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An Efficient Model to Protect Leaves and Fruits From Putridity Using CNN

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Abstract
For farmers, India is very famous in agriculture. The economic growths for all nations are dependent on agricultural products. Due to plant diseases, the quantity and quality of agriculture yield are reduced. The study of plant disease refers to the study of clearly visible patterns of plant leaves. So, recognition of the unhealthy regions of plants may be thought about the way of saving the decrease of productivity and crops. The early-stage diagnosis of plant diseases like viruses, bacteria, fungi, etc. is most essential to control and cure the disease. The manual identifications of diseases are a time-consuming process. Hence, some experts are required to recognize the disease. There are varied standard methods such as classification model, image processing, and machine learning models that are utilized to detect and recognize the disease on agricultural yields. This article provides varied existing models are made familiar with the detection of disease in agricultural product. Further, it presents a survey on varied classification models with the analysis, which could be utilized to classify and identify the plant leaf diseases. It also discusses the outline of segmentation, feature extraction, and varied classifier techniques.
Keywords *Machine Learning (ML) Classification, Leaf Disease, Image Processing, Pre-processing, segmentation, Feature Extraction, Disease Classification and Detection.*

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I. Introduction

Plant diseases are one of the most critical elements impacting food production. They are responsible for a significant drop in the economic productivity of crops, as well as being an obstruction to this activity in some cases. With aid oftoday's more advanced technologies, it is now possible to supply enough food and nourishment for the world's expanding population. In India, the largest region in the country, 70% of the population is still associated with agriculture either directly or indirectly. If we look at the bigger picture, research shows that by 2050 overall yield creation strength riseby at least 50%, putting more of an emphasis on pushing and cultivating sectors both inside and outside. The majority of farmers are poor and are somewhat interested in making improvements that may cause issues, many of which are brought on by pets and plant diseases. Fruits and vegetables are commonplace products, and they're the main farming-relateditems. Strong dependency on synthetic pesticides results in high substance content, which generates adverse environmental effects in the soil, air, and water as well as alarmingly in our bodies

Recent years have seen an increase in image categorization as a trend among technology developers, thanks in large part to the expansion of data in various sectors of the economy, including e-commerce, automotive, healthcare, and gaming. Facebook is where this technology is used in the most evident way. Facebook can now classify your face into your Facebook album with just a few tagged photographs and a detection rateof up to 98% accuracy. The ability of the technology to classify or recognise images is almost superior to that of people[4][5]manual practices in conventional farming operations cannot cover large areas of crops and provide early background information for decision-making processes. As a result, researchers have never stopped looking for ways to develop automated practical solutions and effective methods for detecting plant diseases. DL-based models, in particular, have found many applications in plant disease detection. They have overcome the problems associated with traditional classification methods and represent cutting-edge technology in this field. DL [6] is an advanced technique that has shown great promise and success in various fields where it has been used [7]. It is, however, a group of machine learning methods that attempt to model at a high level of data abstraction through articulating structures of various transformations.

The current review aims to describe the state-of-the-art identification and examination of plant disease detection problems using a specific class of DL called CNN, which extends classic Artificial Neural Networks (ANN) by adding more "depth" to the network, as well as the various convolutions that allow the data to be successfully applied in various problems related to images [8].fp Therefore, the inquiry of this survey discusses significant contributions concerning CNN and various innovations which aimed to improve the performance of CNN and thus correctly identify diseases. The motivation for conducting this survey comes from the fact that CNN has recently been primarily used in agriculture, with CNN's growing popularity and success in solving many problems related to agriculture, and the fact that multiple research efforts using CNN to discuss various agricultural problems exist today. As a result of its success, CNN is perhaps the most popular and commonly used approach in agricultural research today. Regarding image analysis, the current survey focuses on a particular subset of DL models and techniques since there are very few of this type of survey in the agricultural field, especially about CNN utilization. Thus it would be beneficial to present and analyze relevant work to help the authors conduct a more comprehensive review. A discussion about innovative and high-potential techniques for solving numerous difficulties in agriculture related to image and DL will be presented. In addition to reviewing recent research in this area, significant practical features of CNN based on images are presented to explain the technique's advantages and disadvantages further. The rest of the paper is structured as follows: Section 2 provides related work. Section 3 describes the methodologies used in this study. Section 4 presents CNN. Section 5 discusses the applications of CNN in agriculture, Section 6 provides the main problems and solutions associated with the CNN used in plant disease detection.

