Convolution Neural Network (CNN) based Diagnosis of Plant Diseases and Pests Detection

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Abstract :

When plants and crops are affected by pests it affects the country's agricultural products. The only way to diagnose plant diseases is simply to look into the eyes of a specialist where there is a diagnosis of plant diseases. In doing so, a large team of experts and continuous crop monitoring is required, which is very costly when we do on large farms. At the same time, in some lands, farmers do not have the right resources, or they may not even think about consulting experts. Because sight professionals are very expensive and time consuming. In such cases, the proposed procedure proves to be helpful in monitoring large plantations.

Automatic detection using image processing techniques provides fast and accurate results. This paper is concerned with a new approach to the development of a model for the diagnosis of plant diseases, based on the separation of leaf images, through the use of deep networks. It uses the Convolution Neural Network (CNN) which contains the various layers used to predict. Advances in computer vision provide an opportunity to expand and enhance the practice of accurate crop protection and expand the market for computer vision applications in the precise agricultural sector.

Also, after being diagnosed with the disease, suggest the name of the pesticide to be used. It also identifies insects and insects that are responsible for the epidemic.

Keywords:
Plants, Crops, Pests, Plant diseases, Image processing, Convolution Neural Network (CNN)

1. INTRODUCTION

When plants & crops are affected by pests it affects the country's agricultural products. Farmers or experts often look at plants with the naked eye to detect and diagnose diseases. But this approach can be time-consuming, expensive, and inconvenient. Automatic detection using image processing techniques provides fast and accurate results. Nowadays, it is combined or substituted with various technologies such as immunoassays (e.g., enzyme-linked immunosorbent assay, ELISA) and PCR or RNA-seq to detect pathogen-specific antigens or oligonucleotides, respectively [1, 2].This paper is concerned with a new approach to the development of a model for the diagnosis of plant diseases, based on the separation of leaf images, through the use of deep networks. Advances in computer vision provide an opportunity to expand and enhance the practice of accurate crop protection and expand the market for computer vision applications in the precise agricultural sector. The novel training method and the method used to facilitate the implementation of a quick and easy to implement program. All the important steps required to use this diagnostic model are fully explained throughout the paper, from image collection to database, evaluated by agricultural experts, in-depth learning framework for conducting in-depth CNN training.

We use the Convolution Neural Network (CNN) which contains the various layers used to predict. The drone model is also designed that can be used for live coverage of large agricultural fields where a high-resolution camera is attached and will capture images of plants that will serve as software inputs, on which the software is based, whether the plant is healthy or not.

2. RELATED WORK

Recent technical advances and dramatic cost reductions in the field of digital image acquisition have allowed the introduction of an array of image-based diagnosis methods at a practical level [3]. However, as the acquired image encloses condensed information that is extremely difficult for the computer to process, it requires a preprocessing step to extract a certain feature (e.g., color and shape) that is manually predefined by experts [4, 5].

An initial attempt to use deep learning for image-based plant disease diagnosis was reported in 2016, where the trained model was able to classify 14 crops and 26 diseases with an accuracy of 99.35% against optical images [6]. Since then, successive generations of deep-learning-based disease diagnosis in various crops have been reported [7, 8].

Given a training dataset, CNN, unlike traditional machine learning techniques that use hand-crafted features [9], optimizes the weights and filter parameters in the hidden layers to generate features suitable to solve the classification problem. In principle, the parameters in the network are optimized by back-propagation [10] and gradient descent approaches [11] to minimize the classification error.

3. PROPOSED SYSTEM

In some lands, farmers do not have the right resources, or they may not even think about consulting experts. Because sight professionals are very expensive and time consuming. In such cases, the proposed procedure proves to be helpful in monitoring large plantations.

This work has theoretical, practical, and methodological significance: The key purpose is to identify plant diseases using image processing. Also, after being diagnosed with the disease, suggest the name of the pesticide to be used. It also identifies insects and insects that are responsible for the epidemic. Apart from these same purposes, this drone saves a lot of time. The model budget is very high for low-level farming targets however will be a monetary value for large-scale farming. It completes each process in turn achieves each result.

We can reduce pest infestation by using pesticides and appropriate herbs. We can reduce image size by appropriate size reduction strategies and ensure that quality will not be compromised to a large extent. We can increase the projects of the authors mentioned earlier that the cure for the disease is also indicated in the program. The key purpose is to identify plant diseases using image processing. Also, after being diagnosed with the disease, suggest the name of the pesticide to be used. It also identifies insects and insects that are responsible for the epidemic. Apart from these same purposes, this drone saves a lot of time. The model budget is very high for low-level farming targets however will be a monetary value for large-scale farming. It completes each process in turn achieves each result.
The main objectives are, therefore:

- Design such a system that can accurately detect plant and pest diseases.
- Create a database of appropriate pesticides and appropriate diseases.
- Provide a cure for the acquired disease

