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Low-Cost Plant Leaf Disease Detection

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A B S T R A C T

The automatic detection of plant leaf diseases is highly preferred in the field of agricultural information. Deep learning is a hot re- search topic in pattern recognition and machine learning at present, it can successfully solve these problems in vegetable pathology. In this study, we propose a new leaf diseases detection method based on convolutional neural networks (CNNs) techniques. Using a dataset of 260 natural images of diseased and healthy leaves captured from experimental field. To improve the detection accuracy of leaf diseases and reduce the number of network parameters, the CNN model based on deep learning is proposed for leaf disease detection.

Keywords: Low-Cost Plant Leaf Disease Detection, Farmers, Nursery, Agriculture Hardware, etc.

1. Introduction

Here introduces the paper, and put a nomenclature if necessary, in a box with the same font size as the rest of the paper. The paragraphs continue from here and are only separated by headings, subheadings, images and formulae. The section headings are arranged by numbers, bold and 9.5 pt. Here follows further instructions for authors. This project presents deep convolutional networks model to achieve fast and accurate automated detection by using different plant leaf disease images.

Plant leaf diseases have various symptoms. It may be more difficult for inexperienced farmers to detect diseases than for professional plant pathologists. As a verification system in disease detection, an automatic system that is designed to identify crop diseases by the crop's appearance and visual symptoms could be of great help to farmers. Many efforts have been applied to the quick and accurate detection of leaf diseases. By using digital image processing techniques and neural networks, we can detect plant leaf disease. Deep learning has made tremendous advances in the past few years. It is now able to extract useful feature representations from a large number of input images. Deep learning provides an opportunity for detectors to identify crop diseases in a timely and accurate manner, which will not only improve the accuracy of plant protection but also expand the scope of computer vision in the field of precision agriculture. This is the motivation that recognition of leaves unhealthiness is the solution for saving the reduction of crops and productivity.

2. Methodology

A Convolutional Neural Network Architecture is proposed for the detection of disease in plants from leaf images. The proposed architecture gives a higher accuracy as compared to existing models. The classification accuracy is achieved and validated by using different combinations of hyperparameters.

- **Pre-processing: -**

The article aims to learn how to pre-processing the input image data to convert it into meaningful floating-point tensors for feeding into Convolutional Neural Networks. Just for the knowledge tensors are used to store data, they can be assumed as multidimensional arrays. A tensor representing a 64 X 64 image having 3 channels will have its dimensions (64, 64, 3). Currently, the data is stored on a drive as JPEG files, so let's see the steps taken to achieve it. Read the picture files (stored in data folder). Decode the JPEG content to RGB grids of pixels with channels. Convert these into floating-point tensors for input to neural nets. Rescale the pixel values (between 0 and 255) to the [0, 1] interval (as training neural networks with this range gets efficient).

- **Feature Extraction: -**

When performing deep learning feature extraction, we treat the pre-trained network as an arbitrary feature extractor, allowing the input image to propCollege Short Form Name, Branch name 2021 22 agate forward, stopping at pre-specified layer, and taking the outputs of that layer as our features. Doing so, we can still utilize the robust, discriminative features learned by the yelov3. We can also use them to recognize classes the yelov3 was never trained on! Feature extraction is a part of the dimensionality reduction process, in which, an initial set of the raw data is divided and reduced to more manageable groups. ... These features are easy to process, but still able to describe the actual data set with the accuracy and originality.

- **Classification CNN: -**

It is an efficient recognition algorithm which is widely used in pattern recognition and image processing. It has many features such as simple structure, less training parameters and adaptability. It has become a hot topic in voice analysis and image recognition.

3. Hardware / Software Details

User Interface:

- Plant leaf disease using hardware + software

Hardware Interface:

As we are using Machine Learning Algorithm and Various High-Level Libraries,

- Laptop/PC
- RAM minimum required is 8 GB.
- **Hard Disk:** 40 GB
- **Controller:** Raspberry pi

Fig. No. 1 Raspberry pi.

