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IDENTIFICATION OF LEAF DISEASES USING TRADITIONAL ML TECHNIQUES

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ABSTRACT: Agriculture plays a crucial role in India due to the quick population growth and increased request for food. Therefore, it is crucial to implement strategies and techniques that can effectively enhance crop production and ensure higher harvest yields. Plant disease caused by microorganisms, infections, and organisms poses a significant threat to agriculture and can result in low crop yield. The field of agriculture relies heavily on plant disease investigation as a crucial task in the cultivation process. Using manual methods to monitor and detect plant diseases is a complex and challenging task that can be alleviated through the utilization of plant disease detection techniques. It requires a significant amount of manual labor and extensive planning time, which makes the task of monitoring and identifying plant diseases extremely challenging. The utilization of image processing techniques in the detection of plant diseases offers a viable solution to the labor-intensive and time-consuming nature of manual monitoring and care-taking. The process of plant disease classification with machine learning algorithms involves several key phases, including dataset construction, where a collection of images representing healthy and diseased plant leaves is assembled. The mentioned steps: dataset creation, loading pictures, preprocessing, segmentation, feature extraction, training classifier, and classification are essential components of the machine learning algorithm. In this study, the primary aim is to develop a prototypical that can effectively differentiate among healthy and diseased crop plants and provide predictions for various plant diseases. The authors of this study have developed and implemented a prototypical to effectively classify and identify specific crop species as well as detect and diagnose 26 different types of diseases from public datasets of healthy and diseases plant leaves. This paper focuses on the utilization of the ResNets algorithm in the context of plant disease classification and detection. The ResNet algorithm addresses the issue of vanishing or exploding gradients commonly faced in Artificial neural networks by incorporating a residual block. For image classification tasks, the ResNet algorithm achieves significantly improved results compared to other traditional methods. The ResNet algorithm utilizes various techniques such as scheduling the learning rate, gradient clipping, and weight decay in order to improve its performance and accuracy. By applying the powerful and robust ResNet algorithm in their research, the researchers have a strong expectation of attaining impressive levels of accuracy in their plant disease.

Keywords: Machine Learning, ResNet, Plant Disease, Pre-processing, Feature Extraction, Detection, Classification.

INTRODUCTION

Agribusiness has indeed become a crucial driver of economic development in India, with approximately 80% of the population depending on farming for their livelihood. The choice of crops by farmers is importance by various features like the suitability of the loam soil type and the prevailing climatic conditions in the area. The primary cause of farmer suicides in many cases is the inability to repay bank loans taken for farming purposes due to production loss. Currently, the agricultural sector in India is grappling with numerous challenges, including the adverse impacts of climate change on crop yields and the subsequent financial strain on farmers. Various mathematical or statistical methods can play a crucial role in minimizing these risks by accurately identifying and predicting the occurrence of diseases in plants for farmers.

According to the sources mentioned earlier, the worldwide growth of the human population has significantly increased the demand for food. Researchers are actively exploring and working towards the development of new, capable, and unique technologies that have the potential to significantly enhance efficiency and deliver high-quality results. Some of these techniques include precision farming with the use of advanced technologies like global positioning and geographic information systems to optimize agricultural management practices and maximize yields while minimizing. In precision agriculture, a great deal can be done, such as detecting pests in plants, weeds, producing a higher yield, and identifying plant diseases. To effectively manage plant diseases and minimize their impact on agricultural productivity, it is crucial to accurately identify the specific disease affecting the plants. Additionally, manual detection of plant diseases may not be reliable enough, especially in large farms where it is difficult to inspect every single plant. However, this process yields fewer results when applied to a large number of plantations. One approach to convert the manual process of recognizing and classifying plant diseases into an automated process is by utilizing different machine learning classification techniques [1]. The utilization of automation in the process of identifying and classifying plant diseases has the potential to significantly contribute to the maximization of agricultural yields.

