plant diseases detection using convolution neural network

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Abstract - **When plants and crops are infected by pests it aggregates to the failure of agricultural production of the country. Usually, farmers or scientists observe the plants with the naked eye for detection of disease. But this method can be not time efficient, expensive and inaccurate. Automatic detection using image processing, produces fast and accurate results. This paper is concerned with a new approach to the development of a plant disease recognition model, based on leaf image classification, by the use of deep convolutional networks. Advances in computer vision will present an area of opportunity to expand and enhance the precision for the plant protection and extend the market of computer vision applications in the field of precision agriculture. An appreciable way of training and the methodology used to 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 to create a database, assessed by agricultural experts, a deep learning framework to perform the deep CNN training. This methodological paper is a new way of 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 various plant diseases. The advance and novelty of the developed model dwell its simplicity; healthy leaves and background images are in line with other classes, enabling the model to differentiate between diseased leaves and healthy ones or from the environment by using CNN.**

keywords - **plant disease detection, image segmentation, machine learning, convolution neural network**

I.INTRODUCTION

The problem of efficient plant disease protection is closely related to the problems of sustainable agriculture Inexperienced pesticide usage can cause the development of long-term resistance of the pathogens, severely reducing the ability to fight back. Timely and accurate diagnosis of plant diseases is one among the pillars of precision agriculture. it's crucial to stop unnecessary waste of monetary and other resources, thus achieving healthier production during this changing environment, appropriate and timely disease identification including early prevention has never been more important.

There are several ways to detect plant pathologies. Some diseases don't have any visible symptoms, or the effect becomes noticeable too late to act, and in those situations, a classy analysis is obligatory. However, most diseases generate some quite manifestation within the colour spectrum, therefore the eye examination of a trained professional is that the prime technique adopted in practice for plant disease detection. To achieve accurate disease diagnostics a plant pathologist should possess good observation skills in order that one can identify characteristic symptoms.

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II. EXISTING METHODS

In an existing system, Sampling is completed by collecting, counting, or inspecting a little a part of the population. It determines the trends within the population of organisms. The sampling should be done properly in order that it might reflect the condition of the entire population. for instance, the population of insect pests and therefore the damage on the crop are generally randomly distributed that later aggregate into clumps. This may be caused by the behavior of adult immigrants or by the concentration of eggs laid on a plant before the insect moved to subsequent.
Such a situation is additionally pertinent in insect-transmitted virus diseases. Therefore, the estimate of population density depends on taking enough samples and systematic sampling from a field.

Affected crops will be identified by humans. Used ANN classification for
Disease identification
Step1. In the first step, two images have been taken one for the healthy leaf other for the defective leaf.
Step2. In the training process, resizing of the healthy and defective image of rice leaf has been done.
Step3.Then convert RGB to Grayscale image because canny edge detection cannot be applied directly on RGB.
Step4.Then apply stem, stairs, canny edge detection, surf, entropy, warp, images. This technique is applied on both the samples healthy as well as defected.

Step5. Once the training process of first phase samples is finished, Comparison has been done based on values obtained for all the parameters used.

Affected crops will be identified by ANN.

- Hardware dependence: Artificial neural networks require processors with parallel processing power, by their structure. For this reason, the realization of the equipment is dependent.
- Unexplained functioning of the network: This is the most important problem of ANN. When ANN gives a probing solution, it does not give a clue as to why and how. This reduces trust in the network.
- Assurance of proper network structure: There is no specific rule for determining the structure of artificial neural networks. The appropriate network structure is achieved through experience and trial and error.
- The difficulty of showing the problem to the network: ANNs can work with numerical information. Problems have to be translated into numerical values before being introduced to ANN. The display mechanism to be determined here will directly influence the performance of the network. This depends on the user's ability.
- The duration of the network is unknown: The network is reduced to a certain value of the error on the sample means that the training has been completed. This value does not give us optimum results.

III.METHODOLOGY

Machine Learning (ML) is automated learning with little or no human intervention. It involves programming computers in order that they learn from the available inputs. the most purpose of machine learning is to explore and construct algorithms which will learn from the previous data and make predictions on new input file. to unravel this problem, algorithms are developed that build knowledge from specific data and knowledge by applying the principles of statistical science, probability, logic, mathematical optimization, reinforcement learning, and control theory.

Convolution Neural Network (CNN)

Convolution Neural Networks (CNNs) are wont to detect the disease in plant leaves. CNN is an evolution of straightforward ANN that provides better results on images. Because images contain repeating patterns of a specific thing (any image). Two important functions of CNN are convolution and pooling. Convolution is employed to detect edges of patterns in a picture and pooling is employed to scale back the dimensions of a picture. CNN architectures that were applied to a drag are the following: (a) Simple CNN, (b) VGG, and (iii) Inception V3. Moreover, training of those models is completed using Jupyter notebook and Keras API of Tensor Flow. Keras is tensor flow's high-level API for building and training deep learning models.

Dataset Discussion

Two datasets are wont to perform disease detection. the primary dataset consists of 15 classes and therefore the other consists of 38 classes. Both databases have several images of every plant. the ultimate findings of this work are on the Plant Village dataset which contains 38 classes of various plants. it's also openly available on the web. Description of those classes and dataset are given within the following Table- I (a) and (b).