Raspberry pi: -

The Raspberry Pi is defined as a mini-computer the size of a credit card that can interact with any hardware input and output device such as a monitor, TV, mouse or keyboard - converting the configuration to an efficient low-cost full-fledged PC.

Sensors: -

- LDR Sensor
- Humidity Sensor
- Gas Sensor

- Soil Moisture Sensor
- Rain Sensor
- Ultrasonic Sensor

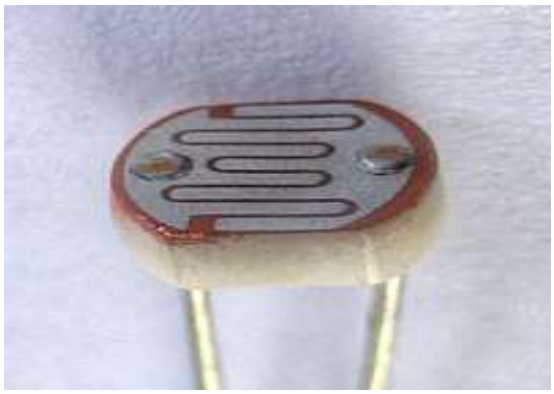

Fig. No. 2 LDR Sensor

LDR Sensor: -

Photoresistor, also known as light dependent resistor (LDR), is the most commonly used light sensitive device to indicate the presence or absence of light or to measure light intensity.

Fig. No. 3 Humidity Sensor

Humidity Sensor: -

A humidity sensor is an electronic device that measures the humidity of the surrounding environment and converts its results into an electrical signal accordingly.

Fig. No. 4 Gas Sensor

Gas Sensor: -

Gas sensors (also called gas detectors) are electronic devices that detect and identify various gases. They are commonly used to detect toxic or explosive gases and measure gas concentrations.

Fig. No 5 Soil Moisture Sensor

Soil Moisture Sensor: -

Soil moisture sensors are used to measure the volumetric water content of soil. This makes it ideal for performing experiments in courses such as soil science, agricultural science, environmental science, horticulture and botany.

Fig. No. 6 Rain Sensor

Rain Sensor: -

The rain sensor is a plate covered with nickel in the form of a line. It works on the principle of resistance. The rain sensor module measures humidity through analog output pins. This module consists of an electronic module and a printed circuit board used to collect raindrops.

Fig. No. 7 Ultrasonic Sensor

Ultrasonic Sensor: -

The use of ultrasonic sensors to detect various diseases is proposed in this report. The ultrasonic sensor generates a pulse reflected signal from the leaves using an echo pin.

- **Processor:** Intel i5 Processor

Pycharm IDE that Integrated Development Environment is to be used and data loading should be fast hence Fast Processor is required.

- **IDE:** Pycharm

Best Integrated Development Environment as it gives possible suggestions at the time of typing code snippets that makes typing feasible and fast.

- **Coding Language:** Python Version 3.5

Highly specified Programming Language for Machine Learning because of availability of High-Performance Libraries.

- **Operating System:** Windows 10

Latest Operating System that supports all type of installation and development Environment.

Software Interface:

- **Operating System:** Windows 10
- **IDE:** Pycharm, Spyder
- **Programming Language:** Python

4. Conclusion / Future Scope

In this paper, a very accurate artificial intelligence solution for detecting and classifying different plant leaf disease is presented which makes use of convolutional neural network for classification purpose. The presented model used the dataset that consists of more than 20,000 images with 19 total classes. The following model can be extended by using even more large dataset with more categories of diseases and the accuracy can also be improved by tuning the hyperparameters. The remedies for the classified disease can also be included in the model. The model then can be deployed on android and as well as iOS platform to reach out the farmers who can make the actual use of the proposed system.

- The future work can also be dedicated to the automatic estimation of the severity of these diseases.
- The instant solutions can be made available to the farmers by designing mobile based applications.
- Online solutions related to plant diseases can be provided by using web portals.
- In future development of the project with use of lot suggested fertilizer can be automatically supplied to plant and soil.

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