International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 4 Issue 2, February 2020 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Crop Leaf Disease Diagnosis using Convolutional Neural Network

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ABSTRACT

The major problem that the farmers around the world face is losses, because of pests, disease or a nutrient deficiency. They depend upon the information that they get from the agricultural departments for the diagnosis of plant leaf disease. This process is lengthy and complicated. Here comes a system to help farmers everywhere in the world by automatically detecting plant leaf diseases accurately and within no time. The proposed system is capable of identifying the disease of majorly 5 crops which are corn, sugarcane, wheat, and grape. In this paper, the proposed system uses the Mobile Net model, a type of CNN for classification of leaf disease. Several experiments are performed on the dataset to get the accurate output. This system ensures to give more accurate results than the previous systems.

KEYWORDS: *Convolutional Neural network (CNN), Mobile Net, Leaf diseases, Classification*

How to cite this paper: Shivani Machha | Nikita Jadhav | Himali Kasar | Prof. Sumita Chandak "Crop Leaf Disease Diagnosis using Convolutional Neural Network" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4 | Issue-2, February 2020, pp.1056-1058, URL: www.ijtsrd.com/papers/ijtsrd29952.pdf

IJTSRD29952

I. INRODUCTION

Agriculture is one of the most significant occupations around the world. It plays a major role because food is a basic need for every living being on this planet. Therefore, increasing the quality of agricultural products has become necessary. Proper management of these crops right from an early stage is important. There are a lot of stages in a plant lifecycle. It includes soil preparation, seeding, adding manure and fertilizers, irrigation processes, disease detection if any, usage of pesticides and harvesting of crops.

Generally, it is estimated that different types of pests such as insects, weeds, nematodes, animals and diseases cause crop yield losses of about 20-40%. More precisely, some data states that crop diseases cause average yield losses of 42% for the most significant food crops. Leaf Spot Diseases make the tress and the shrubs weak by interrupting photosynthesis, the process by which plants create early [2]. So, it is necessary to predict disease at an early stage. At times, crop diseases destroy the entire crop production. Due to this reason, the farmers need to find out all they can about the crop diseases at an early stage so they can manage them properly. The rising interest for nourishment and food products by the current population, the agricultural methods have taken a broad way of using fertilizers for growth purposes. Food is essential to our body healthy but due to the use of an excessive amount of fertilizers, not only plants but even humans are affected. [4]

This paper focuses on detecting leaf diseases at an early stage, thereby decreasing the chances of the destruction of the whole plant. Traditional methods of detecting a disease include manual examining of a leaf and predicting the disease. But a farmer cannot determine the exact disease by this technique. Therefore, knowing the accurate disease image processing techniques can be utilized to recognize the disease of the plant leaf. These are modern techniques that make use of new technologies that give accurate results.

II. LITERATURE REVIEW

A. Tomato Leaf Disease Detection Using Convolutional Neural network [1]

There is a proposed model that can identify the diseases and give up to 94-95 % of precision. The main aim is to provide a solution to the diseases detected under unfavorable conditions. The utilization of tomato is high crosswise over India; it is hard to identify the diseases due to complex nature. There are 3 important stages to detect the tomato leaf diseases namely Data Acquisition, Data pre-processing and Classification. In data acquisition, the images are taken from the plant repository. Different types of images collected stored in JPG format. (RGB color space by default). The pictures are downloaded utilizing Python Script. In data preprocessing, the dataset must contain minimal noise. The images are resized at the fixed resolution from the training process. We get pictures of all the pixels in the fixed range by

utilizing mean and standard deviation. In machine learning, it is termed as the Zscore.

