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Potato Leaf Disease Detection

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A B S T R A C T

Agriculture is one of the prime occupation sector of the nation. Simillarly digitalization touching across all the fields made it easier to handle various difficult tasks. Adapting technology plus digitalization is very crucial for the field of agriculture to benefit the farmer and consumers parallel. Adapting and regular monitoring with the help of modern technology helps us to identify such diseases at early stage. In this document proposes a methodology the detection as well as the classification of diseases in the potato plants. Openly available, standard dataset called as Plant Village Dataset was used for this experiment. For the process of image segmentation, the K-means methodology was considered, for the feature extraction purpose, the gray level co-occurrence matrix concept was utilized, and multi-class support vector machine methodology was utilized for the classification purpose. The proposed methodology is able to achieve the accuracy of 95.99%.

Keywords: Potato Disease Detection, Crops Diseases, Potato Crops, Agriculture Technology

1. Introduction

The paper presents the Potato Leaf Disease Detection with the help of a Support Vector Machine (SVM).Support vector Machine (SVM) is a Supervised Machine Learning Algorithm that is used for classifications well as Regression problems. But primarily, this algorithm is used for Classification problems in Machine Learning. This paper uses SVM to distinguish between the type of expected disease on crop.
The aim of the SVM algorithm is to create the best line or decision boundary that can isolate n-dimensional space in the classes so that we can in future, put the new data point in the correct catogery.

1.1. Motivation

- Revolutionizing the Agriculture sector with the help of Machine Learning
- Potato Leaf Disease Detection is a collection of processes and techniques designed to identify and categorize the diseases affecting potato crop.
- India is a Agricultural Nation and millions of rupees are wasted because of diseases that ruin the crops. This machine helps us to detect those in early stage so that it is easy to treat them at right time.

1.2. Aim and Objective

Aim

The aim of the project is to detect the potato leaf disese using a Support Vector Machine (SVM).
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Objectives

- To Develop a system which can efficiently detect crop disease

- To Revolutionize Agriculture using Machine Learning and SVM.
- To classify plants in the type of disease.

2. Literature Review

In Paper [1] classification and detection techniques are presented that can be used for plant leaf disease classification. preprocess is required before feature extraction. RGB images are converted to white and then into grey level image for extraction of the image of vein from each leaf. And then basic Morphological functions are applied on the image. Then the image is converted in the binary image form. After that if binary pixel value is 0, it is converted to corresponding RGB image value. And finally by using pearson correlation and Dominating feature set and also Naïve Bayesian classifier disease of the crop is detected.

Paper [2] consists of four steps. The first step includes gathering image from several part of the country for training and testing. Second part includes applying Gaussian filter to remove all the noise and thresholding is done to get the all green color component. K-means clustering is used for segmentation of the images. All RGB images are converted in the HSV form for the extracting of the features.

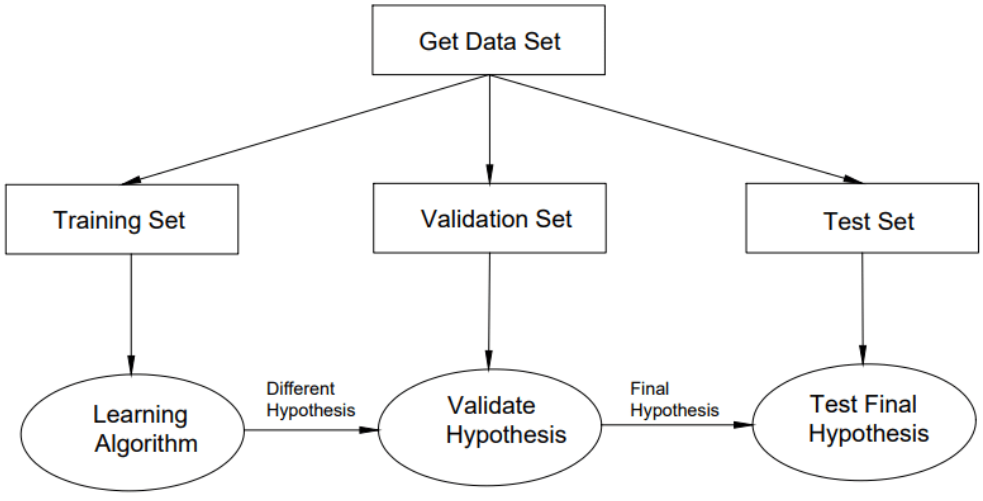
The paper [3] presents the technique of detecting jute plant disease using the image processing method. Images of the jute plants are captured and then it is realized to match the size of the image to be stored in the database. Then image enhancement and noise reduction is done. Hue based segmentation is applied on the image with the help of customized thresholding formula. Finally the image is converted into HSV from RGB as it helps extracting region of our interest. This proposed approach can significantly support detecting stem oriented diseases found in the jute plants.

