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Plant Disease Classification Using Deep Learning Techniques

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Abstract: : Our project presents an innovative approach to address the crucial issue of plant disease identification through the utilization of deep learning techniques. Agricultural productivity is significantly affected by plant diseases, leading to economic losses and food security concerns. In this research, a comprehensive dataset comprising images of healthy and diseased plants is collected and pre-processed for training deep convolutional neural networks (CNNs). The proposed system harnesses the power of deep learning to automatically learn intricate patterns and features from plant images, enabling accurate classification between healthy and diseased states. The trained model is evaluated on an independent dataset to assess its classification performance. Various deep learning architectures, such as VGG, ResNet, and Inception, are experimented with to identify the most suitable architecture for achieving high accuracy and robustness. To enhance the model's generalization capability, data augmentation techniques are employed during training. Transfer learning is also explored, allowing the pre-trained models to be fine-tuned for the specific task of plant disease classification. The performance metrics, including accuracy, precision, recall, and F1-score, are thoroughly evaluated to quantify the model's effectiveness. The proposed deep learning-based plant disease classification system holds great promise for real-world agricultural applications. Its automated and accurate nature has the potential to revolutionize plant disease management by enabling early detection and timely intervention. As a result, this research contributes to the advancement of precision agriculture practices, helping to mitigate the adverse impacts of plant diseases and promote sustainable agricultural production.

Keywords: Recycled Deep Learning Techniques, CNN, VGG, ResNet, Inception , Data Augmentation..

1. Introduction

The introduction (Size 10 Normal) should make the reader aware of the significance of the research, connect it to existing literature, and explain the reasoning behind the investigation in plain terms. It should provide a brief history, the goal of the investigation, and a synopsis of its justification [1]. The works of literature Crop diseases pose a serious concern because they reduce plant productivity, result in financial losses, and affect the amount and quality of agricultural goods. Seventy percent of Indians are employed in agriculture, which generates seventeen percent of the nation's GDP. It is quite difficult for farmers to move from one disease control strategy to another. The conventional method, which involves professionals observing things with their unaided eyes, can be costly, time-consuming, and inaccurate. If illnesses are appropriately diagnosed and discovered early, crop losses can be reduced by using pesticides or their equivalent to counteract the action of specific pathogens. Crop and leaf diseases cannot be identified by the human eye alone, hence an automated method is required in agriculture for their identification. Our technology has advanced to the point where a machine can now predict an illness by just.

The system shows the proper list of fertilizers and treatments for the sickness based on the name of the illness. The goal of this project is to use a web application that the farmer may access on their phone to capture a photograph of the damaged crop, preferably the leaves. The disease kind is then identified by applying an image-processing approach to the image. The crop illnesses and recommended fertilizer and pesticide/insecticide dosages are updated on the web application that farmers previously used to contribute photos.

2. Literature Survey

Apple leaf diseases can degrade apple quality and cause yield losses, but if they are discovered early on, they can be stopped from spreading and the industry's strong growth can be supported. However, due to the fact that the lesions differ in size, current research has not been able to accurately diagnose leaf diseases. This research

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suggested a novel apple leaf disease detection method called VMF-SSD (V-space-based Multi-scale Feature-fusion SSD) to improve the overall detection performance and extract more reliable multi-scale feature representations for a range of diseased spot sizes. Multi-scale feature representation is established with multi-scale feature extraction to further improve the disease detection performance, especially for small spots. After that, a Vspace-based branch is added to enhance the location.

Plant Disease Diagnosis and Image Classification Using Deep Learning. The goal of Indian agriculture's sustainable intensification strategy is to raise yields per unit area while avoiding negative effects on the environment and natural resources. Technology is used in modern farming to increase output. Reducing plant illnesses, enhancing plant health, and increasing the output of food crops all benefit greatly from early and accurate plant disease investigation and diagnosis. Since plant disease experts are not readily available in remote places, automatic, affordable, dependable solutions are needed to identify plant diseases without the need for laboratory testing or expert judgment. Plant diseases are being identified by the application of both classic machine learning-based image classification algorithms and deep learning-based computer vision techniques such as Convolutional Neural Networks (CNN). The CNN model is suggested in this research for rice classification.

