NIET Journal of Engineering & Technology (NIETJET)
Volume 11, Issue 1, 2020 ISSN: 2229-5828 (Print)

Detection of Crop Disease Using Convolutional Neural Network

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Abstract: *Farming lands are increasingly plentiful in developing countries, making it difficult for farmers to keep track of each and every plant in their fields on a regular basis. It is also impossible for farmers to be aware of all illnesses; therefore non-native diseases are frequently overlooked. Expert consultation for this is often time consuming and pricey. As a result, an automated method to identify and classify plant diseases the utilization of image processing is required. Deep learning and convolution neural networks are employed in this study to identify sickness in agricultural produce. Because convolution neural networks are specifically intended to analyze pixel data, they deliver higher accuracy and results when classifying photos into healthy and non-healthy categories. This technique includes two phases: the first requires training the modeling for healthy and diseased photos of crops; the second phase comprises crop monitoring and identification of* specific disease in the plant, which leads to early disease diagnosis.

Introduction

Agriculture is a major source of revenue and livelihood in both developing and developed countries, including India. In India, the agriculture industry has a direct or indirect impact on the people. As a result, in order to support the country's economic development, high-quality agricultural goods must be produced. As a result, identification of plant diseases plays a vital role in the agricultural industry. Agriculture is essential to the survival of all living creatures. The plants must be healthy and disease-free in order to provide the highest harvests. As a result, a technical approach is required to look after them on occasion. Plant diseases are one of the most critical variables that can cause a considerable drop in agricultural output quality and quantity. Crop diseases can have a substantial impact on the quantity and quality of the crop. Farmers frequently diagnose leaf diseases by sight, using visualization. It leads to a misdiagnosis because a farmer's experience anticipates the symptoms. This also results in the usage of costly pesticides that is needless and excessive. Detecting it with the naked eye would need a big team of professionals to diagnose it, which would be prohibitively expensive. As a result, technological advancements, particularly the use of image processing in conjunction with a deep learning technique, will assist farmers in detecting plant disease at an early stage. Accurate and early disease diagnosis would assist to limit the use of excessive pesticides while also improving crop quality. The presence of illness on the plant is mostly indicated by symptoms on the leaves, according to the study. As a result, a machine vision system that detects illnesses from images automatically, accurately, and at a lower cost proposes a better solution to the problem. The present study focus on to obtain an image from the farmer of the diseased crop preferably leaves through the web portal provided to them. The image is then processed using image-processing using the CNN and the disease type is detected based on the training dataset. The disease that affected the crop and the fertilizer or the pesticide/insecticide to be used is also provided in the web portal that was previously used by the farmer to upload image.

Methodology

In the monitoring of huge fields of crops, automatic diagnosis of plant diseases is significant. The suggested method identifies disease automatically based on symptoms that occur on plant leaves. This enables image-based automated inspection, process control, and robot guiding using machine vision. Visual identification, on the other hand, is time-consuming, more precise, and limited to narrow regions.

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The photos are initially obtained from the farmer in the suggested method. The photographs are obtained from the farmer via the Web Portal and are only used for the farmer's benefit. The photographs are submitted by the farmer, who prefers to use the Choose File option to select the proper image of the leaf. When a farmer uploads an image, he gets given a disease name, which he must use to check the pesticides for the illness later. Figure 1 depicts the system's fundamental flow.

