Cotton Plant Leaf Detection and Diagnosis System Using Deep Neural Network.

Dilip Kale and G. P Bhole

***Abstract*—The cotton agriculture industry faces the economic losses due to the pest infections and bacterial or viral contagions, the farmers lose nearly 10-20% of the total profit on an average annually in India. In this paper, a solution to the problem related to agriculture has been suggested, which involves cotton leaf disease recognition by using machine learning and deep learning. In this paper, the study sets out to classify cotton crop images into different classes if the crop has been infected by a disease or not. Also, we endeavor applications that give farmer readily available means to identify the diseases on their crop and take appropriate damage control actions. Training of the models was performed with the user database created (mobile capture images with high-resolution camera) from a farm located in Maharashtra region at Morshi Taluka, Survey No.162, district Amravati. Here, there are two types of cotton plant varieties consider, such as (SP 7517 BG II (Cotton hydride seeds with Bollgard Technology) and Kavari 3028), with Dimension 4160 x 3120, Horizontal and Vertical resolution 96 dpi, bit depth 24, of 3611 images, containing four different class such as rust, Mosaic virus and Woolyphids with healthy plants. Model architectures were trained, with the best performance reaching a 79.53% success rate in identifying the corresponding cotton plant disease with a combination of a healthy plant. The model used in the study delivers significant accuracies of classification on the dataset used by employing Dense Neural Network. The model is very useful advisory or early warning tool for the farmers for identification of diseases in the early stage.**

I. Introduction

Agriculture is the prime occupation of India. Cotton is also called as 'White Gold' and its major use in the textile industry today. Cotton is a major agricultural crop in India, has a dominant impact on the overall Indian agriculture sector. Nowadays there is a tremendous loss in the quality and quantity of cotton yield because of various diseases affecting the plant. Plant disease classification is a critical step, which can be useful in early detection of pest, insects, controlling of diseases, increase in productivity, etc. This study looks to predict crop diseases by looking at the images of the crop. for this Image processing techniques are used for the very fast, accurate and appropriate classification of diseases. Symptoms of diseases in cotton predominantly come out on leaves of plants. Farmers recognize disease manually with foregoing symptoms of plants, and with the help of experts, the actual diseases are not identified with the naked eyes, which is time-consuming to predict whether the crop is healthy or not. Cotton plant leaf disease diagnosis is very difficult through observation to find the symptoms on plant leaves, incorporates it's a part of a high degree of complexity. Due to complexity and a large number of cultivated plants and their existing phytopathological problems, even experienced agronomists and plant pathologists often fail to successfully diagnose specific diseases and are consequently led to mistaken conclusions and treatments. The existence of an automated system for the detection and diagnosis of plant diseases would offer a support system to the agronomist who is performing such diagnoses through observation of leaves of infected plants.

The existing techniques for disease detection have utilized various image processing methods followed by various classification techniques. Crop Yield Forecasting has been an area of interest for producers, agricultural-related organizations. Timely and accurate crop yield forecasts are essential for crop production.

The proposed system uses an artificial neural network to classify the health of a cotton leaf plant. The flow diagram of the proposed system given in Fig. 1. consists of steps which are used to acquire the desired output.

Fig. 1. The flow of the System

The process goes through the following steps:

A. Input images

For this initial process images of high resolution (4160x3120) are taken from datasets as input by setting IMG_W, IMG_H with 3 channels(RGB), for better visibility, go with >180. The features that are used for classification of the images. The images are foremost pre-processed into a 4160x 3120, RGB format with pixel values ranging from 0 to 255. The feature normalization used in the study is the min-max normalization. It is the ratio of the difference between the instance's feature value and the minimum value of a feature in the instance to the difference between the maximum and minimum values of features in the instance.

B. Training and Testing:

The tensor flow framework is used for training and testing. The model which is employed is the DNN Classifier. The DNN Classifier which is created has a seven-layer neural network. The activation function used is ReLu which is used for each of the hidden layers and the softmax function used in the last layer. Gradient descent optimizer is used for optimization. The dataset is divided into a train test split of 70-30%. compare the result and errors back-propagated.

C. Feature Extraction

The DNN classifier used was fed with features(pixels of image instances). DNN classifier is used with 5 hidden units with 100 nodes each and a 6th hidden unit with 50 nodes. The images were pre-processed through resizing. The images with given height, width and channels are fed to the DNN. ReLU (Rectified Linear Unit) activation function was used.

G. P Bhole is with Mumbai

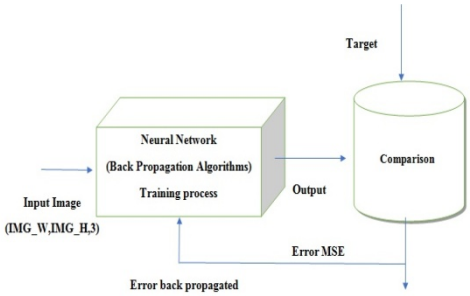

Fig. 1.

