WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Recognition of Multi Diseases in Apple Plant Leaf Using Deep Learning

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ABSTRACT

Vegetables and fruits are the most important export agricultural products in the world. In order to obtain products with higher added value, product quality control is essentially required. Many studies show that the quality of agricultural products can be reduced for many reasons. One of the most important factors of such quality are plant diseases. As a result, the minimization of plant diseases makes it possible to substantially improve product quality. This work presents a way to distinguish types of diseases in plants by processing image feature extraction. A Convolutional Neural Network (CNN) is one of the methods used in deep learning to classify disease in apple plants by extracting image features of apple leaf disease. In this study, a deep learning method using CNN is proposed to recognize 4 types of diseases apple plants using 4663 image data of apple leaf diseases. The accuracy result is 89.36%.

Index terms— Apple leaf disease, Image recognition using CNN

INTRODUCTION

Agriculture is the leading economy in many countries. There are many types of fruit imported and exported to other countries and among them the fruit of apples that it has high demand in many countries [1]. However, apple fields are affected by many diseases, because diseases cannot be avoided in the field of agriculture. PUSH is major diseases in apple fields that can seriously affect the apple plant yield, namely rust (caused by Pucciniaceae sticky rust) and apple scab (caused by the Ascomycete fungus Venturia inaequalis). Because of these apple diseases productivity decreases, which affects the life cycle of plants. Many of these diseases, timely and correct classification of diseases should be done to increase production rate and prevent them from diseases before the situation worsens [2]. In general, in some countries a large team of experts will classify the disease with the naked eye by continuously observing the leaves of the plants. In some countries, farmers are unaware of diseases and lack of facilities to approach experts. In these conditions, they face many problems, including time and high consumption cost operations. Automatic detection of disease symptoms will be more convenient and also cheaper than consultation with experts [2]. Therefore, it is essential to have a mechanism that can automatically detect leaves symptoms of the disease as soon as possible. Recent advances in Deep Learning made it possible to increase the effectiveness and efficiency of the leave disease detection [3]. A successful system based on deep learning would be recognized by Apple disease at an early stage, saving cultivators from high losses or damage. In order to diagnose apple leaf diseases, features such as color, texture, shape, edges, etc. are extracted from the input images using image processing [4]. In apple farms, leaves are generally affected by one or more diseases. In this paper, we propose a method for plant disease detection using classification methods to reduce farmers' time and effort spent on visual inspection. This study will focus on two apple leaf diseases, rust and scab. In addition, this study also detects multiple diseases on the same leaf. It compares performance against a pre-trained deep feature model. The dataset consists of over a thousand sample images of diseased, multi-diseased and healthy apple tree leaves. In this project, a deep learning model is trained to classify various plant diseases. The convolutional neural network (CNN) model is used because of its massive success in image-based classification. A deep learning model provides faster and more accurate predictions than manually observing a plant leaf. A CNN model and pre-trained models are trained using a dataset. Among them, the CNN model achieves the highest accuracy.

Problem Statement

Fruits are much better than junk food which has become the cause of many diseases today. In view of these aspects, it is necessary to prevent the fruits from becoming infected with diseases at an early stage. Because many farmers suffer from low apple productivity due to the effects of major diseases like apple rust, apple scab, healthy and multiple diseases. An image processing approach can be used to determine whether an apple is healthy or not based on symptoms in the leaf

A. Introduction to Jupyter Notebook

Jupyter Notebook is a web application for creating and sharing computer documents. It provides a hassle-free and simple document-centric environment. Works with various programming languages including Python, PHP, R, C#. Jupyter Notebooks are primarily used in Python, as Python is used in artificial intelligence (AI), machine learning, and deep learning.

B. Process of Analysis

To achieve the desired results, the analytical process is divided into phases.

i. Data Exploration

Data exploration is the first step in data analysis and is used to examine and visualize data to uncover insights to identify areas or patterns that need further investigation. NumPy, pandas and os are imported as required libraries. This data shows the image of the multiple diseases in the apple leaf.

ii. Data Pre-Processing

The preprocessing steps includes preparing the image directory and Image Generator API. The image dataset is transferred to a temporary direction called temp1, then the file path and image source are concatenated into the training and validation data. It will be saved in their respective directory. The Image Generator is used to read images. A single is analyzed in different angles such as scale change, rotation range, width shift range, height shift range, shear range, zoom range, horizontal flip and fill model.

iii. Modeling

Deep Learning Models are built using training and validation data. Convolutional Neural Network Modelling is used accurately to classify the given apple leaf image and to identify the multiple diseases on a single leaf. The accuracy has been printed.

