Identification of different plant leaf diseases using CNN

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ABSTRACT:
One of the main reasons for the decline in the amount and quality of agricultural output is plant diseases. New plant diseases are continuously emerging on plant leaves as a result of continuous changes in plant structure and cultivation practices. Thus, limiting the spread of the infection and promoting the healthy development of plant production can be achieved by accurately classifying and detecting plant leaf diseases in their early stages. In order to acquire high-level hidden feature representations, a unique lightweight deep convolutional neural network (CNN) model is proposed in this study. Three publicly accessible datasets are used to train and evaluate the suggested model (Apple Leaf, corn Leaf, grape leaf And Orange leaf). The experiment findings demonstrate that the suggested strategy can offer a more effective means of controlling plant diseases

Keywords: Data Analysis, Classification Deep Learning, Disease Detection,

I. INTRODUCTION

A nation's agricultural sector is its economic bedrock. Though many farmers would like to switch to more contemporary farming methods, they often are unable to because of factors such as a dearth of knowledge about the most recent advancements in the field, the high cost of the necessary equipment, etc. [7]. Many image processing apps have seen improved efficiency in recent years thanks to the use of machine learning based methods . The results of AI-based learning apps have proven fruitful. Methods of machine learning [8] teach the computer to learn naturally and better its performance based on its own observations. It has been noted on numerous occasions that the number of plant illnesses varies according to climatic state, making them challenging to manage. Plants are subject to a wide variety of pathogens, including those of the fungus, bacterial, viral, and parasitic varieties. The prevalence of fungal-like creatures on plants has been estimated at 85% . Traditional methods, which farmers in poor countries still use despite their increased labor and time costs, are generally inferior. It's also conceivable that using your own two eyes won't yield any useful results when it comes to unaided identification. It has likewise been noticed that many ranches use herbicides to neutralize the impacts of illness without first recognizing the particular illnesses at play, a practice that poses risks to both the quality of the crops and the people who eat them. Farmers can benefit from machine learning and deep learning for illness detection and categorization in plants so they can take preventative measures. The use of machine learning and deep learning to identify plant illnesses is more efficient and precise than using conventional picture processing methods. Scholars in the field of plant disease face significant challenges, including a lack of data sets for individual diseases, background noise in recorded pictures, low resolution images, and variations in the material property of plant leaves brought on by environmental shifts.

II. PLANT DISEASES AND ITS SYMPTOMS

The following is some fundamental data about microbial pathogens (bacteria, viruses, fungi).

Bacterial diseases: Overgrowths, leaf blotches, scabs, and cankers are just a few of the signs caused by bacterial illnesses. The signs and symptoms of a bacterial illness are very similar to those of a fungus infection. In the case of bacterial illness, leaf blotch is the most typical sign.Viral diseases: Isolating and analyzing the cause of a virus illness can be a challenging task. Mosaic leaf design, crinkled foliage, yellow leaves, and plant wilting are all signs of a virus illness. Diseases caused by viruses include tobacco mosaic virus, tomato spotted virus, potato virus, cauliflower mosaic virus, and many others.

Fungal diseases: Diseases like these are prevalent on many different types of veggies. Plants can suffer significant losses due to fungal illnesses. Anthracnose, downy mildews, powdery mildews, rusts, rhizoctonia rots, sclerotinia rots, and sclerotium rots are all significant fungus illnesses.

Bacterial diseases **Fig. 1.** Viral diseases **Fig. 2.** Fungal diseases **Fig. 3.**

Traditional Methods of Disease Detection Classifying and identifying plant diseases is a process that relies heavily on digital image processing and machine learning. Catching an image, taking out clamor, portioning a picture, and physically removing highlights are instances of picture handling; include choice and order are instances of AI. Based on the characteristics of the images, machine learning algorithms are used to classify the illnesses.

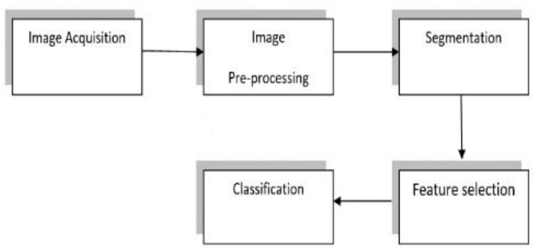


Fig. 4. Approach for diseases detection and classification.

The above diagram depicts the standard procedure for diagnosing plant illnesses and categorizing them. Image pre-processing includes tasks like picture filtration, noise elimination, scaling, and so on; this is just one example of the many sub-steps that make up the overall method. In the same vein, various techniques, such as edge recognition (Sobel, Canny, etc.), k-means clustering, otsu thresholding, etc., can be used to carry out picture segmentation. Histogram of directed gradients, Faster Robust Features, Color and Texture Features, Local Binary Patterns (LBP), etc., can all be used for feature extraction, while NB Classifier, Nearest Neighbor, SVM, DT, Boosted Trees, RF, NN, Logistic Regression, etc., can all be used for classification.

