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Rice Leaf Diseases Detection Using Machine Learning

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ABSTRACT

One of India's most widely grown crops, rice is susceptible to a wide range of illnesses during the growing process. Due to a lack of training and experience, farmers have a hard time making reliable diagnoses when identifying these illnesses manually. Timely detection of diseases and the application of necessary treatments to afflicted plants are crucial for ensuring healthy and normal development of rice plants. In today's agricultural fields, the detection of leaf diseases is of the utmost importance. Consequently, we may use machine learning to identify diseases in rice leaves by image processing. The agriculture sector is in dire need of a system that can identify rice plant problems automatically. We present a novel convolutional neural network (CNN) model for the classification of prevalent rice leaf diseases. From a variety of picture backdrops and capture situations, our algorithm can identify rice leaf illnesses. Classifying disease pictures in rice leaves with complicated backgrounds and varying lighting conditions is our goal. We reach 95% accuracy with the CNNs based model. The outcomes for disease identification in rice demonstrate the effectiveness of suggested approach. Disease detection, CNN algorithm, rice leaf, and machine learning are index terms.

Keywords: Machine learning, rice leaf disease, CNN.

I. INTRODUCTION

More over 80% of the Indian population relies on agriculture as their primary means of subsistence. Employing 52% of the workforce and contributing 15% to GDP growth, it is a major economic driver [1]. Nonetheless, we are aware of the nation's agricultural situation and the dearth of direction and funding. When it comes to agricultural output in India, plant diseases are a major drag. Every year, plant diseases account for 10–16% of the world's agricultural losses [2]. On the other hand, in India, we rely on a more time-consuming and expert-level conventional method for illness identification. A number of practical applications have recently seen an uptick in the use of machine learning (ML) methods, particularly for categorization and object identification [3]. The Indian economy benefits from the production of rice, a crucial crop in the country. They anticipate that fungus, germs, vaginal stains and burns, leaf burns, and so on will impact the quality. There is a disruption in the production, quantity, and quality of rice. It is challenging for farmers to diagnose illnesses. By analyzing picture attributes, image processing methods may forecast rice quality as it relates to diseases. Disease identification feature classification makes use of many classifiers, such as decision trees, neural networks, support vector machines, etc. In a number of contexts, deep learning approaches are competitive with more conventional approaches to image processing. Hence, the purpose of this study was to examine the potential of deep learning models for illness prediction and classification in rice. Because of their remarkable performance in picture categorization, deep learning approaches have piqued the interest of researchers. Deep Convolutional Neural Networks (CNNs) are the most used deep learning method for picture classification. Image classification may make use of a variety of deep learning systems. Brown spot, leaf spot, bacterial blight, and rice plant diseases are all part of the Kaggle dataset, which the suggested model uses to evaluate its success in predicting crop damage. Image classification may make use of a variety of deep learning systems. A number of diseases may infect rice plants. These problems have an effect on efficiency. Multiple big spots on the leaf, which might eventually destroy the leaf entirely, are the most noticeable symptoms of brown spotting, a fungal disease. A leaf spot is characterized by the appearance of tiny black dots on the leaves. Serious losses may occur as a result of bacterial decay. At first, the lesions appear as bands on the leaf blades that are wet with water. Later on, the bands become longer and the diseased leaves eventually dry out. Feature learning extraction makes use of convolutional neural networks (CNNs), which are a subset of deep learning architectures, to extract features and construct nonlinear feature hierarchies. One way to identify and categorize illnesses affecting rice leaves is with the use of the suggested method. Helping farmers obtain excellent yields by detecting and diagnosing rice leaf diseases early on. Six parts make up our study paper. The following sections make up the paper: Introduction: Section 1. Here we lay forth the foundation and purpose of our study report. Part 2: Review of Relevant Literature. This section provides a brief overview of several image processing and machine learning processes used for disease identification in rice leaves. Methodology (Section 3). This part provides a synopsis of the procedure. Part 4: Findings and Analysis. Here are the outcomes that we have accomplished. Chapter 5: Final Thoughts. We have covered the main points and breadth of our study report.