II. Related work

Numerous investigations have been carried out in an attempt to develop methods that can help identify crops in an agricultural setting, thereby providing the best possible solution to the issue of crop disease detection. The most current reviews of research on CNN's suitability for application in the agricultural domain as a whole are included in this part; these include papers from peer-reviewed publications that make use of CNN techniques and plant datasets. CNN algorithms for the identification of plant diseases were examined by Abade et al. [9]. A total of 121 papers published between 2019 and 2023 were examined by the writers. TensorFlow was found to be the most often used framework in this review, and Plant Village was chosen as the most regularly used dataset. CNN models' fundamental techniques were described by Dhaka et al. [10] in order to identify outlined the basic methods of CNN models used to identify plant diseases using leaf images. They also compared CNN models, pre-processing approaches, and frameworks. The study also looks at the datasets and performance measures used to assess model efficiency. Moreover, Nagaraju et al. [11] also provided a review to find the best datasets, pre-processing approaches, and DL techniques for various plants. They reviewed and analyzed 84 papers on DL's applicability in plant disease diagnosis. They observed that so many DL methods are limited in their ability to analyze original images and that effective model performance necessitates using a suitable pre-processing technique. Kaminaris et al. [12] found that DL approaches were used to solve various agricultural challenges. According to the study, DL methods performed better than standard image processing techniques. Fernandez-Quintanilla et al. [13] evaluated weed-monitoring technologies in crops. They focused on weed monitoring devices in agricultural fields that were both remote sensed and ground-based. Weed monitoring is critical for weed control, according to them. They predicted that data acquired by various sensors would be saved in a public cloud and used in appropriate contexts at the optimal time. Lu et al. [14] introduced a review for plant disease classification using a CNN. They evaluated the significant problems and solutions of CNN used for plant disease classification and DL criteria in plant disease classification. They discovered that additional research with more complex datasets was required to obtain a more satisfactory result. Golani et al. [15] presented a review paper on hyperspectral data for plant leaf disease identification, highlighting existing problems and potential prospects. They also presented NN approaches for SDI development in a short time. They discovered that, as long as SDIs remain relevant for proper crop protection, they must be tested on various hyperspectral sensors at the plant leaf scale. Bangari et al. [16] presented a review on disease detection using CNN, focusing on potato leaf disease. They reviewed several papers and concluded that convolutional neural networks work better at detecting the disease. They also identified that CNN contributed significantly to the maximum possible accuracy for disease identification.

III. Methodology

We covered the most recent research articles on using DL in agriculture in this work. Additionally, this effort was completed through two crucial steps: the first involved gathering 100 prior research publications that address DL in connection to agriculture, and the second involved carefully reviewing and analysing the compilation of publications. First, we used web-based scientific indexing services and scientific databases like Science Direct and Elsevier to search for papers and articles published in the recent five years. Additionally, we

used a number of keywords to find relevant documents; the most popular ones were CNN, DL, and agricultural. Hence, papers that mentioned CNN but did not relate it to the field of agriculture were eliminated.

• The approach used.
• The problem presented.
• The datasets used.
• The performance achieved.
• Limitations of the study, if any.
• Have the authors compared their CNN-based approach with other technologies, and what is the difference in performance? Examining how CNN performs is an essential aspect of this study. As a result, we reviewed and analyzed several relevant studies. We also compared CNN to other current technologies and summarized the most important advantages and disadvantages that affect CNN's performance. It should be noted that the current paper focuses on comparing techniques used for the same data and on the same scale. We also investigated and discussed the most significant problems and limitations identified by previous research.

