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Automatic Quality Assessment and Disease Detection of Crops using Deep Learning: An Overview

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Abstract : When plants and crops are affected by pests it affects the agricultural production of the country. We usually farmers or experts observe the plants with naked eye for detection and identification of disease. But this method can be time processing, expensive and inaccurate. Automatic detection using image processing techniques provide fast and accurate results. This paper is concerned with a new approach to the development of plant disease recognition model, based on leaf image classification, by the use of deep convolutional networks. Advances in computer vision present an opportunity to expand and enhance the practice of precise plant protection and extend the market of computer vision applications in the field of precision agriculture. Novel way of training and the methodology used facilitate a quick and easy system implementation in practice. All essential steps required for implementing this disease recognition model are fully described throughout the paper, starting from gathering images in order to create a database, assessed by agricultural experts, a deep learning framework to perform the deep CNN training. This method paper is a new approach in detecting plant diseases using the deep convolutional neural network trained and fine-tuned to fit accurately to the database of a plant's leaves that was gathered independently for diverse plant diseases. The advance and novelty of the developed model lie in its simplicity; healthy leaves and background images are in line with other classes, enabling the mode l to distinguish between diseased leaves and healthy ones or from the environment by using deep CNN.

Keywords : plant disease; deep learning; convolutional neural networks (CNN)

Introduction

Due to this Complexity and the large number of developed plants and their existing psychopathological conditions also fail, given trained agronomists and plant pathologists, to accurately diagnose specific diseases, leading to erroneous assumptions and solutions. Plant pests and rodents represent a major threat for the agriculture sector. In the world's agricultural sector, plant diseases cause significant production and economic losses. The In order to avoid more disruption, proactive action by detecting an early period of plant disease is one of the major challenges in overall crop disease control. Diagnosis of plant disease requires a significantly high degree of complexity through visual examination of the effects on plant leaves. Research results suggest that climate change may modify stages and levels of pathogen production; it may also alter host resistance, which leads to physiological changes in host-pathogen interactions. The condition is further compounded by the fact that pathogens nowadays are quicker to spread worldwide than ever before. There can be emerging pathogens where they had previously been unidentified and where there is apparently no local knowledge to counter them. One of the basics of timely and proper treatment of plant diseases is of precision agriculture [14].

It is Crucial to avoiding unnecessary expenditure of financial and other capital, while ensuring safer production, addressing the issue of long-term pathogen tolerance and minimizing the adverse effects of climate change. In plants, there are several ways to detect pathologies. Some diseases have no visible symptoms or the effect becomes apparent too late to act, and in those situations sophisticated analysis is mandatory. Nonetheless, most diseases generate some sort of manifestation within the visible spectrum, so the Trained naked eye examination by a doctor is the main method that is used in use to detect plant disease. A plant pathologist should have good observational skills to accurately diagnose plant disease, so that signature symptoms can be identified [15][16]. Signs of plant disease are evident in various parts of a plant; however, leaves are known to be the most commonly seen factor for detecting an infection. Hence, scientists have tried to automate the process of recognizing and classifying plant disease using vine images. Advances in artificial intelligence, machine learning, deep learning, image processing and graphical processing units (GPUs) can Expand and improve successful plant protection and plant development practices. Deep learning is about using artificial neural network architectures that include a fairly large number of computational layers. Convolution Neural Networks (CNNs) is the basic method of deep thinking used in the study. CNNs are one of the most effective tools of large-scale computer applications for modelling complex processes and pattern recognition, for example pattern recognition. in images.

Literature Survey

Title	Techniques	Dataset	Accuracy	Gap Analysis
A Survey on Detection and Classification of Cotton Leaf Diseases [1]	NN SVM otsu thresholding	400 images of different Cotton disease	NN 89.56% SVM 89% to 96%	Otsu is very older technique which generate very high error rate.
Machine Learning-based for Automatic Detection of Corn-Plant Diseases Using Image Processing [2]	Feature Extraction RGB HOG SIFT SURF ORB SVM, NB, DT, RF	3823 images of healthy and unhealthy leaf		Only colour shape base features has co