II. RELATED WORK

In order to identify and categorize illnesses in rice plants, researchers also employed image processing and machine learning methods [4]. The suggested study classified the infected rice leaf areas using Support Vector Machines (SVMs) and segmented those areas using K-means clustering. They were able to get a final accuracy of 93.33 percent on the training dataset and 73.33 percent on the test dataset. Although our study also made use of the same dataset, our technique led to improved accuracy in both the training and test datasets. A total of 330 photos of rice plant leaves were utilized to construct the image data shown in [5]. Of these, 60% were used for training purposes, while 40% were used for testing. Using a hybrid of the Otsu and Global threshold methods, we segment the leaf areas. The use of the KNN classifier resulted in a classification accuracy of 76.59%. You may find a novel model for detecting and classifying diseases in rice plants in [6]. The digital camera takes pictures of the rice plants, and then the photos are segmented using K-means clustering based on centroid feeding. The next step is to extract characteristics based on color, shape, and texture. The last step in multiclass classification is the use of Support Vector Machines (SVM). On the training data, the given model achieved an accuracy of 93.3%, while on the test data, it was 73.3 percent accurate. Created a model for disease detection in rice plants using DL techniques in [7]. Five hundred pictures of rice plant leaves and stems are used for testing. Specifically, it employs the Alex Net and LeNet-5 CNN models. The results of this research show that stochastic pooling improves CNN method generalizability and prevents over fitting. The authors of [8] have developed a CNN-based model for accurate rice plant identification. Additionally, a dataset consisting of 500 photographs of both diseased and uninfected rice plant leaves and stems was examined. The suggested approach outperformed the conventional ML models in classifying a group of ten rice illnesses. In order to assess the RoI, we use the neutrosophic logic approach to identify any diseased areas in the picture. When tested on a dataset of 400 photos of leaves, the random forest (RF) model outperformed the other classification methods. In [9] developed a disease detection model for rice plants. In order to establish the severity of the sickness, this approach first finds the affected region. We use pesticides on rice plant illnesses based on their severity. An innovative approach to disease detection in rice plants has been created in [10] by using the Naive Bayes (NB) classification model. With minimal computing time required, our technique has identified and classified three main types of rice plant diseases. Created a novel method for the automated diagnosis of rice plant illnesses in [11]. After the features have been extracted, other classification methods such as SVM, NB, BPNN, and KNN are used. Singh et al. suggested a method for improving images using Histogram Equalization in [12]. To segment the image, K-means organizes pixels of various colors into distinct clusters. Based on the method of pixel separation and unique color intensities, K-means clustering produced accurate results. Before using SVM to classify rice leaf illnesses, we retrieved standard deviation and mean disease portion characteristics. Nguyen et al. used LBP analysis from the local structural aspect in [13]. Various directions in the local area reveal a pixel's connection in the support binary pattern. Through testing with texture classification and disparity map creation, they determined that the model outperforms state-of-the-art local pattern techniques. Phadikar et al. presented a method for distinguishing between two rice illnesses in [14]. The first step was to sort the leaves by disease status using the histogram peaks. The second level involves the use of SVM and Bayes classifier to categorize the illnesses affecting rice leaves. Phadikar et al. presented a method for distinguishing between two rice illnesses in [15]. The first step was to sort the leaves by disease status using the histogram peaks. There is a second level of disease classification for rice leaves using support vector machines and Bayes' classifier. One study suggests utilizing convolutional neural networks (CNNs) in conjunction with transfer learning to categorize illnesses affecting rice leaves [16]. We train and evaluate the proposed CNN architecture using data acquired from internet and rice fields, which is based on VGG-16. The dataset used to assess the algorithm includes 1649 photos of three prevalent diseases: brown spot, rice leaf blast, and rice leaf blight. Pics of healthy leaves number 507. The test accuracy is 92.4%, whereas the training set accuracy is 97%. Here, we show that using a transfer learning strategy improves classification accuracy.

III. METHODOLOGY

This methodology describes the steps to systematically use machine learning to identify and diagnose illnesses in rice leaves. Early disease identification is critical for maintaining crop health and agricultural output, especially in the case of rice, one of the most important staple crops in the world. Our goal is to create a reliable disease detection system that will let farmers intervene quickly by following these procedures. Data collection, preprocessing, model creation, and deployment are all parts of the methods that help identify rice leaf diseases efficiently and accurately. We provide a graphic illustration of this procedure below.

Proposed Method:

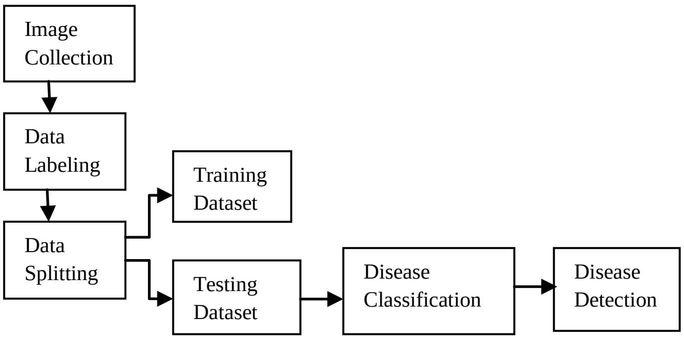

Figure1: Methodology for Rice leaf disease detection

Data Description:

We are using a Kaggle picture dataset. There are a variety of pictures of healthy and sick rice leaves in the collection. Collecting data on leaf photos is the first stage in diagnosing rice plant illnesses using convolutional neural network (CNN) architectures for classification. This is not an easy task. Since many microorganisms might impact this, it is important to have all data for all periods. The secondary function is to enhance the accuracy of categorization. Scoping out the target area becomes more challenging when dealing with detection in the presence of a diverse backdrop. Finally, for the third point, we'll be using a plethora of trainable parameters in our CNN architecture training model for autonomous rice disease identification. There are four categories in the open-source dataset of one thousand photos used to train the model: healthy, bacterial blight, brown spot, and leaf blast. Diseases may affect various regions of the rice plant. Training and testing use the loaded picture data set. Training involves storing the class labels and associated pictures in separate arrays. The train_test_split function uses 70% of the data for training and 30% for testing. We further divide the 70% data and utilize 20% of it for validation. After initial encoding as integers, the class labels undergo one-hot encoding to transform them into vectors. After that, we delete the last completely linked layers and load the VGG-16 model from Keras. We rendered the remaining layers untrainable. First, we used a fully connected layer to flatten the feature extractor's output. Then, we used an output layer with softmax. Adam optimizer that uses categorical cross-entropy as its classification loss function. After 25 epochs, the findings were steady, so we ended. Each of the four convolution layers in the CNN model with ML comes after a maxpooling, dropout, ReLU, and two fully connected layers, and finally, SoftMax. With 25 epochs and a batch size of 10, the suggested CNN model achieved a 95% success rate.