D. Display the shape of whole dataset and their labels. Figure 2: Image classification.

II. Literature review

The existing techniques for disease detection have utilized various image processing methods followed by various classification techniques. Crop Yield Forecasting has been an area of interest for producers, agricultural-related organizations. Timely and accurate crop yield forecasts are essential for crop production. According to the literature available on crop yield forecast, that can be done using the following techniques.:-

- Disease Detection using Image classification and Regression Techniques.
- Disease Detection Using Segmentation, Texture Pattern, Feature Extraction analysis, and color transformation.
- Disease Detection Using IoT.
- Disease Detection using Deep Neural Network.
- Disease Detection Using Convolutional Neural Network.

Image classification and regression techniques play a very important role because it allows identifying, group, and properly of organisms from a standardized system. In [1], present an application of machine learning to agriculture, solving a particular problem of diagnosis of crop disease based on plant images taken with a smartphone, the author presents a classification system that trains a 5 class classification system to determine the state of disease of a plant. The 5 classes represent a 10 health class and 4 disease classes. Crop disease classification using texture analysis [2], used Image processing to detect and classify sunflower crop diseases based on the image of their leaf, using k-means clustering to get the diseased part of the leaf. These are then run through the various machine learning algorithms and classified based on their color and texture features.

An algorithm for image segmentation technique which is used for automatic detection and classification of plant leaf diseases. In [3], [4], Use segmentation and texture pattern feature, color transformation methods to classify images. A Novel Approach to classifying individual pixels in crop diseased images taken in the field as diseased or healthy. The approach is based on the machine learning algorithm linear discriminant analysis (LDA) and color transformation. Five color spaces were applied and compared over diseased images infected by four diseases commonly observed in cucumber crops - target spot, angular leaf spot downy mildew, and powdery mildew.

Deep learning is a set of learning methods attempting to model data with complex architectures combining different non-linear transformations. The element of deep learning is the neural networks that are combined to

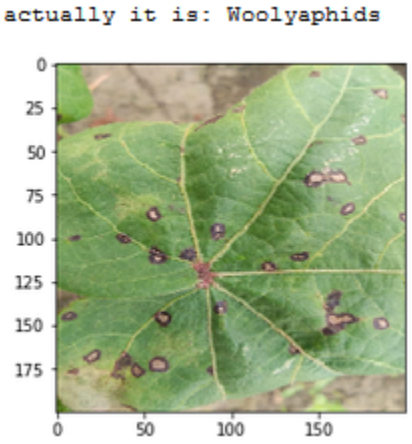

Fig. 2. Woolyphids

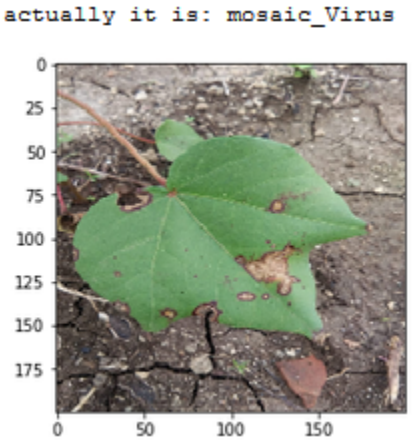

Fig. 3. Mosaic Virus

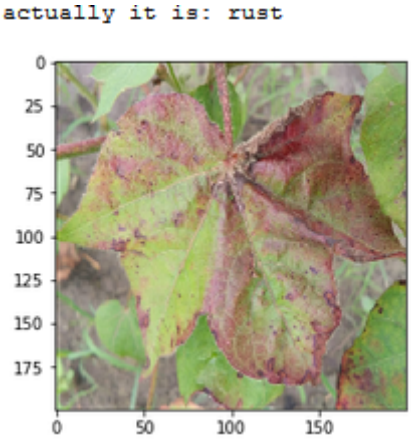

Fig. 4. Rust

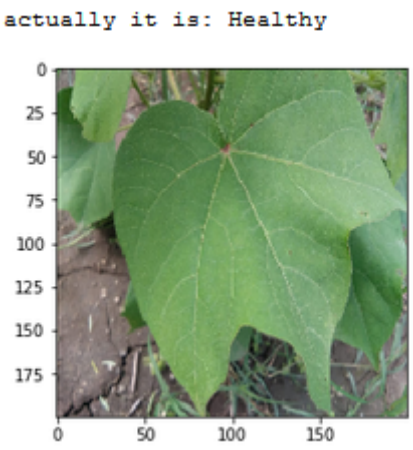

Fig. 5. Healthy