Difference between Machine Learning and Deep Learning

While both Profound Learning and customary machine learning use information, the way that data is presented to the system is where the two diverge significantly. Deep learning in machine learning models and methods for organized data, where the number of ANN layers makes a difference. While traditional machine learning approaches to plant disease identification and categorization rely heavily on human-executed feature extraction, deep learning takes care of this step autonomously.

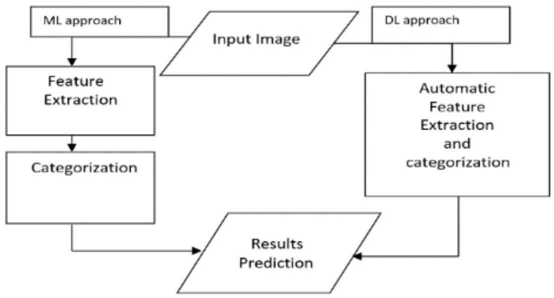


Fig. 5. shows two different approaches for disease detection and classification.

III.LITERATURE SURVEY OF DISEASES PREDICTION

[1] S. S. Sannakki and V. S. Rajpurohit, proposed a "Classification of Pomegranate Diseases Based on Back Propagation Neural Network" which mainly works on the method of Segment the defected area and color and texture are used as the features. Here they used neural network classifier for the classification. The main advantage is it Converts to L*a*b to extract chromaticity layers of the image and Categorisation is found to be 97.30% accurate. The main disadvantage is that it is used only for the limited crops.

[2] P. R. Rothe and R. V. Kshirsagar introduced a" Cotton Leaf Disease Identification using Pattern Recognition Techniques" which Uses snake segmentation, here Hu's moments are used as distinctive attribute. Active contour model used to limit the vitality inside the infection spot, BPNN classifier tackles the numerous class problems. The average classification is found to be 85.52%.

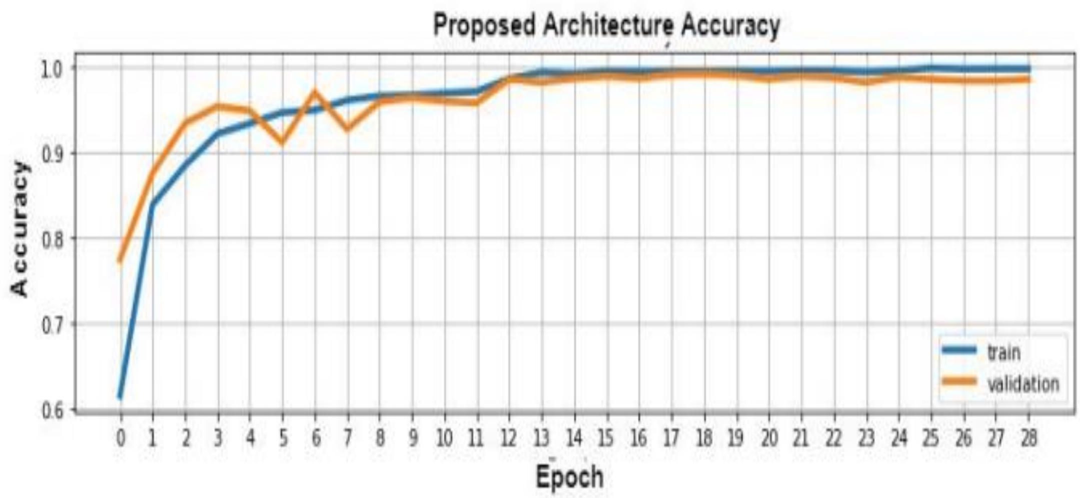
[3] Aakanksha Rastogi, Ritika Arora and Shanu Sharma," Leaf Disease Detection and Grading using Computer Vision Technology &Fuzzy Logic". K-means clustering used to segment the defected area; GLCM is used for the extraction of texture features, Fuzzy logic is used for disease grading. They used artificial neural network (ANN) as a classifier which mainly helps to check the severity of the diseased leaf.

[4] Godliver Owomugisha, John A. Quinn, Ernest Mwebaze and James Lwasa, proposed" Automated Vision-Based Diagnosis of Banana Bacterial Wilt Disease and Black Sigatoka Disease "Color histograms are extracted and transformed from RGB to HSV, RGB to L*a*b.Peak components are used to create max tree, five shape attributes are used and area under the curve analysis is used for classification. They used nearest neighbors, Decision tree, random forest, extremely randomized tree, Naïve bayes and SV classifier. In seven classifiers extremely, randomized trees yield a very

high score, provide real time information provide flexibility to the application.