One factor affecting plant quality and productivity that can result in a scarcity of food is plant diseases. Classifying plant diseases is therefore crucial to the agriculture sector. The goal of this study is to categorize plant illnesses using a single-layer feed-forward neural network-based machine learning classification technique called Extreme Learning Machine (ELM), which evaluates leaf images. The image features used in this study are pre-processed using the HSV color space, and features are extracted using Haralick textures. The model training and testing are then carried out by fitting the features in the ELM classifier. After testing is complete, the accuracy of ELM is computed.

Crop diseases pose a serious risk since they reduce the amount and quality of agricultural products produced, as well as productivity and financial losses. About 17% of India's GDP comes from agriculture, which employs 70% of the nation's workforce. In India, cotton is a significant cash crop. It is challenging for farmers to move from one disease control strategy to another. Since it is difficult for the unaided eye to distinguish between different types of leaf diseases on plant leaves, large farms may find it too expensive to hire experts to monitor their plants on a continuous basis. The primary method that is accepted and applied in practice to identify plant diseases is skilled visual inspection.

3. Materials and Methods

Dataset: This dataset contains a lot of train and test image records of features extracted from plant leaf disease, which were then classified into 10 classes. Our project dataset contains 8 different plant images. The plants are Apple, Cherry, Corn, Grape, Pepper, Potato, Strawberry, Tomato.

Deep Learning : A subset of machine learning known as "deep learning" is entirely dependent on artificial neural networks. Since neural networks are designed to mimic human disease, deep learning can be thought of as a form of disease mimicking. Because we didn't have as much processing power and data earlier, it's all the rage these days. Neurons are the formal definition of deep learning. By learning to represent the world as a layered hierarchy of concepts, with each notion defined as a simpler one and more abstract representations computed in terms of less abstract ones, deep learning is a specific type of machine learning that reaches considerable power and flexibility. This image represents a single neuron, and there are thousands of neighbors connecting each neuron to the approximately 100 billion neurons that make up a disease. How it replicates these neurons in a computer is the question here. In other words, it builds an artificial neural network, or artificial neural net, with nodes or neurons. There are neurons for the input and output values, and in the hidden layer, there could be a large number of interconnected neurons. To find the best answer, the real issue must be recognized and understood. Deep Learning's viability must also be examined (that is, whether it fits Deep Learning or not). It must determine the pertinent information that should match.

Convolutional Neural Networks: One kind of artificial neural network is the convolutional neural network (CNN). Convolutional neural networks, or CNNs, are neural networks with one or more convolutional layers that are primarily utilized for segmentation, classification, and image processing, among other auto-correlated data applications.

Dencenet - Dense Connectivity: DenseNet creates dense connections between layers, allowing each layer to be connected in a feed-forward fashion to all levels that come before and after it. This indicates that the feature maps from each of the earlier layers are combined and supplied into the current layer. The deep network that results from this dense connectedness enhances information flow and feature reuse.

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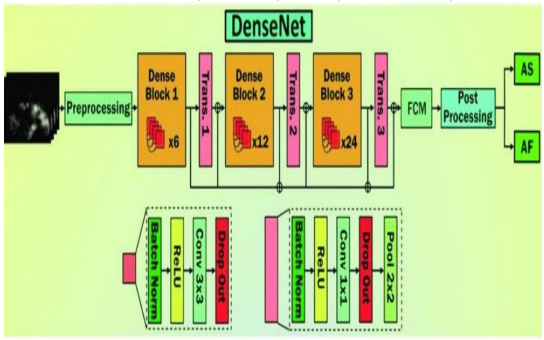
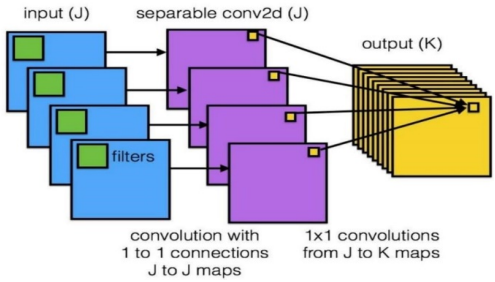