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CNN

1) Dataset Preparation: The first step is to gather and organize photos of rice leaves to use as a dataset. Please provide an example image depicting a rice illness. To serve as a training set of input images, we extract them from the folder.

2) Data Augmentation: Machine learning and deep learning often use this method to artificially augment datasets in terms of size and variety.

3) Data Preprocessing: To enhance the model's ability to generalize, preprocess the photos by scaling, standardizing, and enhancing them.

4) Model Architecture: Building the framework of your CNN comes next. Multiple Convolutional layers, maxpooling layers, and a succession of fully linked layers would make up a standard CNN architecture for rice leaf identification.

5) Training the Model: Training a CNN using an optimization technique, such the VGG 19 model, using a dataset you've already prepared is the next step after designing the CNN architecture.

6) Evaluation: Applying your trained model to a test dataset will allow you to see how well it performed. You may gauge your model's ability to generalize to new data sets using this.

7) Model testing: Retrieve information from input images stored in the database in order to make predictions.

IV. RESULTS AND DISCUSSIONS

Using machine learning methods, this effort aims to develop a model for illness identification in rice leaves. This model will be useful for disease recognition. Kaggle is the source for the data used in this assignment. We trained our model using a variety of machine learning methods implemented in Jupyter, an open-source machine learning platform. A number of variables, including dataset size and quality, model complexity, and preprocessing methods, could affect the outcome of the test. When trained on test data, a convolutional neural network (CNN) model for disease identification in rice leaves may get very high accuracy, often above 95%. But individual studies' findings may differ. When it comes to processing and interpreting pictures and spatial data, one deep learning technique that stands out is a Convolutional Neural Network (CNN). It makes use of a tiered architecture of linked neurons, with completely linked layers handling classification, pooling layers handling down sampling, and convolutional layers handling feature extraction via convolution operations. In applications like as medical image analysis, object identification, and image recognition—where the precise capture of complex visual patterns and structures is crucial for decision-making—convolutional neural networks (CNNs) shine by learning hierarchical features from input data. As a result of this examination, we have uncovered a number of facts and observations about the work that will aid the reader in comprehending the work's output; the most important discovery is the CNNs approach. Most research has focused on blast, brown spot, and rice leaf blight. With the use of CNNs, we were able to achieve an accuracy rate of 95%..

Figure2: [a] Leaf blast [b] Bacterial blight [c] Brown spot [d] Healthy diseases in rice leaf

The presence of tiny, linear, black lesions on the leaf blades and the possible dryness and graying of the leaf tips are symptoms of a rice leaf blast, as shown in figure [a]. Rice blast is among the most dangerous rice diseases. Downy mildew may kill plants and seedlings even before they enter the vegetative stage of growth. Grain yield drops when late-stage leaf burning severely reduces the amount of leaf area that may cover the grain.

When a fungal infection develops in rice leaves, as seen in figure[b], the color of the affected areas changes from white to yellow to grey, and the lesions get longer and closer to the edges and tips of the leaves. Bacteria that cause plant diseases may easily spread via the airborne droplets produced by strong winds and heavy rains. Bacterial blight may cause significant damage to susceptible varieties of rice when fertilized with a lot of nitrogen.

Brown spots on rice leaves, as seen in figure[c], are lesions that are oval or circular in form and have a dark brown tinge. Sepals, leaves, the sheath around the leaves, deltoid branches, petioles, and spikelets are all susceptible to brown spot fungus. A number of huge spots that kill the whole leaf are the most noticeable sign of damage. When a seed is sick, it starts to acquire speckles or discoloration, or unfilled grains.

A healthy rice leaf, as seen in figure[d], is vibrantly green and devoid of any signs of illness.

V. CONCLUSION

The majority of farmers encounter rice diseases. Consequently, prompt diagnosis is crucial. Scientific advancements have made the hitherto laborious process of manually examining rice leaves for signs of illness considerably simpler. This study compiles the many approaches used by researchers to diagnose rice illnesses based on the classifiers employed. Pattern recognition is fundamental to image processing, and the CNN classifier performed quite well on this task as well. By using CNN, our suggested model demonstrates encouraging outcomes in attaining commendable accuracy. Describes a method using machine learning to identify several illnesses affecting rice leaves. There was a comparison of machine learning algorithms used for disease detection in rice leaves. The accuracy of the algorithms used to forecast illnesses affecting rice leaves varied. On the test data, the decision tree achieved the highest accuracy rate of 95%.

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