature vectors to twofold values in order to reduce the storage capacity of rearranged file feature vectors. In the similarity computation between the acquired features data and the lesion features from the produced disease picture files, the hamming separation was used.

Singh, Malti K., and SubratChetia [22] introduced the use of accelerated computer innovation to develop an automatic detecting method. Image processing, for example, can assist farmers in identifying diseases at an early or early stage and providing useful information for disease control. As a result, utilising image processing techniques, the presented investigation was performed on automatic disease identification of *Phaseolus vulgaris* (Beans) and *Camellia assamica* (Tea) plant leaves. Image acquisition, image pre-processing, image segmentation, feature extraction, and classification are all part of the process.

Rajalakshmi et al [44] has explained the prospects and problems in Paddy cultivation. They have pointed out that insects and fungal issues are the main problems in paddy cultivation along with irrigation and preservation issues. After cultivation, finding market and appropriate price for the product is next issue faced by the farmers.

Qing, Y. A. O., et al. [23] Using image processing, a new three-layer detection technique was developed to recognise and distinguish white-backed planthoppers (WBPHs, *Sogatella furcifera* (Horváth)) and their formative stages. To recognise WBPHs and remove pollutions, the designers used an AdaBoost classifier based on a histogram of arranged inclination (HOG)

feature and a support vector machine (SVM) classifier based on Gabor and Local Binary Pattern (LBP) features in the first two detection layers.

Elangovan, K., and S. Nalini [24] For sustainable agriculture, disease classification on the plant is critical. Physically, it's difficult to keep track of or treat plant ailments. It takes a lot of labour and takes a long time to process; the creators used image processing to detect plant problems in this way. Load picture, pre-processing, segmentation, feature extraction, and svmClassifier are some of the methods used to classify plant diseases.

Narmadha, R. P., and G. Arulvadiu [25] The goal of this study is to identify paddy illnesses. Blast Disease (BD), Brown Spot Disease (BPD), and Narrow Brown Spot Disease (NBSD) are some of the paddy diseases that prevent paddy development and insurance. The disease can infect paddy at any stage of development and in any region of the plant, including the leaf neck and hub. Bacteria, growth, and other factors can all contribute to the spread of paddy illnesses. The process was designed to mechanically expel the commotion, a human error, while also decreasing the time it took to menstruate the effects of paddy leaf sickness.

Islam, Taohidul, et al. [26] used image processing to introduce a new technique for identifying and classifying diseases based on the amount of RGB value of the impacted parcel. When the RGB levels from the affected area are split and grouped into different classes, they are fed through a simple classifier called Naive Bayes, which categorises the disease into different groups. Rice brown spot, rice bacterial blight, and rice blast have all been successfully identified and discriminated using this technique. This method is efficient and rapid because it just uses one feature, such as the RGB values of the effected partition, which requires the least amount of computation time to distinguish and categorise diseases.

Bakar, MN Abu, et al. [27] Using the image processing technique, they portrayed Rice Leaf Blast (RLB), a coordinated mechanism for detecting pathogens on leaves. The Hue Saturation Value (HSV) colour space is used for picture pre-processing, image segmentation, and image research. Image segmentation (the most basic operation in image processing) is used to clear the district of intrigue, and design recognition based on the Multi-Level Thresholding approach is proposed.

Atole, Ronnel R., and Daechul Park [28] The use of deep convolutional neural networks in the classification of rice plants as indicated by their wellbeing level based on photographs of their leaves was investigated. Through exchange learning from an AlexNet deep network, a three-class classifier speaking to typical, unhealthy, and snail-swarmed plants was implemented.

Kitpo, Nuttakarn, and Masahiro Inoue [29] introduced a rice disease detection and classification system based on the Internet of Things (IoT) engineering and ongoing information, including data collecting and data examination using image processing techniques. The system is capable of providing systematic results, such as the location of infected rice plants in rice fields, as well as mapping them using GPS sensors to characterise the condition over time. With the use of IoT engineering, this system was planned and offered as an essential to support system for ahead of schedule and continual disease detection.

Kodama, Takuya, and Yutaka Hata [30] By analysing photographs of rice planted in the paddy field, a system was developed to distinguish healthy and unhealthy rice plants. The creators focused on colour information because the symptom is clearly visible in rice illnesses. Following that, the pixel value was used as the feature, and an SVM classifier was created.

Ramesh, S [31] developed a machine-learning calculation to find the illness symptoms in rice plants. A machine learning computation is used to complete the automatic detection of plant disease. For the proposed system, images of healthy and blast disease-affected leaves are taken. For the healthy and disease-affected sections of the rice leaf, the features are deleted.

