Machine Learning for Plant Disease Identification Tracking and Forecasting for Farmers

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Abstract

Early pest detection is a major challenge in agriculture field. The easiest way, to control the pest infection is the use of pesticides. But the excessive use of pesticides are harmful to plants, animals as well as human beings. Integrated pest management combines biological and physical methods to prevent pest infection. The techniques of machine vision and digital image Processing are extensively applied to agricultural science and it have great perspective especially in the plant protection field, which ultimately leads to crops management. This paper deals with a new type of early detection of pests system. Images of the leaves affected by pests are acquired by using a digital camera. The leaves with pest images are processed for getting a gray colored image and then using feature extraction, image classification techniques to detect pests on leaves. The images are acquired by using a digital camera. The images are then transferred to a PC and represented in python software. The RGB image is then converted into gray scale image and the feature extraction techniques are applied on that image. The Support Vector Machine classifier is used to classify the pest types.

Keywords: Pesticides • Diagnosis • Convolutional neural networks • Pooling layer • Support vector machines

Introduction

India is an agricultural country. 70% of the people mainly depend upon agriculture. So increasing the productivity of crops is an important matter now. Most of the scientists are doing their researches on this field. By using their new techniques and practical implementations this is very easy. But one of the most important problem now exists is “pest infection” on plants. This paper mainly focuses on greenhouse crops. There are different crops cultivated under greenhouse. For example, vegetables like cucumber, potato, tomato etc. and flower plants like rose, jasmine etc. The most common pests which will effect on this greenhouse crops are whiteflies a, aphids and thrips. One way to control the pest infection is by using the pesticides. Pesticides will suppress particular species of pests. Pesticides are detrimental for the environment and produce considerable damage to eco systems. The excessive use of pesticides will pollute air, water, and soil. Carried by the wind pesticides suspensions contaminate other areas. In this paper, we focus on early pest detection. This implies to regular observation the plants. Images are acquired using cameras. Then the acquired image has to be processed to interpret the image contents by image processing methods. The focus of this paper is on the interpretation of image for pest detection [1].

Materials and Methods

System analysis

In the application of plant diseases and pests identification, the manifestation symptoms are not obvious, so early diagnosis is very difficult whether it is by visual observation or computer interpretation. However, the research significance and demand of early diagnosis are greater, which is more conducive to the prevention and control of plant diseases and pests and prevent their spread and development. The best image quality can be obtained when the sunlight is sufficient, and taking pictures in cloudy weather will increase the complexity of image preprocessing and reduce the recognition effect. In addition, in the early stage of plant diseases and pests occurrence, even high-resolution images are difficult to analyze. It is necessary to combine meteorological and plant protection data such as temperature and humidity to realize the recognition and prediction of diseases and pests. By consulting the existing research literatures, there are few reports on the early diagnosis of plant diseases and pests [2-4].

Disadvantages

- Information is often unstructured and difficult to interpret and requires advanced computational techniques to effectively implement.
- The sensitivity is unclear, and the percentage of outbreaks that can be identified by these strategies needs to be identified.
- The specificity is unclear, and a high false-positive rate could create workload issues because of the need for verification.
- Availability of information to the public may create challenges in risk communication.
- Privacy concerns for strategies that have the potential to identify individual internet activity.

Design and implementation

UML stands for Unified Modeling Language. UML is a standardized general-purpose modeling language in the field of object-oriented software engineering. The standard is managed, and was created by, the Object Management Group. The goal is for UML to become a common language for creating models of object oriented computer software. In its current form UML is comprised of two major components: A Meta-model and a notation. In the future, some form of method or process may also be added to; or associated with, UML. The Unified Modeling Language is a standard language for specifying, Visualization, constructing and documenting the artifacts of software system, as well as for business modeling and other non-software systems. The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems. The UML is a very important part of developing objects oriented software and the software development process. The UML uses mostly graphical notations to express the design of software projects.

Implementation

Upload pest dataset: Using this module we will upload dataset to application.

Preprocess dataset: Using this module we will acquire images from dataset and then filter images to grey colour and then normalize images and then split dataset into train and test part where application use 80% images for training and 20% for testing [5].

Run SVM algorithm: Process images will be input to SVM algorithm for training and then calculate its prediction accuracy.

Check for affected from test image: Using this module we will upload test image and then SVM will predict type of pest as Aphid, White fly or Unaffected (Figure 1).

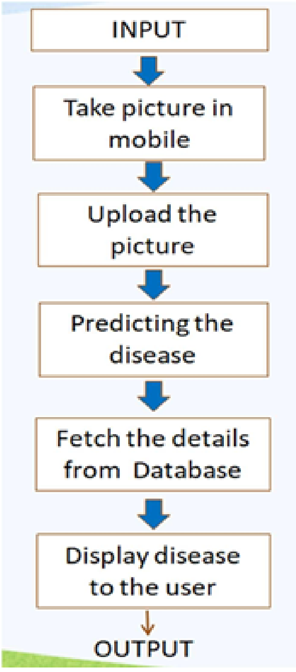

Figure 1. Flow graph for Predicting the plants affected and unaffected diseases.