In the order, the unstructured picture input is changed over to corresponding classification output labels. LeNet is a basic CNN model that comprises convolutional, enactment, pooling and completely associated layers. The design utilized for the classification of the tomato leaf sicknesses is a variety of the LeNet model. It comprises an extra square of convolutional, initiation and pooling layers in contrast with the first LeNet design [1]. The architecture used is a simple CNN with minimum no. of layers to classify the tomato leaf diseases into 10 different classes Out of the 18160 pictures, 4800 pictures were saved for testing and 13360 pictures were utilized for training [1]. This paper can distinguish and recognize 10 different diseases in the tomato crop. Creating and training a CNN model from scratch is a tedious process when compared to the usage of existing deep learning models for various applications to achieve maximum accuracy. [7]

B. Leaf Disease Detection And Recommendation of Pesticides Using Convolutional Neural Network [2]

In this paper, they have two phases namely the Training phase and Testing phase. In the initial phase, they have carried out image acquisition, pre-processed the image and trained the images using CNN. In the second phase, classification and identification of the disease are done along with pesticide identification. Their dataset has 54,309 images. For training purposes, image is taken from the dataset whereas, for testing, real-time images can be used. For the pre-processing of the image, they have resized the image into a 150×150 dimension. CNN method is written using Tensor flow. Using this technique, they have carried out classification [2]

The results are shown for training accuracy and testing accuracy for different epochs along with different layers of CNN i.e. five, four, three-layer CNN and class labels of 38 classes and 16 classes. The highest accuracy is obtained for the five-layer model with 95.05% for 15 epochs and the highest testing accuracy achieved is for the five-layer model with 89.67% for 20 epochs.

C. Detection of Plant Disease by Leaf Image Using Convolutional Neural Network [4]

As the diseases spread rapidly, it is very essential to detect the disease and provide a solution to it. Modern technology is used to recognize the disease and give good accuracy. CNN is used to detect visual objects. The model consists of many layers from layer 1 to layer 16. Regularization is achieved by applying batch normalization and dropout [4]. In batch normalization, it will convert the values high in numbers into the range from 0 to 1. By transforming it reduces the time for calculation. The Dataset is collected from open sources such as Plant Village. Secondly, augmentation is done using python. Different transformation is applied to the given image every time. The Image Data Generator class is the Pycode that is used in the transformation of the image. All the true cases, false cases are identified and classified. Around 86% of precision is produced.

III. PROPOSED SYSTEM

Our proposed system helps to diagnose the disease of the leaf. This System can identify the disease of largely 5 types of plants specifically Corn, Rice, Wheat, Sugarcane and Grape. Each crop leaf can be affected by several diseases. Corn leaf diseases are common smut, common rust, eyespot, fungus. Rice leaf diseases are bacterial leaf blight, brown spot, and leaf smut. Wheat leaf diseases are brown rust, flag smut, leaf blight, powdery mildew. Sugarcane leaf diseases are grassy shoots, smut, leaf scald, red striped, rust, yellow leaf. Grape leaf diseases are black rot, chlorosis, and esca. Datasets of crop leaves are created by extracting images from several websites. Pesticides are also recommended according to the disease of the crop. Each disease consists of 200-300 images. From the whole dataset, 80% of data is reserved for training and the remaining 20% is reserved for validation.

This system uses Tensor flow and Keras libraries which makes the preprocessing of data less complicated. Tensor flow provides a platform for exhibiting algorithms of machine learning. Image height, image width and light intensity of the images are manipulated using these libraries. Convolutional Neural Network (CNN) is applied to analyze images. Mobile Net an open-source model is used with convolutional neural network architecture to distinguish between different plant leaves and their diseases. This model is trained by giving input as images from the created dataset. 80% of the images in the dataset is trained and analyzed using the Mobile Net model and libraries. Once the model is trained the classification of leaf diseases is carried out. 20% of remaining data is used for validation which gives us the proof of accuracy achieved while testing. Any recently added image can also be considered as testing or validating data. When tested with the latest images of grape leaves with the disease, this proposed system achieved a precision of 97.33%. Fig 3.1 shows the course of action of the proposed framework.

In this following proposed system, the diagnosis of the leaf disease is done with the images that are uploaded in the system or present in the database. If the real-time input is taken from the surrounding, then the image needs to be pre-processed followed by the feature classification. Classification is done as mentioned above. Secondly, classification is carried out using Dataset images. Through convolutional neural network classification, whether the leaf is healthy or unhealthy is detected. The Diagnosis of diseases is detected and the name of the disease is obtained.