According to paper [4] they have proposed for a technique that can be used for detecting paddy plant disease by comparing it with dataset having 100 healthy images and 100 sample of disease1 and another 100 sample of disease. It's not sufficiently enough only to detect disease or classify it training data if it is not linearly separable.

Lastly, In paper [5] detection of unhealthy plant leaves include some steps of RGB image acquisition. These steps include, Converting the input image from RGB to HSI format, Masking and removing the green pixels, Segment the components using Ostu's method, Computing the texture features using color-co-occurrence methodology and finally classifying these diseases with the help of Genetic Algorithm.

3. Proposed Method

A generalized overview of the classification of the potato plant leave disease is presented here. To implement our new transfer learning model a dataset is taken from public database. The images are labeled according to their class category then pre-processing is conducted including resizing of images, filtering of images, applying various data augmentation techniques such as image rotation, flipping and shifting to maximize the size of the dataset. The training and validation images are fed into the pre trained inception-v3 model and features are extracted.



Deep learning is a part of machine learning and artificial intelligence algorithm in which its layers are closely related(14) . The result of the first layer will be used as an input to the next layer. In this work, we try to design an inception-v3 based transfer learning model for potato leave disease detection to build high performance detection for small data using pre trained on large datasets. In plant disease identification experiment, convolutional neural network is an appropriate learning technique in deep learning approach in which it can accurately recognize plant diseases

3.1 Data acquisition: In our work we have analyzed 2152 potato leave images taken from plant village dataset, which have three categories. We split the data into two sections, the training portion which is dedicated to train the proposed model and the testing part is used for validation purpose. The data is divided by 80/20 for training and testing respectively. In this approach, we have resized the image dimension into the standard deep learning approach models which is 256 x 256 x 3 pixels in order to train the inception v3 model and to make the training computationally feasible.

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3.2 Image pre-processing: The contaminated plant leaves in an image produces noise. The noise here would be leaf sand, may be dust and other stuff. To get high training accuracy performance, it is significant to remove the noisy data from plant images. Image pre-processing methods then are used to remove noises from leave images. Many image pre-processing ways are accessible such as image clipping in which cropping the leaf image to get area of interest. The other technique is smoothing filter which is performed to achieve image smoothing. In image processing ZCA whitening, standardized rotation and translation were used for data augmentation.

3.3 Segmentation Image: segmentation is a technique of classifying each pixel in an image as belonging to specific class. As for the various sizes of the potato plant leaves, it is imperatively essential to locate and segment the image to increase the performance of identification of potato diseases by reducing the background interference information of the leave images to get the image's interest of region that is convenient for the inception v3 model to extract features. Image segmentation technique is conducted based on various intensity discontinuity and similarities among the pixels. Image segmentation means partitioning the image into various parts with same features, or having rough resemblance which can be used to identify feature similarities in the gray levels between the pixels in an image region. We have achieved segmentation in this work through converting an RGB color mode images to HIS model.

3.4 Feature extraction: Feature extraction plays an important role in digital image analysis. Different image pre-processing methods such as standardization, thresholding, binarization, etc. are applied to the sample digital images before gaining functionality. After this feature extraction technique is applied to acquire patterns that are useful in image identification. After all the depiction of the image significant patterns of the image is extracted using innumerable natures of feature extraction with respect to images, the similar features together form a feature vector to recognize and categorize an object. In this work feature extraction is performed using inception-v3 model.

3.5 Classification: The great variations in size, shape, color, texture, background, layout, shape and imaging illumination of plant diseases and pests in real time environment makes the detection task difficult. Because of the strong feature extraction capability, the adoption of convolutional neural network-based identification and classification network has become the most commonly applied pattern in plant leaf diseases and pests detection. Feature extraction part of neural network identification network consists of cascaded convolution layer plus pooling layer which is followed by fully connected layer plus softmax classification layer. Softmax classifier performs identification of outputs based on the given inputs.

4. Conclusion

Plant disease identification in its early stage plays a vital role in the agriculture industry. In this study, we attempt to design an inception-v3 transfer-learning model for potato plant leave diseases identification. The model is fine-tuned and trained to detect the healthy and diseased potato leave images. The achieved results indicate that the proposed model outperforms than the AlexNet and GoogleNet architectures. In our experiment work, the potato leave image from plant village dataset has three classes including the healthy leave images. The dataset we used for the experiment is a three-color channel image dataset by applying segmentation method. In the first experiment, the model achieves a training accuracy of 96.8%. However, after the augmented dataset, and applying segmentation on the images, the training accuracy is enhanced to 98.3% which is a higher performance. In the future work, potato leave disease identification would be further investigated with large number of datasets. We will conduct further research works using ensemble learning to analyze the diseases severity and to find higher performance

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