International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 06 | June - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

Deep Learning Techniques for Plant Disease Detection

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Abstract: In the lives of humans, agriculture is incrediblyvital. Almost 60% of the population is either directly or indirectly involved in agriculture. Farmers are not interestedin expanding their agricultural production day by day because there are no technologies in the old system to identify diseases in different crops in an agricultural setting. Early diagnosis of crop diseases is essential since they have an effect on the growth of their particular species. Numerous Machine Learning (ML) models have been used to identify and categorise agricultural illnesses, but new developments in a subset of ML called Deep Learning (DL) seem to hold great promise for increased accuracy in this field of study. The suggested method effectively and precisely recognises the symptoms of crop disease using a convolutional neural network and a deep neural network. Furthermore, these solutions are evaluated using a variety of efficiencyindicators. The DL models that are used to depict crop diseases are fully described in this article. Additionally, a number of research holes are found that can provide more clarity for identifying plant diseases even before symptoms appear. Convolution neural network-based technology will be developed using the suggested methodology to identify plant leaf disease.

Keywords: Plant Disease Detection, Deep Learning, Convolution Neural Network, OpenCV

1. Introduction

India is a country that is quickly industrialising, and its early development was mostly supported by agriculture. As the world's population is expanding quickly, agriculture is havingdifficulty keeping up with demand. Instilling in the younger generation an understanding of the value of horticulture is also necessary. Food security is still in danger from a numberof issues, including climate change, pollinator decrease, agricultural pests, inadequate irrigation, and others. Crop disease lowers food production in terms of both volume and quality. Crop diseases have a negative influence on small- scale farmers whose livelihood depends on safe farming as well as the world's food security. By spotting crop illnesses assoon as they manifest on crops, the value of monitoring cropdiseases is realised.

The development of the internet and the science of computer vision have made it possible to offer a practical answer to this issue. An incorrect plant disease diagnosis causes a considerable loss in production, time, money, and product quality. Effective cultivation depends on knowing the plant'scondition. Crops are impacted by a variety of environmental anomalies, including fungi, water shortages, insects, and weeds. These are the kinds of problems that need farmers taking precautions in order to increase yield. This study assists in focusing on the crop's visually appealing attributes. Recent developments in artificial intelligence have made it possible to automatically detect plant diseases from unprocessed photos.

A neural network-based learning technology called deep learningis used. Deep learning has the ability to automatically extract features from images, which is one of its advantages. The neural network learns how to extract features during preparation. CNN,a multi-layer feed-forward neural network, is the most well- known deep learning model.

LITERATURE SURVEY:

Deep learning is a method of learning based on neural networks. One benefit of deep learning is its capacity to extract information from photos. During preparation, the neural network picks up howto extract features. The most well-known deep learning model is CNN, a multi-layer feed-forward neural network.

"In the **paper "Deep learning Techniques for Plant disease detection"** the authors Prasanna Mohanty et al., has proposed an approach to detect disease in plants by training a convolutional neural network. The CNN model is trained to identify healthy and diseased plants of 14 species. The model achieved an accuracy of 99.35% on test set data. When using the model on images procured from trusted online sources, the model achieves an accuracy of 31.4%, while this is better than a simple model of random selection, a more diverse set of training data can aid to increase the accuracy. Also some other variations of model or neural network training may yield higher accuracy, thus pavingpath for making plant disease detection easily available to everyone."

" Malvika Ranjan et al. suggested a method to identify plant illnesses using the image of the sick leaf that was collected in their study, "Detection and Classification of Leaf Disease UsingArtificial Neural Network." In order to discriminate between healthy samples and diseased plants, an artificial neural network (ANN) is trained by carefully selecting feature values. The accuracy of the ANN model is 80%."

" The four key steps in the disease detection procedure are as follows, according to the publication "Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features" by S. Arivazhagan: The input RGB imageis first given a colour transformation structure, and the green pixels are then identified and excluded using a certain threshold value. Next comes segmentation, and in order to produce useful

segments, texture statistics are generated. Finally, a classifier is employed to categorise the disease using thefeatures that were extracted."