Xception- An further deep learning architecture called "Xception" is intended for image classification applications. In the 2017 academic paper "Xception: Deep Learning with Depthwise Separable Convolutions," François Chollet put out this idea. "Xception" is a portmanteau of "Extreme Inception," as it expands upon concepts first presented in the Inception architecture. The Inception architecture, which employs several convolutional filters of varying sizes to collect features at various scales, served as the model for the Xception network. Xception, on the other hand, uses depthwise separable convolutions, which are more computationally efficient than conventional convolutions.

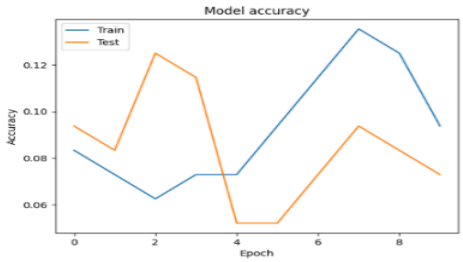


4. Procedure

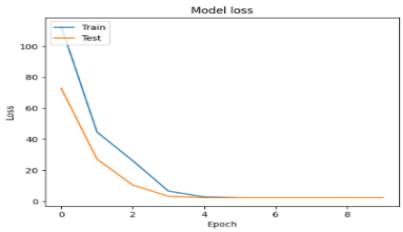
Import The Image From Dataset : Using the Keras pre-processing picture data generator tool, we must import our data set and generate the size, rescale, range, zoom range, and horizontal flip functions. The data generator function is then used to import our image dataset from the folder. In addition to setting the train, test, and validation parameters here, we also define the target size, batch size, and class mode. Using this function, we must train our own network by building layers of CNN.

Train The Module By Image Dataset : Using the classifier and fit generating function, as well as the number of epochs, validation data, and validation steps, we may train our dataset. We can also make training steps for each epoch. Training a dataset using the classifier and fit generator function involves several crucial steps to ensure effective model learning and validation. First and foremost, it's essential to prepare the dataset and define the appropriate data generators to feed batches of data into the model during training. Create data generators using the Image Data Generator class in Keras or any other suitable method. These generators pre-process the data, perform data augmentation (if necessary), and yield batches of input images along with their corresponding labels. Create an instance of the classifier model, whether it's a pre-trained model (e.g., DenseNet, Xception) or a custom-built architecture. Compile the model using the compile function, specifying the optimizer, loss function, and metrics to monitor during training.

Working Process Of Layers In Model: Convolutional Neural Networks, often known as CNNs, are Deep Learning algorithms that are able to distinguish between different objects and aspects in an input image by assigning weights and biases that can be learned. A ConvNet requires a lot less pre-processing than other classification techniques. While filters are manually designed in more archaic techniques, ConvNets may learn these filters and attributes given sufficient training. ConvNet architecture was inspired by the structure of the visual cortex and is comparable to the connection pattern of neurons in human disease.Only in a small area of the visual field known as the Receptive Field do individual neurons react to inputs. There are four tiers in their network:



CNN model trained dataset accuracy



CNN model trained dataset loss values

Plant Disease Classification Identification: Using the Keras preprocessing package, we provide the input image. Using the pillow and image to array function package, the input image was converted into an array value. The dataset of plant disease images has already been categorized. It categorizes the different plant diseases. Next, we must use predict function to forecast our plant illness.