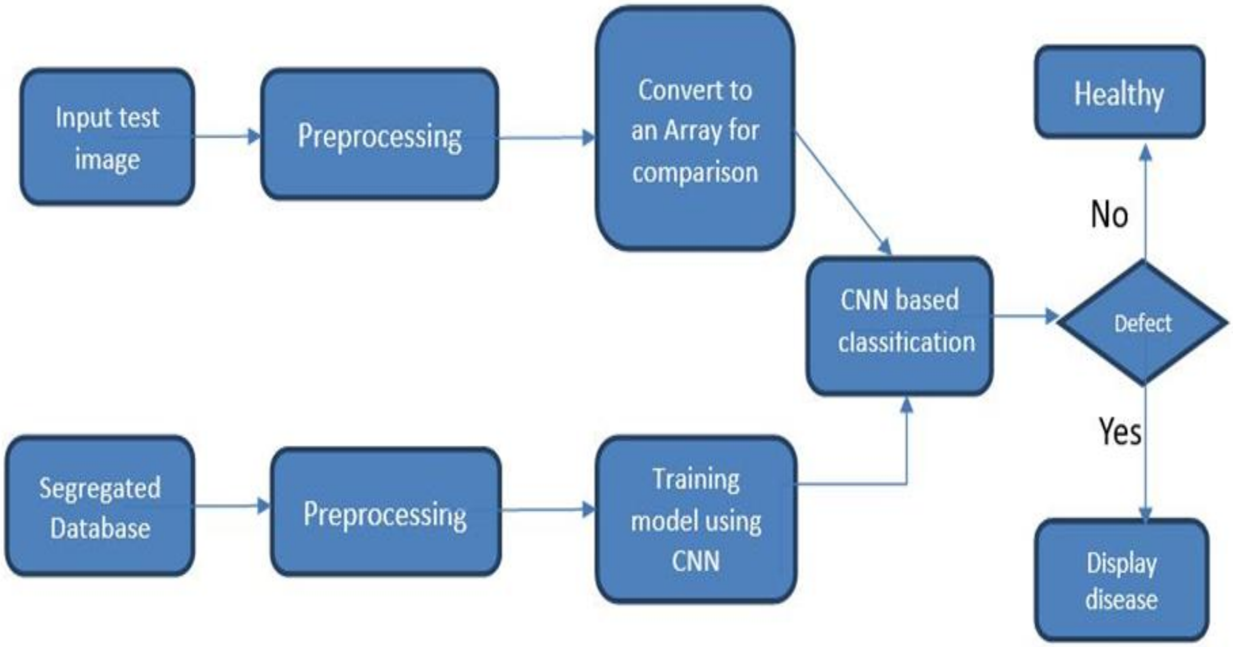

Figure 1: System Flow for Proposed Work

General Explanation:

- Firstly, the input test image is required and then it is pre-processed to convert it into array for comparison.
- The selected database is then segregated precisely and pre-processed. This Data is used for training out model using CNN.
- The model is now properly trained and it can be tested over the new data passed inside.
- It'll show the result. If the defect is found it'll show healthy or display the disease.

4. METHODOLOGY

This section shows the complete methodology for proposed system.

- Database Collection

Initially, we need to collect a valid database for any image processing project. Generally, we prefer a standard database but sometimes proper database is unavailable. Therefore, in such circumstances we prefer collecting images in order to create our own database. A plant disease classification challenge is often used to let database access it.

This data doesn't have a label. Hence, we clean a data and further label it to proceed with the process. Originally, we've a large database so, good angles and better resolution images are selected. Once the images are selected, we'll ponder upon various categories of leaves and disease they have. For this, a research is being taken place from a plant village organization repository. Here, the study is carried over different type of plant diseases. After the completion of the study, we segregate the images having different diseases and label them.

- Disease Database of following plants
    - ♦ Pepper bell bacterial spot
    - ♦ Apple cedar apple rust
    - ♦ Apple scab
    - ♦ Tomatoes bacterial spot
    - ♦ Potato late blight
    - ♦ Potato early Blight
    - ♦ Tomato plant blight

- Pre-Processing of Database

Resizing, conversion, reshaping into an array form are certain measure steps of how to pre-process an image database. The test image also goes through a similar processing. As a result, we obtain a database of 32000 plant species. Out of all these images, model can use any image to be a test image. CNN model is used to train the database which helps in identifying the test image and its acquired disease.

The layers of CNN models are Dropout, MaxPooling2D, Dense, Activation, Flatten, Convolution2D. Once the model is trained, my system is able to find the disease out of all the mentioned plant species in the database. At the end of pre-processing and training the test image and the trained CNN model are compared so as to predict a disease.

5. REMEDY

Table 1 shows the dieses, symptoms and their remedies.