Groundnut Leaf Disease Detection and classification by using Back Propagation Algorithm [3]	SVM HSV & RGB	100 images of groundnut plant diseases	97.41%	No provision for multi objects disease detection.
Wheat Disease Detection Using Image Pre-processing [4]	NN SVM	342 Captured images	NN 80.21% SVM 89.23%	Low accuracy for NN and SVM as well
An Artificial Intelligence and Cloud Based Collaborative Platform for Plant Disease Identification, Tracking and Forecasting for Farmers [5]	ANN with feed forward and back propagation	811 images	80.60%	Both approaches generates different accuracy for heterogeneous dataset.
Plant Disease identification & Classification Through Leaf Images	Various Machine learning Techniques	117 Images	90% to 97%	It works only specific image dataset, not for cross images.
A Review on Machine Learning classification Techniques for plant disease detection [6]	SVM, ANN Classifier, KNN, Fuzzy, Deep learning CNN	300 images of different plants disease	SVM 93% ANN 93% KNN 82.5% Fuzzy 88% CNN 96.3%	High error rate due to similar feature extraction.
Deep learning models for plant disease detection and diagnosis [7]	CNN VGG	985 images of 14 different plants and disease	98.87 %	Much time consuming, and high resource dependency.
A Robust Deep Learning-Based Detector for Real-Time Tomato Plant Diseases and Pests Recognition [8] [11] [12] [13]	Faster R-CNN	1000 real time tomato images	R-CNN 95.00%	Applicable on tomato images only.
The problem of over-fitting [9]	Machine learning and statistic over fitting with random noise underlying relationship	Various plant images	85% accuracy with noise patterns	Low accuracy as well as time complexity issues.
Method for 2-D affine transformation of images [10]	transformation techniques including affine transformation,	Various plant images	ML approach 90.00%	Basic image processing techniques has followed which takes much time.

	perspective transformation, image rotations and intensity transformations (contrast and brightness enhancement, colour, noise)			

System Design

Further describes the entire process of developing a model for the recognition of plant disease using deep CNN. In the following parts the full cycle is divided into several appropriate steps, starting with the collection of images for classification using deep neural networks.

Dataset

Appropriate Datasets are needed at all stages of the object recognition study, from the training phase to the recognition algorithms performance assessments. All the photographs that were obtained for the dataset were downloaded from the Internet, indexed by disease and plant name on different sources. Images in the dataset are divided into different classes representing plant diseases clearly recognizable from the plants. A further class to distinguish normal leaves from diseased leaves was inserted into the dataset. This contains just photographs of healthy leaves. An Additional class was useful in getting a more precise description in the background images dataset. So deep neural network could be taught to differentiate the leaves from the surroundings. All duplicated images taken from different sources have been extracted using a python script which implemented the comparison procedure. By matching picture metadata the script removed the duplicates: name, size and date. After the automated removal, human experts studied the images in much repetition. The next step included introducing upgraded objects to the dataset. The The main aim of the presented study is to train the network to learn the features that distinguish one class from another. Therefore the ability of the network to know the correct functionality was improved when more enhanced images were used. A database, containing 30880 training images and 2589 validation pictures, was eventually developed. The augmentation approach demonstrates all approved disorders, together with the number of original images and the number of modified images for each class used as a training and testing dataset for disease classification model.

Image Pre-processing and Labelling

Images downloaded from the Internet were available in various formats, along with different resolutions and accuracy. Final images intended to be used as a sample for the deep neural network classifier have been pre-processed to improve precision in order to get better performance extraction. Pre-processing images usually involves removing low-frequency background noise, normalizing the amplitude of the individual particle photographs, extracting shadows, and masking parts of images. Pre-processing photos is the technique for data optimization, but pre-processing images allowed all the files to be filtered. manually, Build a square that displays the area of interest (plant leaves) around the plants. During the collection phase of the data set, images with a lower resolution and scale of less than 500 pixels were not deemed to be sufficient photographs for the dataset. Additionally, only the images were marked as eligible candidates for the dataset where the higher resolution region of interest was in. In this way, images were ensured to include all the information necessary for device learning. Internet surfing may provide several resources but their utility is often unreliable. In the Interest in checking party accuracy in the sample, initially clustered by a keyword search, agricultural experts evaluated leaf images and marked all products with the right acronym for disease. The use of correctly categorized photographs is essential for the collection of data for training and validation, as established. Only in this manner can a suitable and accurate model for detection be created. In this stage, duplicated images left after the initial iteration of collecting and sorting objects into groups were removed from the dataset.