Plant diseases can be detected and classified effectively through the use of image processing and machine learning techniques. Unsupervised and supervised machine learning are two primary classifications of machine learning. Supervised learning is a widely used method in machine learning that involves using labeled data to train an algorithm to make predictions or classify new, unseen data. Unsupervised learning methods are particularly useful when the label or target values are unknown or not available for the training data. The utilization of machine learning algorithms has revolutionized numerous fields such as computing and bioinformatics, enabling more accurate and efficient data analysis and decision-making processes. Machine learning encompasses a wide range of algorithms, including naive Bayes, Artificial neural networks, decision trees, support vector machines, and K-means clustering. Machine learning consists of some basic steps such as data selection and preprocessing, model development and training, and evaluating the performance of the model.

The researchers aim to develop a model that can accurately classify plant leaves as either healthy or unhealthy and also identify the specific disease affecting the crop. The authors of this study focused on a dataset consisting of 54,306 images, which included images of plant leaves in both poor and good health. By employing a convolutional neural network, the researchers successfully accomplished a model to recognize 14 harvest types, 26 diseases, and 38 classes. Furthermore, this level of accuracy is particularly impressive considering that the model was trained using a limited amount of data for each test case [2]. Deep learning techniques have shown promising results in accurately diagnosing diseases in crops and analyzing images at a pixel level, thereby enhancing the precision and reliability of disease. There is no way for the naked eye to examine this level of detail; advanced technology and scientific methods are required for accurate analysis [3].

RELATED WORK

Shruth et al [1] authors provide a detailed analysis of each stage involved in the application of machine learning

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techniques to the detection of plant diseases, which includes image acquisition, annotated dataset creation. The first stage of the imaging chain is the image formation and acquisition stage, where the raw data of the desired object or scene is captured by a camera or other imaging device. In this stage, the acquired images undergo image preprocessing to improve their quality. The second stage in the process involves creating an annotated dataset, which is essential for training machine-learning (ML) models. In this stage, the data is transformed and structured according to the specific requirements or needs of the user or application in order to create an information-based dataset. During the third stage of image processing, various algorithms and techniques are applied to the acquired image in order to enhance its quality, perform feature extraction, and extract. In this image-processing phase, two sequences were achieved: (i) pre-processing method (ii) segmentation method. is quite important for the identification and prediction of plant diseases. By extracting features such as color, shape, and texture from images of diseased plants, researchers can effectively distinguish and classify different types of plant diseases. The fifth stage of classification is crucial for accurately predicting and categorizing data in various fields such as energy systems, biology, medicine, facial recognition, image processing, and object detection Classification is a crucial task in the field of machine learning, as it encompasses various techniques that enable accurate prediction and categorization of data in a wide range of fields.

Sehgal et al [2] demonstrated the effectiveness of utilizing soft computing supervised machine-learning in plant illness classification. Their investigate focused on the digital image processing and machine-learning (ML) techniques to accurately detect and classify plant diseases. Image acquisition is the initial step in the image processing pipeline and involves capturing an optical image and converting it into numerical data. Some aspects of an image can be improved by image processing. Specifically, image separation techniques are employed to accurately identify and isolate the diseased regions present on plant leaves. Feature extraction is an important technique used to extract relevant information, such as color, from images of diseased plants. These techniques analyze images of plant leaves and apply image classification algorithms to accurately detect and classify various types of plant diseases. The research paper intended to expansion vision into the performance and efficacy of many machine learning categorization methods, including naive Bayes, Random Forest, and decision tables.

Ramesh et al [3] introduced a novel approach to plant disease detection by utilizing machine learning techniques. Their proposed system consisted of several stages, starting with the creation of a dataset containing images of healthy and diseased plant leaves. Next, they applied feature extraction techniques to extract meaningful information from the image dataset. Then, a classifier was trained using the extracted features to identify and classify the diseases present in the plants. This approach allowed for the accurate finding and organization of plant diseases, contributing to the overall improvement of agricultural practices. images of 145 papaya greeneries were used in this training model, which achieved a 90% accuracy rate.