How it works

Image capturing: The first step of every image processing application is image acquisition or image capturing. The images of leaves are captured by using the camera and it will store it in some formats like .PNG, .JPG, .JPEG etc.

Image pre-processing: Image preprocessing is used to create an enhanced and please full version of the captured image. The image preprocessing steps used in the system are:

Conversion of RGB image to gray image: In RGB color model, each color appears in its primary spectral components of red, green, and blue. The color of a pixel is made up of three components; Red, Green, and Blue (RGB). The disadvantages of RGB models are, it requires large space to store and it will take more time to process. So there is a need for converting the RGB model to Gray model

Resizing of the image: Resizing is an important step in image preprocessing. The acquired image is resized according to the requirement of the system. Resizing of the image: Resizing is nothing but, changing the dimensions of an image. The captured image is resized using some resizing methods according to the requirement of the system. There are different methods for the resizing of images. Blinear, Bicubic and nearest neighborhood interpolation are the common resizing methods. Here in our system, we are using bicubic method

Filtering of the image: Filtering is nothing but, eliminating the unwanted portion of the image. Different types of filters are available. Low pass filters are smoothening filters, it will pass only low

Feature extraction: Feature extraction is the most important part of this project. Some properties of the images are considered here. The different types of properties includes region properties, gray covariance matrix properties etc. The properties standard deviation, entropy, contrast etc. are extracted from the image and are used to train the dataset for the SVM classification. Support Vector Machines (SVM's) are a relatively new learning method used for binary classification. The basic idea is to find a hyper plane which separates the d-dimensional data perfectly into its two classes. The different types of properties of an image is listed in the table below (Table 1).

Table 1: Different types of properties of an image.

Mean	Returns the mean value of the elements along different parameters of an arra
Standard deviation	Computes the standard deviation of the values in matrix
Contrast	Returns a measure of intensity contrast between pixels
Energy	Returns the sum of squired elements in the glem
Filled area	Scalar specifying the number of pixels in filled area

Results and Discussion

In this module the affected and unaffected images are compared by using the dataset provide in the SVM. If it is an affected image again it is compared by using the second dataset provided in the SVM. From this comparison the type of pest can be detected (Figure 2).

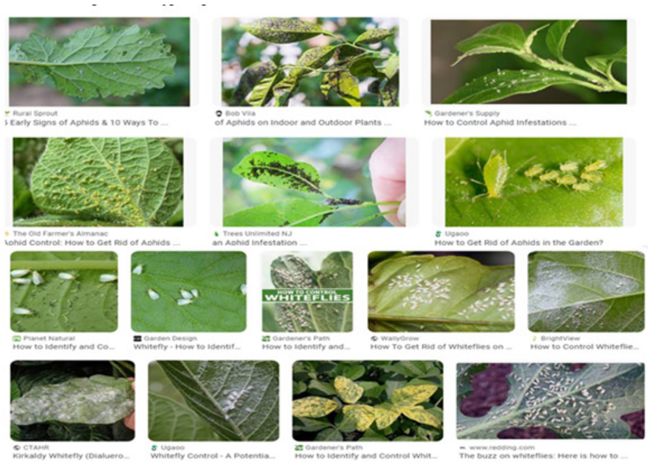

Figure 2. Plants affected with whitefly,aphids,and non affected.

Flowchart for the proposed system is given in Figure 3. The images are acquired by using camera and it is filtered by using bicubic filters to avoid unwanted noise portions [6,7]. This is actually the image preprocessing step. The next step is SVM classification to detect the pest infection. If the image is affected, then again it is applied to the SVM to detect the type of pest (Figures 3 and 4).

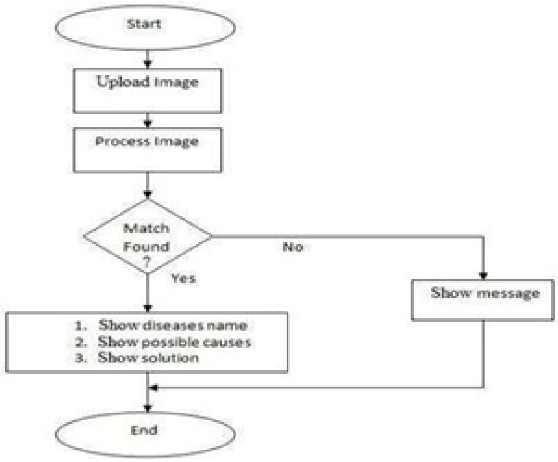

Figure 3. Flow chart for classification of pest using SVM.