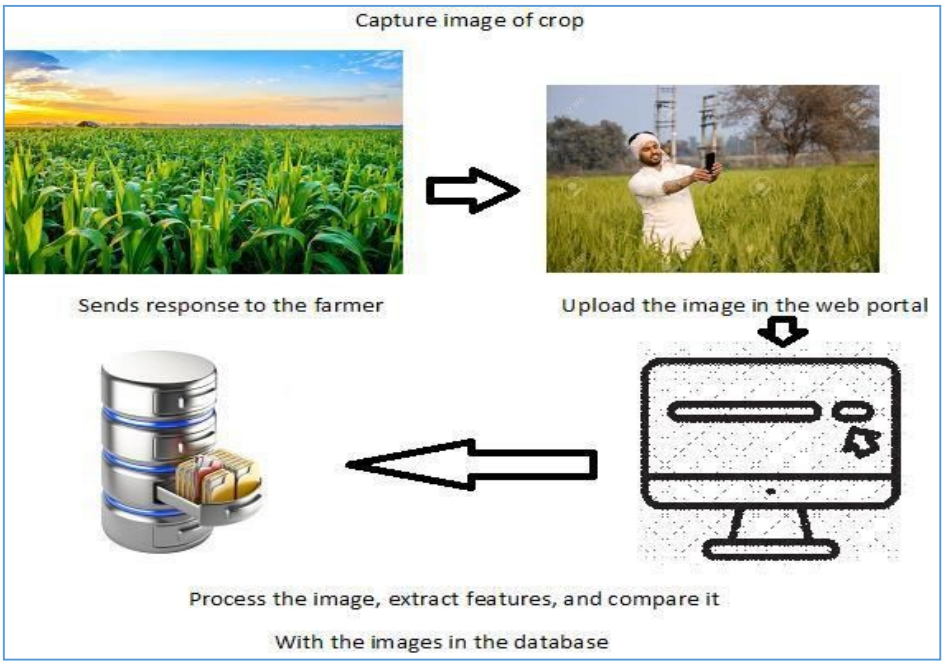

Fig 1: Basic Flow of System

CNN processes the photograph that the farmer has supplied. The obtained pictures are then subjected to image processing techniques in order to identify valuable information for future study. The photos are then classified using many layers based on the specific challenge at hand. The created model detects and displays the disease kind. The damaged region is also shown to help determine the disease's severity. The pesticides for the discovered illness may be looked up using the online portal's URL. To see the information, the farm worker must click another option on the online page called Click to check cures. When he clicks the link, he is taken to a paper where he may compare organic and chemical methods of crop protection. The following are the tools and technology used to create the systems.

Web Portal

The Web portal for the farmer was developed using the VS Code. The development of the web portal had various stages such as local server, storing images in the local storage, and accessing images from local storage, updating information into the local storage and extracting messages from the local storage. The layout of the web portal contains three buttons which are Choose File, Predict and click me for remedies and more info. The click me for remedies in turn would open a document which will help the farmer to find ways to take care of his crop

Python Keras

Keras is a Python-based deep learning API that runs on top of TensorFlow, a machine learning platform. It was created with the goal of allowing for quick experimentation. It's crucial to be able to get from idea to outcome as quickly as feasible when conducting research. Our database has 15 classifications, with 12 being used to diagnose plant illnesses and three being used to identify healthy plants. There are 20474 photos in all. It's been trained with a CNN technique to filter out the characteristics and offer us with an accurate anticipated result.

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DISEASES BEING IDENTIFIED

Bacterial Blight/Spot:

Bacterial blight/spot is a bacterial infection caused mostly by the bacterium "Xanthomonas Campestris pv Malvacearum." Dark grass and 1 to 5 mm water spots appear sideways in the red-brown leaf border as a result of bacterial blight damage. These angular patches first look to be waterlogged, then turn dark brown and finally black.

Fig 2 . Bacterial Blight

Leaf Mold:

The fungus Passalora fulva (formerly known as Fulvia fulva) is the principal cause of the disease leaf mould. There is no evidence that it is pathogenic to any plant. It mostly affects tomato plants, causing infected flowers to become black and fall off.

Fig 3. Leaf Mold

Spider Mite:

Spider mites are insects that feed on the bottom surface of the leaf, causing the afflicted leaf to become yellow and eventually defoliate. As their number grows, they spread to other areas of the plant, causing defoliation.

Fig 4. Spider Mites

Leaf Curl:

Leaf curl is a crop disease caused by the fungus Begomovirus, which causes leaf deformation and colouring. Abiotic disorders and pesticides may also be to blame. It is one of the most damaging tomato diseases, mostly seen in tropical and subtropical climates.

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Fig 5. Leaf Curl

Mosaic Virus:

The plant's leaves and look become speckled as a result of this. When infected leaves brush against healthy leaves, the disease spreads quickly. It infects about 150 different plant species, including vegetables and fruits.

Fig 6. Mosaic Virus

CONVOLUTION NEURAL NETWORK

To train the model, data from the diseases mentioned above is collected. Following the acquisition of the dataset, the model must be trained for both healthy and ill leaf pictures. After the training is done, a fully connected neural network is built for picture categorization.

WORKING OF CONVOLUTION NEURAL NETWORK

A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning system that can take an input picture, assign relevance (learnable weights and biases) to various aspects/objects in the image, and distinguish between them. When compared to other classification techniques, the amount of preprocessing required by a ConvNet is significantly less. While basic approaches need hand-engineering of filters, ConvNets can learn these filters/characteristics with enough training.The architecture of convolutional neural networks like this:

Input (image) ->Convolution ->ReLU ->Convolution ->ReLU ->Pooling -> ReLU ->Convolution ->ReLU ->Pooling ->Fully Connected Layer.