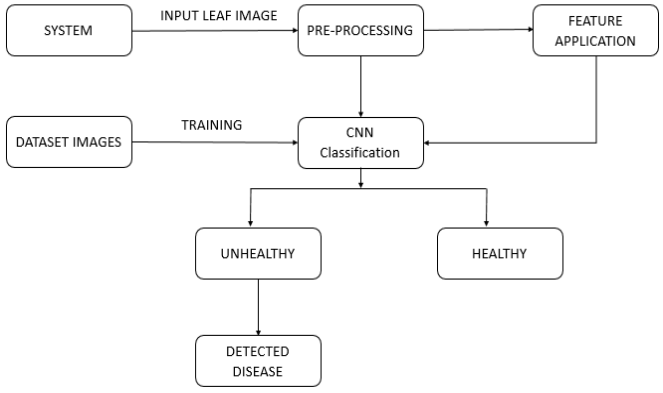

Figure3.1: Block Diagram

RESULTS

To acquire results, experiments and tests were executed on the proposed system by giving input as images that were not used before for training as well as testing. The results which were acquired during the results are as per the following:

Experiment A:

Experiment A was carried out by the dataset which is well trained using epoch count as 10 and count of training the dataset is more the 10. The dataset contained more than 300 images of each disease. The result of experiment A concluded with an accuracy of 97.43%. Where each image given as input was classified into its respective disease. Even though the images given as input to the model were new and dissimilar. This experiment was carried on two types of crops which are grape and rice.

Fig 4.1 and Fig 4.2 shows that the images are determined by their independent leaf diseases.

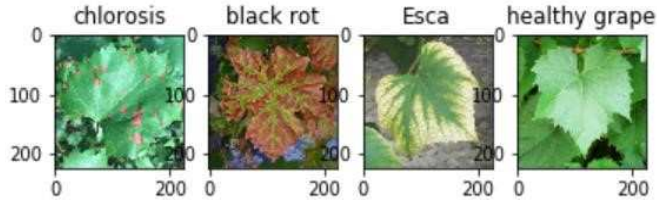

Figure 4.1: Classification of Grape leaves

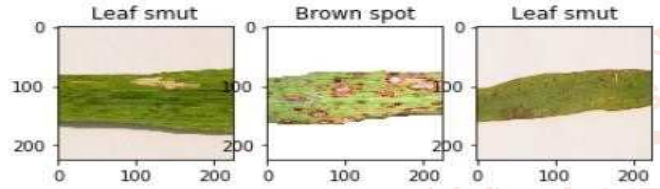

Figure4.2: Classification of rice leaves

Experiment B

Experiment B was carried out by the dataset which is not well trained using epoch count as 5 and the count of training a dataset is less than experiment A. The dataset contained less than 100 images of each disease. The result of experiment B concluded with an accuracy of 52%. Where each image given as input was not able to be classified into its respective disease. This experiment was carried on two types of crops which are corn and wheat.

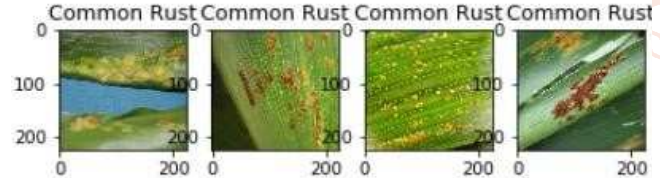

Figure4.3: Classification of Corn leaves

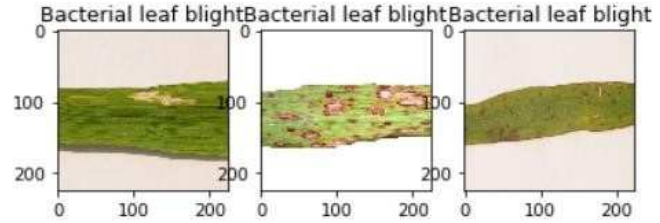

Figure4.4: Classification of wheat leaves

Fig4.3 and Fig 4.4 which show that the classification of corn leaf is not determined with its respective disease rather the leaf images are considered as infected with the same disease. Even though the images are given as to the model input where non-identical.

CONCLUSION.

This paper presents a trained model that determines the disease of the plant leaf. Various diseases of plant leaves such as cotton, sugarcane, wheat, grape are detected. The data is processed and trained on CNN architecture. Mobile Net algorithm is used to train the data. Python programming is along with Tensor flow/Keras libraries is used for manipulating the classification of the leaf disease. The model is built on Colab with an accuracy of 97.33%.

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