Table 1: Plant disease and their remedies

Disease	Symptoms	Remedy
Apple Scab	The fungal disease forms pale yellow or olive-green spots on the upper surface of leaves. Dark, velvety spots may appear on the lower surface	For best control, spray liquid copper soap early, two weeks before symptoms normally appear.
Apple cedar Rust	Pale yellow pinhead sized spots on the upper surface of the leaves shortly after bloom	Spray copper solution (0.5 to 2.0 oz/ gallon of water) at least four times between late August and late October.
Potato Early Blight	Small brown spots with concentric rings that form a “bull’s eye” pattern.	Containing copper and pyrethrins, Bonide® Garden Dust is a safe, one-step control for many insect attacks and fungal problems
Potato Late Blight	Appears on the lower, older leaves as water-soaked, gray-green spots. A white fungal growth forms on the undersides.	Used as a foliar spray. Apply a copper based fungicide (2 oz/ gallon of water) every 7 days or less, following heavy rain or when the amount of disease is increasing rapidly.
Tomato Early Blight	Bulls-eye-shaped brown spots on the lower leaves of a plant	Organic fungicides based on Bacillus subtilis or copper can help prevent or stop the spread of this tomato plant disease. Bicarbonate fungicides are also effective

6. IMPLEMENTATION AND RESULT

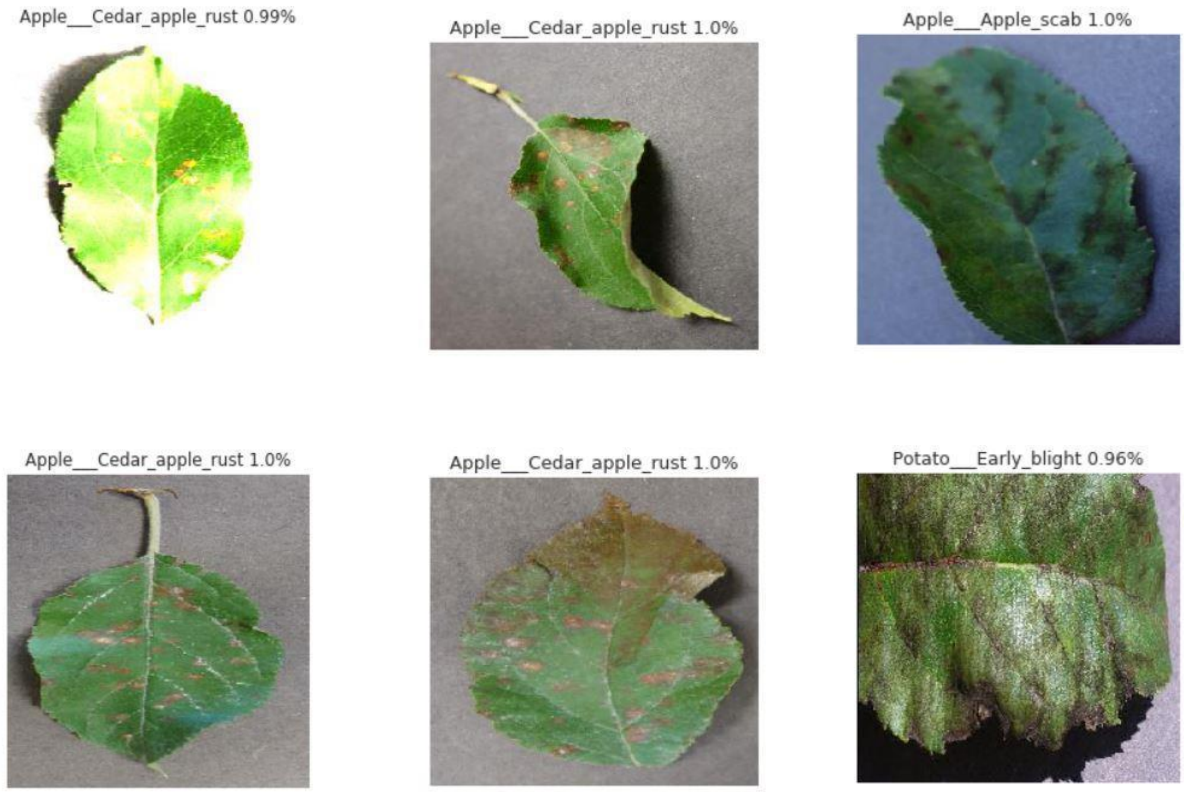

Figure 2: Plotting image with predicted class name

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[INFO] Calculating model accuracy
591/591 [==============================] - 1s 2ms/step
Test Accuracy: 96.44670223221561
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Figure 3: Model Accuracy

7. CONCLUSION

This system's area of focus was the benefits of farmers and agriculture sector. It can easily detect various plant diseases and further provide remedy for the disease. With the deep knowledge of pant disease and it's remedy we can improve the health of the plant. The model is written in python programming language with an accuracy of 96% approximately. Our model can be installed in the drones for aerial surveillances. We are also planning to deploy my model for use with an android application via an API. Using Custom REST-API with Django or Flask we can carry out this process and deploy it on higher levels.

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