Venkataramanan et al [4] conducted a study on a deep neural network approach to detecting and classifying plant diseases. Their research focused on leveraging deep learning techniques for the accurate recognition and classifying of plant diseases. Their proposed approach involved training deep neural networks on a huge dataset of plant images, consisting of both healthy plants and plants infected with various diseases. The proposed system achieved a significant 96% accuracy in extracting leaf from an information image using a progression of ResNet 18 models, as investigated by utilizing yolov 3 for entity identification and leaf deletion.

PROPOSED SYSTEM

This dataset is widely used in the field of plant pathology and contains a large collection of images representing various types of leaf diseases in plants. By utilizing the Plant Village dataset, the researchers were able to benefit from a comprehensive collection of images that accurately represent a wide range of leaf diseases in plants. The dataset utilized in this research consists of 87,000 RGB images of plant leaves, encompassing both healthy and unhealthy specimens. Out of the 38 available classes in the dataset, the researchers have chosen to focus on 26 specific classes for their experimental procedure. These modules are exposed in Table 1

Table 1. Dataset Stipulations

Plant	Disease Name	No. of Images
Grapes	Healthy	1782
	Diseased: Leaf blight (Isariopsis)	1812
	Diseased: Esca (Black Measles)	1790
	Diseased: Black rot	1897
Tomato	Healthy	1746
	Diseased: Early blight	1820
	Diseased: Bacterial spot	1901
	Diseased: Leaf Mold	1362
	Diseased: Late blight	1971
	Diseased: Septoria leaf spot	1565
	Diseased: Target Spot	1797
	Diseased: Two-spotted spider mite	1601
	Diseased: Tomato mosaic virus	1897
	Diseased: Yellow Leaf Curl Virus	1863
Corn	Healthy	1959
	Diseased: Common rust	1801
	Diseased: Cercospora leaf spot	1743
	Diseased: Northern Leaf Blight	1801

The following figure shows some examples from the given dataset.

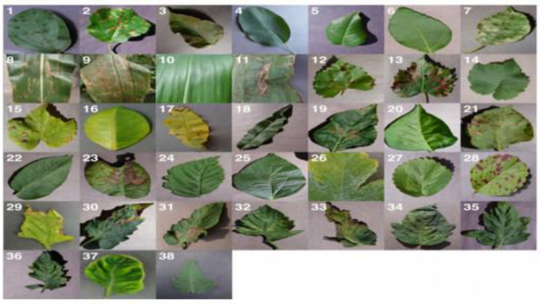

Fig. 1. Sample images in the dataset

Loading Dataset (RGB Images): Loading the dataset is an essential step in the initial period of plant disease identification and classification system. By loading good excellence RGB (red, green, blue) plant images from the dataset, researchers have access to a collection of images that depict both healthy and diseased plant leaves.

Pre-Processing: The preprocessing stage plays a crucial role in the plant disease detection and classification system. By removing noise and inconsistencies from the dataset, the preprocessing stage ensures that only relevant and accurate information is used for further analysis. During preprocessing, techniques such as image resizing, image smoothing, and improving the quality of images is accomplished through image enhancement.

Segmentation: Segmentation is a crucial step in the plant disease identification and classification framework as it allows for a more accurate and detailed analysis of the image. Segmentation helps to separate the diseased parts of the plant from the healthy parts, enabling further analysis and classification.

Feature Extraction: Plant disease identification and classification proceed through the fourth stage of feature extraction. Image classification relies heavily on feature extraction. Feature extraction can be used in a variety of requests. Many traits, including color, texture, morphology, and edges, are used in the classification of in-plant diseases. This method has discovered that morphological outcomes are preferable to other qualities. It is usually used to identify the diseased plant leaf of the categorization plant image. We can also extract novel plants and illnesses from the collection.

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Classification: The classification technique plays a crucial role in the plant infection recognition and classification system, as it is the fifth stage of the process. This classification stage plays a crucial role in accurately categorizing and identifying various diseases in plants by utilizing machine learning or deep learning techniques.

Analyzing and identifying of Plant Disease: This is the conclusion stage of our proposed system. In this period, employers can recognize and describe the plant impurity.