Devi, T. Gayathri, and P. Neelamegam [32], For the most part, image processing techniques are regarded to be a strategy for automatically distinguishing leaf diseases. The suggested system incorporates picture acquisition, image pre-processing, segmentation, and classification of paddy leaf illness to determine these diseases. Currently, the discrete wavelet transform, scale-invariant feature transform, and grayscale co-event framework approach are used to remove the features. Finally, to classify disease and non-disease plants, the deleted features are fed into several classifiers such as K closest neighbour neural network, backpropagation neural network, Nave Bayesian, and multiclass SVM. To classify leaf disease, a variety of classification strategies are examined.

Sethy, Prabira Kumar, et al. [33] The rice leaf blast is currently the main impediment to rice production (RLB). Monitoring RLB is the first time to time in this manner. This paper introduced a new on-field picture segmentation technique that combines channel extraction, thresholding, and masking to identify RLB.

Larijani, Mohammad Reza, et al. [34] The goal of this study is to determine how quickly and efficiently rice blasts can be resolved in field situations using image processing techniques. To accomplish so, colour images were prepared using an image processing technique, and the images were classified in Lab colour space using an upgraded KNN calculation by Kmeans. The Otsu approach was used to play out an automatic limit histogram of images based on the shape or to lower the Gray level in paired images, and the squared classification was based on Euclidean separation.

Mique Jr, Eusebio L., and Thelma D. Palaoag [35] Using a Convolutional Neural Network (CNN) and image processing, an application was proposed to assist farmers in differentiating rice bug pests and diseases. It looked into the various bugs that attack rice fields; information on how to control and oversee them was considered; farmers' knowledge of various rice nuisances and diseases, as well as how they control these bugs, was respected at the time; and the announcing component of farmers to government organisations was also considered. The application that distinguishes rice irritations and infections was produced using CNN and image processing. A CNN-based model was used to search for and examine captured photos against a stack of rice bug photographs.

Chen, Junde, et al. [36] Considered using a deep learning strategy to solve the problem because it has demonstrated exceptional performance in image processing and classification problems. The DenseNet pre-prepared on ImageNet and Inception module was chosen to be used in the network because it combines the benefits of both, and this methodology provides a better presentation with deference than other cutting-edge methodologies.

Li, Hui [37] centred on the recognition and detection of crop diseases, which has attracted a lot of attention in the field of computer vision innovation. The acquisition and processing techniques of rice disease images are now being examined, as well as the essential standards, key approaches, recognition strategies, and application effects of some common techniques, in the hopes of providing a reference to rice disease recognition study.

Shrivastava, Vimal K., et al. [38] proposed an image-based machine learning method for classifying and identifying plant diseases. Currently, the creators are focusing on the rice plant (*Oryza sativa*) disease. From the rice field, photos of sick symptoms in leaves and stems were captured.

Saleem, Muhammad Hammad, Johan Potgieter, and Khalid Mahmood Arif [39] gave a thorough explanation of the DL models that are used to predict various plant diseases. Furthermore, several study gaps have been identified from which to gain a clearer understanding of how to recognise diseases in plants even before symptoms appear.

Barbedo, Jayme Garcia Arnal [40] Instead of considering the entire leaf, researchers looked into using particular lesions and spots for the task. Because each district has its own qualities, the data's inconstancy is increased without the need for more photographs. This also allows for the detection of various illnesses that affect the same leaf. Nonetheless, appropriate symptom segmentation should be performed physically, avoiding full automation [46-49].

Chen, Junde, et al. [41] Because of the distinctive presentation, intense deep learning is becoming the preferred technique. Study the learning of deep convolutional neural networks for the detection of plant leaf diseases right now, and consider employing a pre-prepared model derived from conventional, enormous datasets, before moving on to the specific challenge given by our data. In our methodology, we chose the VGGNet pre-prepared on ImageNet and the Inception module. We instate the loads using the pre-prepared networks on the massive marked dataset, ImageNet, rather than starting the training without any preparation and arbitrarily adding the loads.

5. CONCLUSION AND RESEARCH DIRECTION

This review clarified the different research works done on the Rice plant disease detection using Image Processing, Machine Learning, and Deep Learning approaches. Additionally, numerous representation techniques/mappings were abridged to recognize the symptoms of diseases. Albeit much critical advancement was watched, there is still some research hole which is depicted right now:

- The seriousness of plant diseases changes with the progression of time, along these lines, Machine Learning and Deep Learning models ought to be improved / altered to empower them to identify and classify diseases during their total cycle of the event.
- ML/DL model architecture ought to be productive for some brightening conditions, so the datasets ought to show the actual condition as well as contain images taken in different field situations.
- An exhaustive investigation is required to comprehend the factors are affecting the detection of plant diseases, like the classes and size of datasets, learning rate, illumination, and the like.

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