" Several studies have explored the use of deep learning techniques for plant disease diagnosis. For instance, Mohanty et al. (2016) developed a deep convolutional neuralnetwork (CNN) model called PlantVillage for automated diagnosis of plant diseases. The model was trained on a dataset of over 50,000 images of diseased and healthy plantsand achieved an accuracy of 99.35% in classifying 38 different plant diseases.

Similarly, Ferentinos (2018) proposed a deep CNN model for automated diagnosis of tomato diseases. The model was trained on a dataset of over 20,000 images of healthy and diseased tomato leaves and achieved an accuracy of 99.53%in classifying seven different tomato diseases.

In another study, Sladojevic et al. (2016) proposed a deep CNN model for automated diagnosis of grapevine leafdiseases. The model was trained on a dataset of over 1,100images of healthy and diseased grapevine leaves and achieved an accuracy of 98.2% in classifying four differentgrapevine leaf diseases.

Recently, Wu et al. (2020) proposed a deep CNN model for automated diagnosis of rice diseases. The model was trained on a dataset of over 5,000 images of healthy and diseased rice leaves and achieved an accuracy of 98.9% in classifyingsix different rice diseases.

In a study by Zhang et al. (2018), a deep learning-based model was developed for the detection of rice blast disease.The model was trained on a dataset of over 1,000 images ofhealthy and diseased rice leaves and achieved an accuracy of 98.2% in detecting the disease.

2. Problem statement

In India, agriculture plays a crucial role in economic growth.In India, the agricultural industry employs about half of the workers. Pulses, rice, wheat, spices, and spice products are all produced in the greatest quantities worldwide in India. The quality of the products that farmers produce, which is dependent on plant growth and yield, determines the farmers' economic growth. Consequently, it is critical to identify plantdiseases in agriculture. Diseases that prevent plant growth arequite likely to affect plants, which has an impact on the ecology of the farmer. When a plant disease is found early on,it is desirable to utilise an automated disease detection technique. Plant diseases can show up in many areas of the plant, including the leaves.

The manual diagnosis of plant disease using leaf images takes a lot of time. To automate the process of illness identification and categorization using leaf photos, computational techniques mustbe created.

3. Existing system

The current method for identifying plant illnesses is through straightforward observation with the naked eye by plant experts, which can be used to find and diagnose plant diseases. The suggested method can be used in these situations to track huge fields of crops. In certain countries, farmers also lack access to suitable facilities or are unaware that they can speak with professionals. Because of this, consulting with professionals is more time and money intensive. The suggested method for tracking a lot of plants would be helpful in those situations.

3.1 Disadvantages of Existing System

- Only humans are capable of predicting diseases.
- The procedure is extremely slow.
- Consumption of time and space is also very high.

4. Proposed solution

The detection of plant diseases is the main goal of this research. Plant diseases are identified using the segmentation, feature extraction, and classification procedures. Using a digital camera or similar device, pictures of leaves from different plants are obtained, and the pictures are then utilised to categorise the afflicted area in the leaves. In the suggested framework, a Convolution neural network and a Deep neural network are used to identify plant illness. This research suggests a system for accurately identifying plant diseases thatmakes use of open-source, inexpensive software.

4.1 Advantages

- Detects related images with a low-cost camera and open cv.
- Opencv aids in the efficient analysis of images and videos.

5. List of modules

- Image acquisition.
- Image pre-processing.
- Image enhancement.
- Image segmentation.
- Image analysis.
- Feature extraction.
- Disease classification.