RESEARCH METHODOLOGY

A. Collecting the data

Kaggle was used to collect the dataset for apple leaf disease recognition. The dataset consists of 3640 different apple leaf images[5].

B. Loading data into Jupyter notebook

After collecting the data, load the data into a Jupyter Notebook using the Pandas library in Python. Data imported using the Shutil operation in the form of directories.

C. Data Pre-Processing

Image classification is the task of assigning an input image, one label from a fixed set of categories. Keras Image Generator is used to perform image classification and data augmentation [6]. So the image generator is used to read the images and then used for training and validation. Here single image is analyzed in different angles like scale change, rotation range, width shift range, height shift range, shear range, zoom range, horizontal flip and fill mode.

Fig .1. Image Generator

D. Data split

Following pre-processing, the dataset is divided into training and validation datasets for model construction. Train test split is an in-built function in the scikit learn library used for splitting the dataset.

E. Model building

After splitting the dataset, deep learning model like Convolutional Neural Network was built. The model was built using training and validation dataset. The accuracy was calculated from the model and it was used for prediction. The apple leaf disease prediction method takes an image as input which represents various diseases[7].

i. Convolutional Neural Network

Convolutional neural networks are deep learning algorithms that are very powerful for the analysis of images [8]. Keras Conv2D is a second convolution layer. this accretion creates a convolution kernel convoluted with the input layer to create an output tensor. In photograph processing, a kernel is a convolution matrix or mask that can be used to perform blurring, sprucing, embossing, edge detection, and other convolution operations among the kernel and the picture. Max Pooling is a pooling operation that selects the largest function from the feature map area blanketed by way of the record. So the output after the max pooling layer can be a feature map containing the maximum salient features of the previous characteristic map. knocking down is used to convert all of the second arrays as a result of the concatenated function maps into a unmapped long continuous linear vector [9]. The flattened matrix is fed as enter to a completely related layer for photo classification.

A dropout layer is a mask that cancels the contribution of a few neurons to the following layer, leaving all others alone. Dropout is a method that ignores randomly decided on neurons throughout schooling. They "drop out" randomly. because of this the contribution to downstream neuron activation is quickly eliminated inside the forward pass, and weight updates are not applied to the neuron inside the reverse pass[10].

Fig .2. Convolutional Neural Network

RESULTS AND DISCUSSION

The work focuses on problems in the classification of leaf diseases, especially on apple leaves. The system works with a given trained data set with textural properties and classifies the test samples with respect to the training samples to recognize different types of diseases such as rust, scab and multiple diseases. In general, image recognition faces many challenges, most of which are related to robustness, computational complexity, and scalability. Also, the choice of the used recognition and classification method depends to a large extent on the set and quality of the image data, as well as on the available computing resources. Thus, deep neural networks can potentially provide the highest classification accuracy, the available computing resource data is not always sufficient in simple classifiers. Thus, a conscious decision was made to use the CNN model and its properties when compared to simple classifiers. The CNN model is predicted. It then calculates the accuracy rate for each leaf image using the training and validation data and plots the accuracy in a line graph for the training and validation data. For each leaf image, the accuracy of each disease is calculated and then the image is classified.

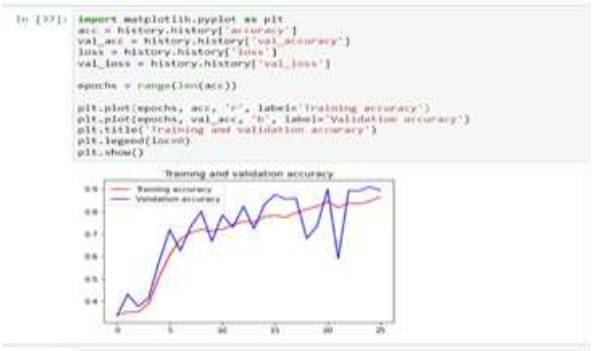

Fig .3. Convolutional Neural Network-Accuracy

Fig .4. Apple Leaf image classification

Fig.5. Prediction of different diseases in apple leaves

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