The two channel architecture that forms the basis of the plant disease recognition method allows it to classify different types of plant diseases. The CNN's inception

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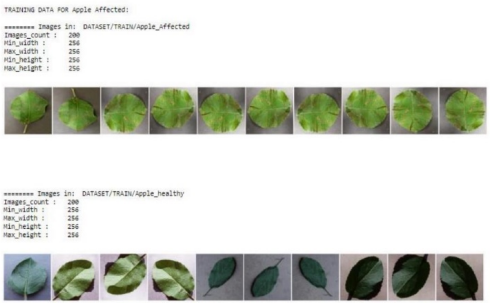
layer receives the photos of hydroponic plant diseases as input. Using a convolution neural network, features are extracted and classified during the training phase.



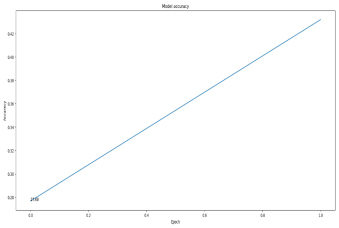
5. Result and Discussion

A result is the ultimate outcome of events or actions, either qualitatively or quantitatively stated. An operational analysis is performance analysis, which is a collection of fundamental quantitative relationships between performance quantities.

5.1 Dencenet

```
Total params: 7070042 (26.97 MB)
Trainable params: 6988570 (26.66 MB)
Non-trainable params: 81472 (318.25 KB)
```

Dencenet Model Accuracy



5.2 Xception

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Non-trainable params: 54528 (213.00 KB)
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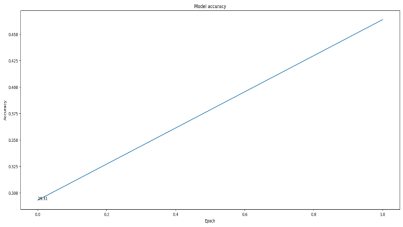
Xception Model Accuracy



6. Conclusion and Future Scope

Convolution neural network is used to identify and classify plant leaf diseases. The Neural network is trained using the dataset taken in the natural environment and achieved good classification ability. There are numerous methods by which we can identify plant illnesses and offer treatments for them. Every one of them has advantages and disadvantages. Although visual analysis is the simplest and least expensive approach, it is not as effective or dependable. The technology of image processing is widely recognized for its exceptional precision and little time consumption, which are its main benefits. Convolutional neural networks, or CNNs, have been used in applications for the identification and categorization of diseases affecting plant leaves.

The major goal of the suggested strategy is to precisely and swiftly recognize the condition. The experimental findings show that the suggested strategy is a useful one that can greatly aid in the precise identification of leaf diseases with minimal computing work. In addition to being supplied with cultivation tools, farmers also require precise information for effective crop management, and what better way to provide this requirement than by offering them a software-based service?**.** We can deploy the model in any cloud-based system. We can implement more than three architectures. We can connect this model to the hardware.

References

[1]. IEEE/ACM Transactions On Computational Biology and Bioinformatics, Vol. 20, No. 3, May/June 2023-VMF-SSD: A Novel V-space Based Multi-scale Feature Fusion SSD For Apple Leaf Disease Detection.

[2]. IEEE July 2021 Journal of Physics Conference Series 1962(1):012024 Plant Diseases Classification using Machine Learning.

[3]. IEEE 2018 Eleventh International Conference on Contemporary Computing (IC3)Noida, India (2018.8.2-2018.8.4)] 2018 Eleventh International Conference on Contemporary Computing (IC3) - Tomato Leaf Disease Detection Using Convolutional Neural Networks.

[4]. IEEE 2020 IEEE Applied Signal Processing Conference (ASPCON) – Kolkata (2020.10.72020.10.9)] 2020 IEEE Applied Signal Processing Conference (ASPCON) –Plant Disease Detection Using CNN.

[5]. IEEE 2019 IEEE Eurasia Conference on IOT, Communication and Engineering (ECICE) - Yunlin, Taiwan (2019.10.3-2019.10.6)] 2019 IEEE Eurasia Conference on IOT, Communication and Engineering (ECICE) - Plant Leaf Detection and Disease Recognition using Deep Learning.