Neural Network Training and Testing

Training using deep convolutional neural network Rendering the algorithm for classifying photographs from a dataset was suggested. Tensor Flow is an open source distributed software platform that utilizes data flow graphs. Grid nodes represent mathematical operations, while the grid edges show the multidimensional data arrays (tensors) between them. The modular model lets you link computation to one or more CPUs or GPUs via a simple API on a desktop, server, or mobile device. Tensor Flow was originally developed for analysis by researchers and engineers working in the Google Brain Team within the research organization Artificial Intelligence at Google machine learning and deep neural networks research, But the approach is versatile enough to also apply to a wide array of other situations. A convolutional neural network in machine learning is a kind of feed-forward artificial neural network in which the configuration of the visual cortex in animals affects the coordination mechanism between its neurons. Specific cortical neurons react to stimulation within a restricted region of space known as the receptive field. Different fields of the receptive neurons partly overlap to map the field of vision. The response of an individual neuron to stimuli within its receptive region may be approximated mathematically by a convolution method. Convolutional networks These have been influenced by biological processes, and are multilayer perceptron combinations engineered to use limited amounts of pre-processing. We have comprehensive visual and video recognition software, and support programs which natural language processing. Convolutional neural networks (CNNs) Consists of multiple levels of sensitive areas. These are tiny neuron arrays, which process portions of the input signal. The outputs of such arrays are then tiled to overlap their input regions in order to achieve a higher-resolution approximation of the original image; this is repeated for each layer. Tiling helps CNNs tolerate translation of the input file. Convolutional networks may include local or global pooling layers which combine the outputs of neuron clusters. These often consist of different combinations of convolutional and completely linked layers, adding point wise nonlinearity at the end of or after each layer. A Phase of Transformation on small regions of input is introduced to reduce the number of free parameters and improve generalization

Discussion

The various The existing system utilizes the DCNN classification framework to explain picture disease identification. Essentially machine performs image processing model first and then tests system performance. Figure 2 below shows the time required in system for single image processing with different functions. Figure 3 shows the time needed to process single images of different functions in system.

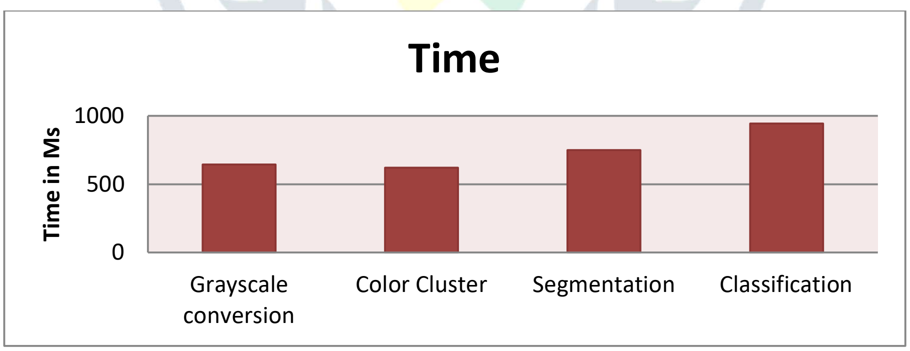

Figure 2 : Time required for single image processing with various function in stand alone system

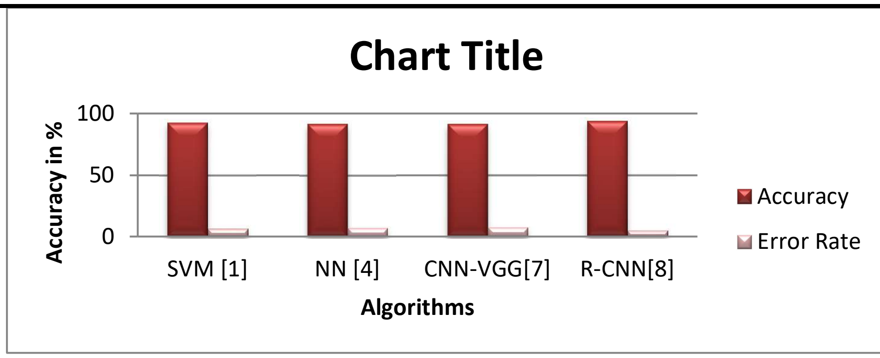

Figure 4 : disease classification detection accuracy using various machine learning and deep learning algorithm

Conclusion

The complete protocol was established from the collection of images used for training and testing to pre-processing and image augmentation, and finally, the training of deep CNN and fine tuning procedures, respectively. Numerous tests were performed to test the feasibility of the newly created model. New plant disease database picture has been created, containing more than 2,000 original images taken from open Internet sources. The conclusions obtained from the experiments precision between 91% and 98%, for separate class tests. The final overall accuracy of the trained model was 95%. Fine-tuning average performance has not significantly changed but the process of augmentation has had a greater influence on achieving acceptable results. As far as we are aware, the technique mentioned was not used in the field of plant disease detection; there was no comparison with similar tests using the same methods. Compared to other strategies used and supported, comparable or even better results have been obtained, particularly given the wider number of classes in the presented study.

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