Smart Farming Plant Disease Recognition Using Model-based Statistical Features

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***Abstract*: The recent focus of our research is to detect and categorize the plant disease in the agricultural domain, by implementing image processing techniques. We aspire to propose an inventive set of statistical texture features for classification of plant diseases images of leaves. The input images are taken by various mobile cameras and any good resolution cameras. The Scale-invariant feature transform (SIFT) features used as texture feature and it is invariant to scaling, rotation, noise and illumination. However, the exact mathematical model of Scale-invariant feature transform texture descriptor is too complex and takes high computing time in training and classification. The model-based arithmetical features are intended from Scale-invariant feature transform descriptor to represent the features of an image in a small number of dimensions. The major focus of our proposed feature is to reduce the computational cost of mobile devices. In our research, 10-Fold cross-validation with SVM classifiers is practical to show that our experiment has no data bias and exclude hypothetically derived principles.**

***Keywords*: Tomato plant diseases, deep learning, Classification, Leaf Images, Convolutional Neural Network Classifier, Predication.**

1. Introduction:

Plant diseases have various symptoms. It may be more difficult for inexperienced farmers to diagnose diseases than for professional plant pathologists. As a verification system in disease diagnostics, an automatic system that is designed to identify plant diseases by the plant's appearance and visual symptoms could be of immense help to farmers. According to the survey in food production, the plant disease is one of the main reasons for food distortion in agriculture domain. The precise statistical models are essential to represent the image information. In this paper, a new model for SIFT texture feature is proposed for image modeling, and is successfully applied in tomato plant diseases recognition. Tomato is a commonly refined commercial crop used, e.g., to produce tomato sauce but virus, fungal and bacterial attacks reduce profits. If the farmers know the name of the plant disease at the early stage, they can easily diagnose these diseases without expert's identification. As a result, they can recover from damage and loss of production. The plant disease can be found on stems, leaves, fruit, flower or root. But here we are going to identify disease present on tomato leaf. The input image is taken by various type of smart phone camera. The input image contains the symptom of plant disease on leaf. The input image is preprocessed to extract whole region of leaf. From preprocessed image, the SIFT features are extracted. The extracted SIFT features are modeled by Generalized Pareto Distribution (GP).

2. Related Work:

a. An open access repository of images on plant health to enable the development of mobile disease diagnostics:

Description: Human society needs to increase food production by an estimated 70% by 2050 to feed an Expected population size that is predicted to be over 9 billion mobile people.

Limitation: When tested on a set of images taken under conditions different from the images used for training, the model's accuracy is reduced substantially.

b. Erosion Band Features for Cell Phone Image Based Plant Disease Classification

Description: Aiming at minimal computational costs on the cellular
device and highly accurate prediction results, we present an efficient detector of potential disease regions and a robust classification method based on texture features.

Limitation: Result is reduced costs and environmental burden due to a more targeted treatment.

c. Sift descriptors modeling and application in texture image classification

Description: This paper presents a new statistical model for describing real textured images. Results demonstrated that our model leads to good improvement in term of the accuracy rate.

Limitation: A new model based texture classification approach has been proposed. The latter, which incorporates SIFT descriptors, uses Gamma two parameters for discriminating database images.

d. Vonn distribution of relative phase for statistical image modeling in complex wavelet domain

Description: The simulation results, the Vonn model are applied to texture image retrieval application and improve retrieval accuracy.

Limitation: Although we have good reason to believe that other application areas, such as denoising or segmentation will benefit from the proposed statistical models in a variety of ways, this remains to be shown in future research work.

e. An analysis of co-occurrence texture statistics as a function of grey level quantization
Description: Generally, as a function of increasing grey levels, many of the statistics demonstrate a decrease in Classification ability while a few maintain constant classification accuracy. Correlation analysis is used to rationalize a preferred subset of statistics.
Limitation: This is important, since users usually set the image's grey level quantization
Arbitrarily without considering that a different quantization might produce improved results.

3. Motivation:

- In agricultural productivity is something on which economy highly depends.
- This is one of the reasons that disease detection in plants plays an important role in the agriculture field, as having the disease in plants are quite natural.
- Automatic plant disease identification and classification is to development of automated computer vision or machine vision system with the use of image processing technique.

System Architecture:

Figure shows the detailed flow of Tomato plant Leaf Disease. In this system user upload image as an input. Using CNN Classifier, given image file will be processed. KNN algorithm is used to identify the correct combination of the components to validate the disease.KNNis a simple algorithm that stores all available cases and classifies new cases based on a similarity measure (e.g., distance functions). This system is used to determine and predict an automated system to accurately detect Tomato plant leaf diseases for the user.

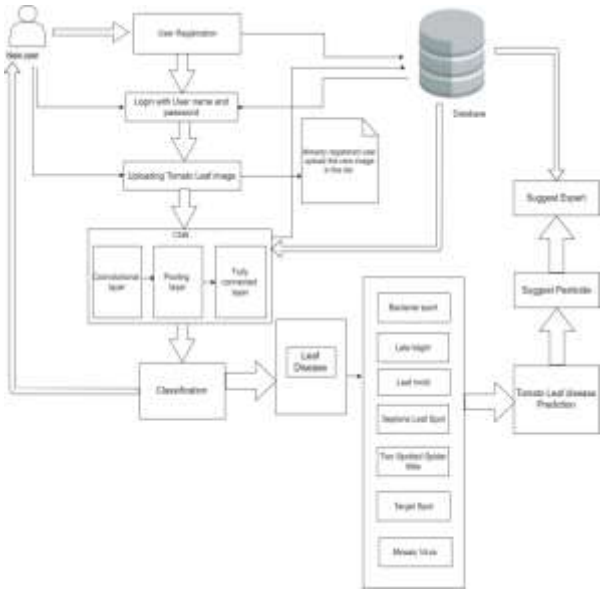

Fig: system overview

In this project, CNN classifier (Convolutional Neural Network) algorithm is used to extract the features from the images and KNN algorithm used to stores all available cases and classifies new cases based on a similarity measure to validate the disease.

Convolutional Neural Network (CNN)

Convolutional neural networks are deep artificial neural networks that are used primarily to classify images (e.g. name what they see), cluster them by similarity (photo search), and perform object recognition within scenes. They are algorithms that can identify faces, individuals, street signs, tumors, platypuses and many other aspects of visual data.

Steps in CNN:

1. Convolution Layer- In this layer we apply filter (3*3) on image.
2. Pooling layer- Pooling is an important component of convolutional neural networks for object detection.

3. Fully Connected layer- It is the fully connected layer of neurons at the end of CNN.
4. A CNN consists of an input and an output layer, as well as multiple hidden layers. The hidden layers of a CNN typically consist of Convolutional layers, pooling layers, fully connected layers and normalization layers.
5. Convolutional layers apply a convolution operation to the input, passing the result to the next layer.

Conclusion:

The system is developed for prediction of tomato plant disease from its leaf image. And for the disease prediction uses Convolutional Neural Network and KNN classifier. The system predicts tomato plant diseases viz. Bacterial sport, Late blight, Leaf mold, Septoria Leaf Spot, Two Spotted SpiderMite, Target Spot, Mosaic Virus, Healthy. The system also provides the user with an analysis report that consists of the symptoms and remedies of predicted disease.

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