5.1 Image Acquisition:

Data collection from a publicly available repository is the initial stage. The input for additional processing is the image. We've selected the most popular image domains so that our approach may accept input in any format, including.bmp,.jpg, and.gif. Direct real-time image feeds are provided by the camera. Since thecolour of most leaves varies from red to green, a white background is offered for additional research, proper visibility, and simple image analysis. In this technique, cotton photos are taken utilising an image-capturing technology. Any distortion is prevented by the way the photo was captured. Since direct sunlight would have distorted the image, the photo wasn't taken in that situation.

5.2 Image Pre-processing

Image pre-processing is the practise of performing image processing on digital images using computeralgorithms. By using a specialised algorithm to analysethe image, we can identify the plant. With a particular algorithm, we employ a similar strategy for picture processing and detection. In this process, the image quality is crucial since without a clear image, the algorithm won't work.

Fig.1. Infected plant

5.3 Image Enhancement

The process of modifying digital images so that the effects are more appropriate for display or further image processing is known as image enhancement. Any of the following can be used to improve an image:

- Histogram Equalization.
- Noise removal using filters.
- Unsharp mask filtering.
- Decorrelation stretch etc.

5.4 Image Segmentations

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picture segmentation (sets of pixels, often known as picture objects) is the process of dividing a digital image into several segments. By breaking the image up into different segments and studying each section separately, image segmentation helps to make image identification and analysis simpler. Thenumerous portions all share the same features in terms of colour, texture, and intensity.

5.5 Image analysis

In this step, image segmentation is used to locate the region of interest. The technique used in segmentation is region- based segmentation, which uses the colour of the leaf to distinguish between healthy and diseased regions of the plant

5.6 Feature Extraction

The dimensionally reduced technique in machine learning, which splits and reduces a big collection of raw data into smaller groups, includes feature extraction. This stage is crucial when we have a lot of data and need to conserve resources while avoiding mistakes. Function extraction, which chooses and combines variables into functions, enables the extraction of the best feature from enormous datasets.

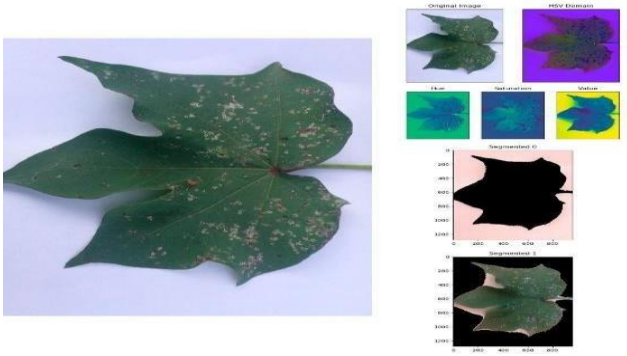

Fig.2. Training Data

5.7 Disease Classifications

This method for identifying plant diseases makes use of our expert deep learning model. The leaf of the contaminated plant should be photographed using a digital camera or a similar apparatus. The image was scanned utilising Opencv. The type of plant is then determined. After discovering it, it determines what kind of sickness the plant has.

Conclusion

The suggested system continuously monitors the farmland. Crop diseases are early-identified using the CNN and DNN algorithms. The model is trained using machine learning techniques, which helps with disease decision-making. The farmer is encouraged to apply pesticides as a treatment to control infectious diseases.

The suggested plan might be enhanced in the future to include more services like close-by public markets, pricing lists for pesticides, and a nearby open market, among others. In addition to a method for image segmentation that may one day be utilised for automated detection and classification of plant leaf diseases, this research reviews numerous diseaseclassification strategies for crop disease detection. . The suggested algorithm is tested on a variety of organisms,including bananas, beans, jackfruit, lemons, mangoes, potatoes, tomatoes, and sapota. As a result, related ailments for these plants were looked at. The bestoutcomes were attained with a minimal amount ofcomputing
work, illuminating the effectiveness of the suggested method in identifying and categorising agricultural illnesses. The ability to identify plant diseases at an early stage, or even at the outset, is another advantage of this method. The classification process may make use of deep neural networks and convolution neural networks to improve recognition rates.

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