[5] uan Tian, Chunjiang Zhao, Shenglian Lu and Xinyu Guo," SVM-based Multiple Classifier System for Recognition of Wheat Leaf Diseases," Color features are represented in RGB to HIS, by using GLCM, seven invariant moment are taken as shape parameter. They used SVM classifier which has MCS, used for detecting disease in wheat plant offline.

IV. OUTPUT RESULTS



(a)

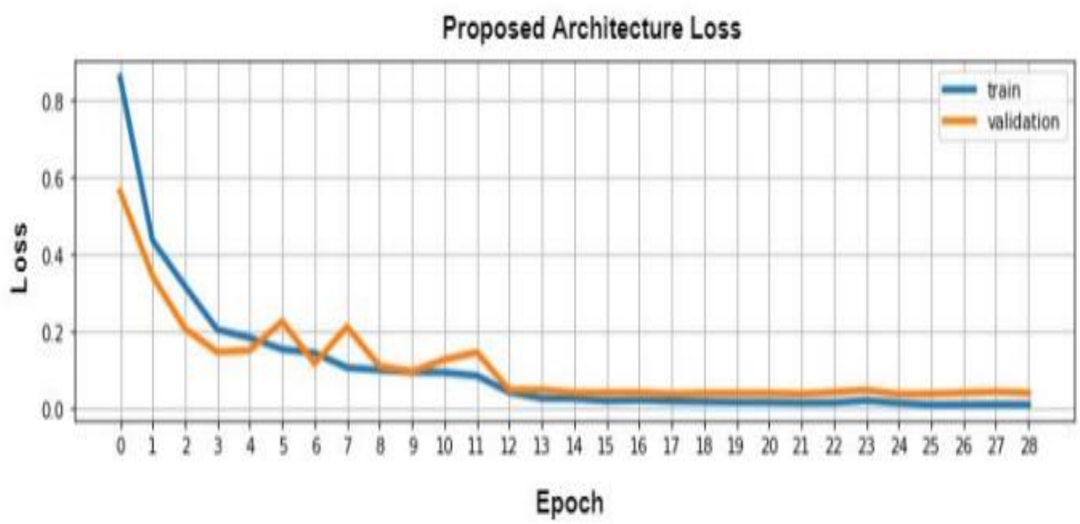


FIGURE 1.

Classification accuracy of the proposed architecture (CNN + LBP) with apple leaf dataset: (a) Training and validation accuracy; (b) Training and validation loss.

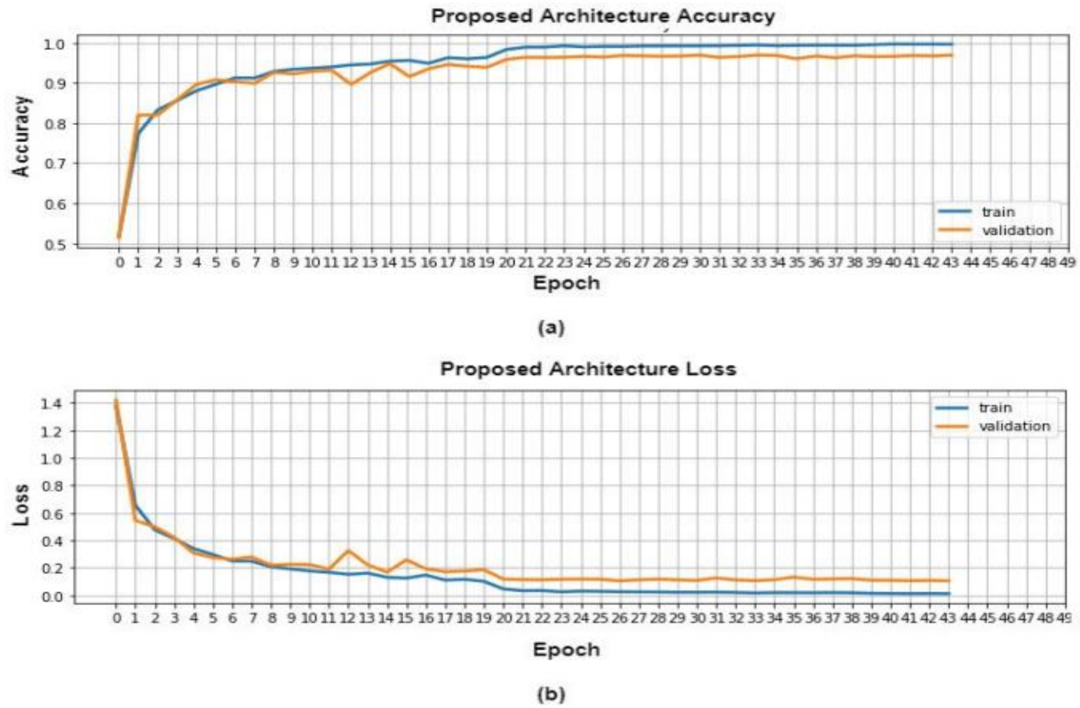


FIGURE 2. Classification accuracy of the proposed architecture (CNN + LBP) with tomato leaf dataset: (a) Training and validation accuracy; (b) Training and validation loss.