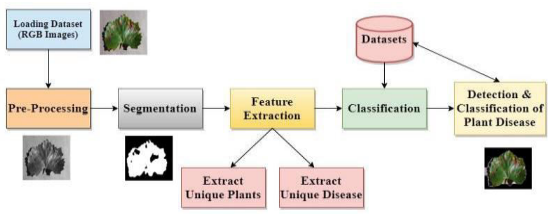

Fig. 2. Proposed System using Dataset

RESULTS AND DISCUSSION

The experiment made use of a data collection from kaggle. This dataset comprehends approximately 88k RGB photos of both unhealthy and healthy harvest leaf sorted into 38 distinct classifications. Training tasks have a ratio of 80%, while testing tasks have a ratio of 20%. Test images with another index developed afterwards for prediction purposes. The presentation parameters for individual model built for individual plant are shown in Table 2. We can see that the reliability scores are roughly identical to the f1 scores. This is due to a balance of incorrect negatives and incorrect estimates. This is the best-case scenario for every machine learning algorithm. The overall precision was 99.35%.

Table 2. Dataset Specifications

Plant	Accuracy	F1 Score
Apple	0.91	0.91
Corn	0.94	0.94
Grapes	0.95	0.95
Potato	0.98	0.98
Tomato	0.87	0.87

The utilization of a flask-based web application for detecting plant diseases is a significant development in the field of agriculture and agricultural technology. Figure 3 demonstrates the interface of the deployed web application, indicating the homepage design and layout. On the other hand, Figure 4 showcases the input images of plant leaves and the corresponding predictions made by our system.

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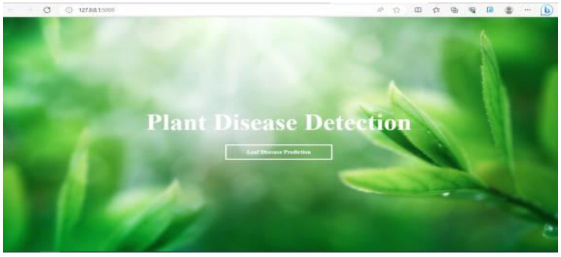

Fig. 3. Homepage of deployed Application

The integration of computer vision and expert systems enables the system to effectively identify and classify various plant diseases, thus aiding in the early detection and timely treatment of these diseases. Furthermore, the system's real-time capabilities allow for immediate action to be taken by farmers or agricultural workers to prevent further spread of the disease and minimize its impact on crop yield.

Our algorithm addresses the challenges of both cost and time associated with expert identification of plant diseases, making it a valuable tool for farmers. Additionally, the integration of computer vision and machine learning techniques in our algorithm allows for early detection of plant diseases, which is crucial in minimizing the spread of diseases and preventing further crop losses.

To enhance the efficiency and productivity of the agricultural system, the development of a website that utilizes image recognition technology to detect plant diseases and provide tailored suggestions and fertilizer recommendations based on the detected disease is proposed.

Fig 4 shows the input image

Loading images in the RGB format allows for the preservation and accurate rendering of color information within the image. The system uses a series of procedures to convert RGB images into grayscale and then into binary image formats, generating segment images in the process. A classification technique is selected by the user (K-means cluster algorithm). Users can also easily detect leaf disease and achieve classification results.

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Fig 5 shows the Output image of leaf Disease prediction

CONCLUSION

This paper describes the results of training a model using 53,406 images of diseases as well as healthy plant leaves collected under measured circumstances that can recognize 26 diseases as well as some unique harvests. This paper studied the ResNets algorithm. Based on the ResNet algorithm, we were able to achieve high accurateness outcomes and detect extra diseases from numerous harvests. Images can be classified much more accurately with ResNets. There are several parameters that ResNets techniques apply, including scheduling learning rate, gradient clipping, and weight decay. It correctly predicted each image in the test set without any faults using this ResNets model. Further research on large datasets of images will be conducted in the future to achieve high accuracy.

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