Table- I (a): Dataset Description

Class	Plant Name	Healthy or Diseased	Disease Name	Images (Number)
C_0	Apple	Diseased	Apple scab	504
C_1	Apple	Diseased	Black rot	496
C_2	Apple	Diseased	Cedar apple rust	220
C_3	Apple	Healthy	-	1316
C_4	Blueberry	Healthy	-	1202
C_5	Cherry (including sour)	Diseased	Powdery mildew	842
C_6	Cherry (including sour)	Healthy	-	684
C_7	Corn_(maize)	Diseased	Cercospora leaf spot Gray leaf spot	410
C_8	Corn_(maize)	Diseased	Common rust	953
C_9	Corn_(maize)	Diseased	Northern Leaf Blight	788
C_10	Corn_(maize)	Healthy	-	929
C_11	Grape	Diseased	Black rot	944

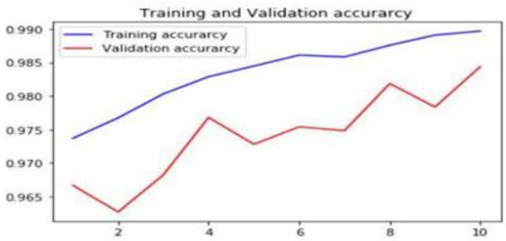
C_12	Grape	Diseased	Esca (Black Measles)	1107
C_13	Grape	Diseased	Leaf blight (Isariopsis Leaf Spot)	861
C_14	Grape	Healthy	-	339
C_15	Orange	Diseased	Haunglongbing (Citrus greening)	4405
C_16	Peach	Diseased	Bacterial spot	1838
C_17	Peach	Healthy	-	228
C_18	Pepper bell	Diseased	Bacterial spot	797
C_19	Pepper bell	Healthy	-	1183
C_20	Potato	Diseased	Early blight	800
C_21	Potato	Diseased	Late blight	800
C_22	Potato	Healthy	-	121
C_23	Raspberry	Healthy	-	297
C_24	Soybean	Healthy	-	4072
C_25	Squash	Diseased	Powdery mildew	1468
C_26	Strawberry	Diseased	Leaf scorch	887
C_27	Strawberry	Healthy	-	364
C_28	Tomato	Diseased	Bacterial spot	1702

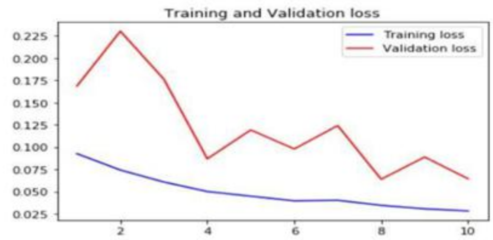
By using this table you'll come to understand the number of images in each class. Each class contains approximately 1000 images. Fourteen different plants are available during this dataset. for each plant's health also as diseased images of leaves are available. Most of the pictures belong to Tomato and Apple plants. the smallest amount images are from Raspberry, Soybean, and Squash class. The below image shows some images of various leaves which are available within the dataset.

Class	Plant Name	Healthy or Diseased	Disease Name	Images (Number)
C_29	Tomato	Diseased	Early blight	800
C_30	Tomato	Diseased	Late blight	1527
C_31	Tomato	Diseased	Leaf Mold	761
C_32	Tomato	Diseased	Septoria leaf spot	1417
C_33	Tomato	Diseased	Spider mites Two-spotted spider mite	1341
C_34	Tomato	Diseased	Target Spot	1123
C_35	Tomato	Diseased	Tomato Yellow Leaf Curl Virus	4286
C_36	Tomato	Diseased	Tomato mosaic virus	299
C_37	Tomato	Healthy	-	1273
Total				43384

IV. SIMULATION STUDY OF PERFORMANCE IN MEASUREMENT OF ACCURACY

However, most diseases generate some kind of manifestation in the visible spectrum, so the naked eye examination of a trained professional is the prime technique adopted in practice for plant disease detection. To achieve accurate plant disease diagnostics a plant pathologist should possess good observation skills so that one can identify characteristic symptoms. Timely and accurate diagnosis of plant diseases is one of the pillars of precision agriculture. To achieve accurate plant disease diagnostics a plant pathologist should possess good observation skills so that one can identify characteristic symptoms. Timely and accurate diagnosis of plant diseases is one of the pillars of precision agriculture.





The testing dataset gives an accuracy of more than 96%. It means 1379 images from 14,059 images were classified correctly by model. Below are the Training and Validation accuracy graph generated by our model on the testing dataset.

V. RESULTS AND DISCUSSION

This study shows the importance of disease detection lately. This model was developed using Machine Learning in python. 20% (14,059) images from the Plant Village dataset were wont to test the accuracy of this model. These images are from 38 different classes. 20% of every class randomly selected for testing. Some real-time images were also used. Those images were captured from the local environment. they are doing not belong to any class which is present within the dataset.

But the model gives us quite 96% accuracy on those images also by telling either the leaf is healthy or unhealthy. a complete of 100 images were used and 96 were classified correctly. Some images were captures in the dark with the assistance of a flashlight and a few images have dirt upon them in order that they were misclassified. a number of the pictures which we captured from the local environment.

Healthy

Unhealthy

VI. SUMMARY AND CONCLUSION

As it is understood that convolutional networks can learn features when trained on larger datasets, results achieved when trained with only original images won't be explored. After fine-tuning the parameters of the network, and overall accuracy of 96.77% was achieved. Furthermore, the trained model was tested on each class individually.

The test was performed on every image from the validation set. As suggested by good practice principles, achieved results should be compared with another results. Besides, there are still no commercial solutions on the market, except those handling plant species recognition supported the leaf's images. during this paper, an approach of using the deep learning method was explored to automatically classify and detect plant diseases from leaf images.

The complete procedure was described, respectively, from collecting the pictures used for training and validation to image pre-processing and augmentation and eventually the procedure of coaching the deep CNN and fine-tuning. within the future, image data from a smartphone could also be supplemented with location and time information for extra improvement inaccuracy.

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