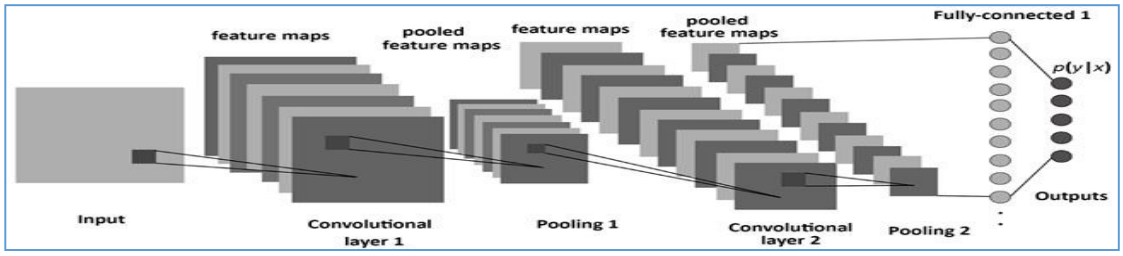

Fig 9. Basics architecture of CNN

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Results and discussions

Validation of model

Because CNN was created specifically for image categorization, it has a higher level of accuracy. It was discovered that after training and testing the model to identify crop disease, the following results were obtained:

We acquire a training accuracy of 95.55 percent and a testing accuracy of 95.69 percent since we only used 70 EPOCHS (number of runs) to train this data. If we increase the number of epochs to 200-250, our prediction accuracy would jump to 98-99 percent, resulting in proper illness prediction.

The photos below depict how the user interface appears and its functions.

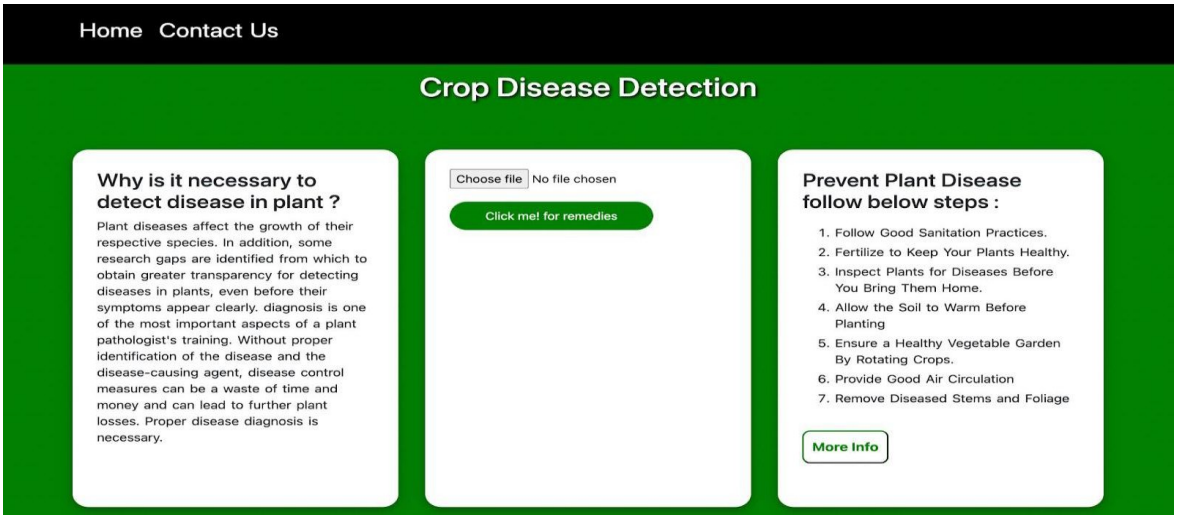

Fig 10. User Interface

This is the online portal's home page; when you click the Choose file button, a dialogue box appears, allowing you to select the image for which the disease will be forecasted.