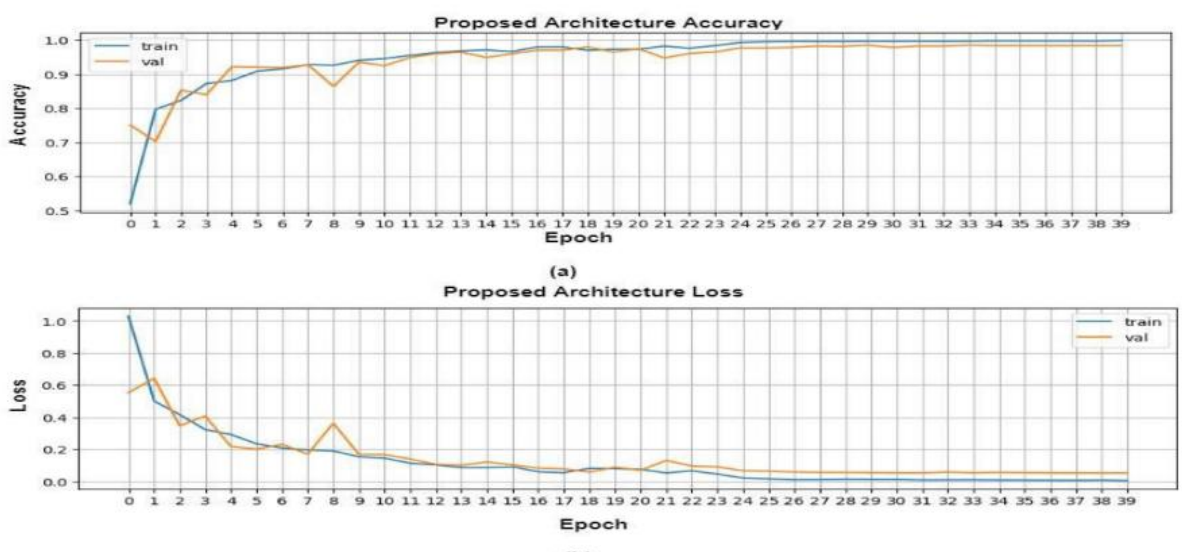


FIGURE 3. Classification accuracy of the proposed architecture (CNN + LBP) with grape leaf dataset: (a) Training and validation accuracy; (b) Training and validation loss.

V. CONCLUSION

In this research, we analysed the strengths and weaknesses of traditional techniques, machine learning, and deep learning when it comes to classifying plant illnesses and making diagnoses. We talked about four key steps—Image Pre-processing, Segmentation, Feature selection, and Classification—in the process of detecting and categorising illnesses. K-means for segmentation, support vector machines, and artificial neural networks are the most effective methods for detecting and classifying sick plants, as evidenced by the aforementioned review. Comparing CNN's performance to that of more conventional machine detection and categorization methods for plant illnesses, the results are clear from a review of the literature on deep learning. It is evident that, when comparing all of the various learning techniques, deep learning is by far the most effective. Some of the dataset was recorded under ideal conditions, which means there was no background noise. If noise is introduced to the image, the algorithm's effectiveness could suffer. After looking at a large number of papers, one significant shortcoming was identified: many researchers created their own dataset, which isn't available to different specialists. Thus, new calculation improvement from different specialists can't assess the dataset, which isn't straightforwardly accessible. The next step is to implement a programmed that will aid farmers in illness detection and classification in hardware.

VI .DISCUSSION AND FUTURE SCOPE

In this study, we developed a unique lightweight deep convolutional neural network (CNN) model for the identification and classification of plant leaf diseases. By utilizing high-level hidden feature representations, our model effectively detects diseases at an early stage, which is crucial for limiting the spread of infections and promoting healthy plant growth. The model was trained and evaluated using three publicly accessible datasets: Apple Leaf, Corn Leaf, Grape Leaf, and Orange Leaf. The experimental results validate the efficacy of our approach, demonstrating that the proposed CNN model can accurately and efficiently identify various plant leaf diseases. This advancement in plant disease detection holds significant potential for enhancing agricultural productivity and ensuring the health of crops. Future work will focus on further refining the model and exploring its application across a broader range of plant species and disease types.

VII. REFERENCES

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