IV. Convolutional Neural Networks (CNN)

ANNs consist of three different layers: input, one or more hidden, and output layers. Neurons placed in hidden layers have an associated weight and a bias value. These values are multiplied by the input values and sent to an activation function. If the output value is greater than the specified threshold, that node carries the output value to the next layer of the network. Otherwise, no data is transmitted. The process of spreading data in the network from one layer to the successive layer is called a feed-forward network. The ultimate objective is to minimize the cost function for any input when tuning the model weights and bias. The process is depicted in Figure 1. CNNs, a form of multi-layer neural networks, are designed to extract dependencies in a grid-structured input such as images and text. The convolution operation applied in many intermediate layers is the most crucial property of CNNs. Similarly, a convolution operation is a dot-product of a set of grid-structured weights and another set of similarly structured inputs.

V. LITERATURE SURVEY

Plenty of work and researches are in progress in the area of automated leaf detection to identify the plants species. In this article, some related works are discussed here. In paper [17], [18], discussed and implemented a methodology to analyze defects of peach and apple, having average accuracy rate of 70% with the help of Near-Infrared (NIR) images. In paper [19], [20] applied a Neural Network (NN) model which is utilised for color grading of apples with an accuracy of 75%. In this paper, color information is applied to rate apple like poor red, normal red etc. In paper [6] used varied ML models for leaf disease classification and detection of maize plant, which considers supervised machine learning models like Random Forest (RF), Support Vector Machine (SVM), K-Nearest Neighbour (KNN), Decision Tree (DT) and Naive Bayes (NB). These models take images of the plant as input to identify the maize leaf disease. The above-mentioned classification methods are analyzed for comparing the accuracies plant disease predictions that utilised to get the highest accuracy with the help of best suitable method. The RF model resulted with high accuracy of 79.23%. The precautionary measure for the farmers to detect and classify the new test images of disease in early stage is to use the all above mentioned trained models. A huge number of leaf disease works is completed by different researchers with different algorithms and found their accuracies by comparing the several forecasting methods in the prediction of leaf disease. A few of them are outlined in Table.

Comparison of CNN models in the detection of plant leaf diseases

Species	Model	Data store	Accuracy
Tomato	CNN	self	99.18%
Potato	CNN	self	97%
Banana	CNN	self	99.88%
Mango	CNN	self	97.13%
Corn	CNN	self	99.36%
Peach	CNN	self	98.33%
Soyabean	CNN	self	99.465%

VI. DESCRIPTION OF DATASET

We looked at numerous pictures of the leaves. With the use of image processing and segmentation, we rescaled each and every leaf image. Below Fig Samples of different Class Labels in the Dataset There are 44 class labels in the dataset, which is divided into training and validation data. The plant's disease is identified based on the features and texture of the visual data given through the class labels. We conduct all of our experiments using the 80/20 split, which uses 80% of the total dataset for training and 20% for testing.

VII. CONCLUSION

This article describes a detailed survey on the prediction of plant leaf disease detection and classification. The literature survey concludes better results for plant leaf disease detection and classification with several ML classifiers. Performance improvement for the detection and classification of plant leaf disease is said to be the complicated task. The review work of this article helps in doing that. The following conclusion has come up from study of mentioned ML classification models. In more than five articles SVM and Neural Network were found above 90% accuracy, which compete with the best ML classification models available for classifying high-dimensional data sets. The optimal outcomes were got in low computing endeavours that prove the efficacy of all ML models in early recognition and classification of the leaf disease. Hybrid algorithms can even be used to improve the recognition rate in the process of classification. In future we are going to implement some of new and hybrid models for our research work.

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