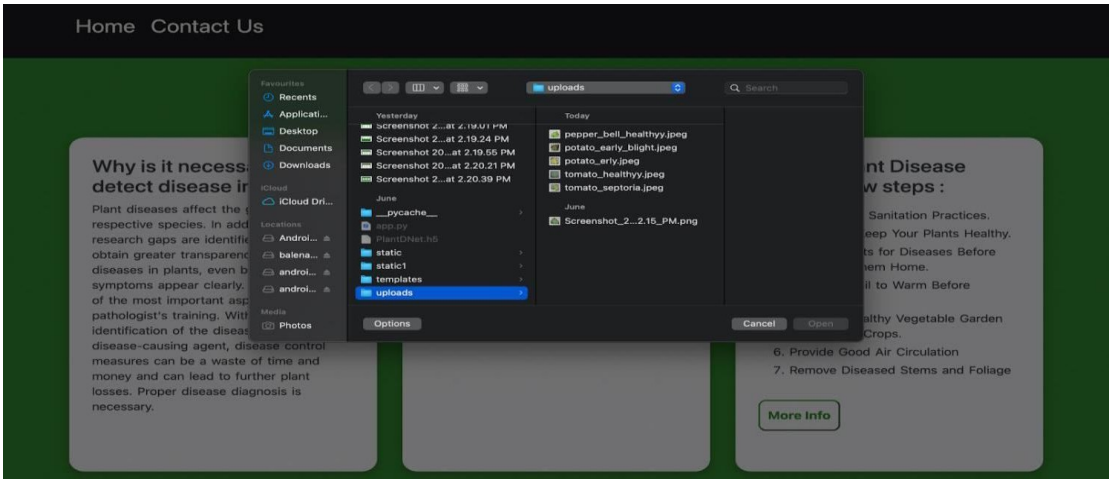

Fig 11.UI to click on predict button

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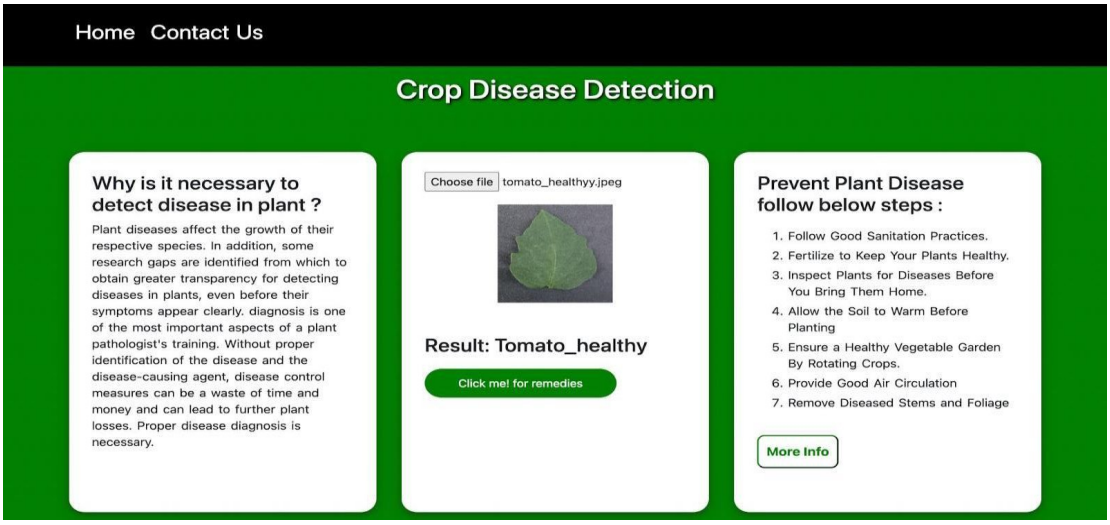

Fig 12. Result

When a user hits the predict button, CNN processing begins, and once completed, a message appears indicating whether the submitted image is of a healthy plant or not. If the plant is suffering from a disease, the illness label is presented on the portal.If the projected result is a diseased plant, the user may check out the cures by clicking on the button on the portal that says "Check for Remedies." When the user clicks the button, he is sent to a word page where he may look for organic and chemical cures for his crop.

Conclusions

Image Processing presents an automated and unique technique for detecting agricultural illnesses in diseased crops. Early detection using CNN and deep learning methods allows the farmer to be warned in a timely manner and take suitable actions to cure the disease. Images are sent into the network, which extracts attributes from them and then categorises them as healthy or unhealthy. By running additional epochs, the accuracy may be improved, and increasing accuracy leads to better prediction and accurate detection of the crop disease. This saves farmers money and helps them build their businesses. As a result, it can be stated that CNN is the most effective method for classifying and detecting these pictures.

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