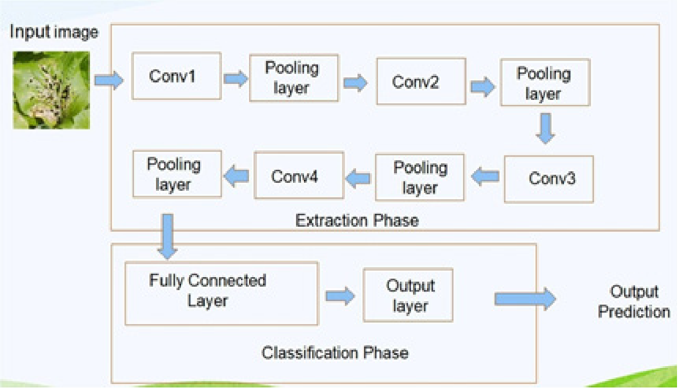

Figure 4. Flow diagram for classification of pest using CNN(Convolutional Neural Networks)

Convolutional neural networks

Convolutional Neural Networks (CNN), has a complex network structure and can perform convolution operations. As shown in Figure 2, the convolution neural network model is composed of input layer, convolution layer, pooling layer, full connection layer and output layer. In one model, the convolution layer and the pooling layer alternate several times, and when the neurons of the convolution layer are connected to the neurons of the pooling layer, no full connection is required. CNN is a popular model in the field of deep learning. The reason lies in the huge model capacity and complex information brought about by the basic structural characteristics of CNN, which enables CNN to play an advantage in image recognition. At the same time, the successes of CNN in computer vision tasks have boosted the growing popularity of deep learning (Figure 5).

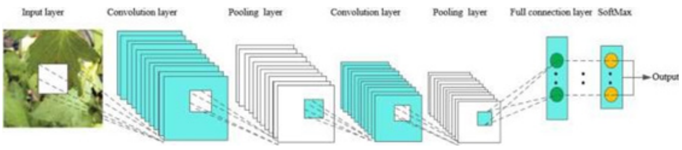

Figure 5. The convolution layer are connected to the neurons of the pooling layer.

In the convolution layer, a convolution core is defined first. The convolution core can be considered as a local receptive field, and the local receptive field is the greatest advantage of the convolution neural network. When processing data information, the convolution core slides on the feature map to extract part of the feature information [6]. After the feature extraction of the convolution layer, the neurons are input into the pooling layer to extract the feature again. At present, the commonly used methods of pooling include calculating the mean, maximum and random values of all values in the local receptive field. After the data entering several convolution layers and pooling layers, they enter the full-connection layer, and the neurons in the full-connection layer are fully connected with the neurons in the upper layer. Finally, the data in the full-connection layer can be classified by the softmax method, and then the values are transmitted to the output layer for output results. class_names = ['aphids', 'whitefly', 'rust', 'unefficted ']

plt.figure(figsize=(10,10)) for i in range(25):

plt.subplot(5,5,i+1) plt.xticks([])

plt.yticks([]) plt.grid(False)

plt.imshow(train_images[i])

The CIFAR labels happen to be arrays, # which is why you need the extra index plt.xlabel(class_names[train_labels[i][0]])

plt.show()

Image processing technique plays an important role in the detection of the pests. Our first objective is to detect whiteflies, aphids and thrips on greenhouse crops. We propose a novel approach for early detection of pests. To detect objects we use pan tilt camera with zoom. So without disturbing the pests we are able to take the image. It illustrates the collaboration of complementary disciplines and techniques, which led to an automated, robust and versatile system. The prototype system proved reliable for rapid detection of pests. It is rather simple to use and exhibits the same performance level as a classical manual approach. Our goal is to detect the pests as early as possible and reduce the use of pesticides [8,9].

Conclusion

Human life is completely dependent over plants and agriculture and yield of crops play a very important role in deciding the overall development and growth of the human race, for this purpose, there is an urgent need to solve the issues and problems that are related to plants and agriculture. Therefore we in this project are aiming to create a model that will help in the monitoring and well keeping of the agricultural plants from the various diseases by analyzing them thoroughly of crops. In future, we will extend our database since as we increase the training data, the accuracy of the system will be higher. We also try to make the application as user-friendly and time-saving as possible so that even a 10-year-old child may be able to use it effectively. We also plan to develop a system within the app in future that will predict and tell the farmers the best crop/plant that may be grown on their land as per the soil conditions.

References

1. Leite JB, et al. “Detecting and locating non-technical losses in modern distribution networks.” IEEE Trans 9.2 (2018): 1023-1032.
2. Ostendorp PM, et al. “Power factor requirements for electronic loads in california.” Tech. Rep 19.3 (2020): 1348-1407.
3. Parameshachari M, et al. “Secure transmission of an image using partial encryption based algorithm.” Int. J. Comput. Appl 16 (2013): 163-165.
4. Mahadik Y, et al. “Electric Vehicle Monitoring System Based on Internet of Things (IOT) Technologies.” Springer 244.1 (2022).
5. Lee SH, et al. “How deep learning extracts and learns leaf features for plant classification.” Pattern Recogn 71.1 (2017): 1-13.
6. Tsaftaris SA, et al. “Machine learning for plant phenotyping needs image processing.” Trends Plant Sci 21.12 (2016): 12-35.
7. Yang D , et al. “MF-CNN: traffic flow prediction using convolutional neural network and multi-features fusion.” IEICE Trans Inf Syst 102 (2019): 1526-1536.
8. Kumar S, et al. “Occluded thermal face recognition using bag of CNN(BoCNN).” IEEE Signal Process Lett 27 (2020): 975-979.
9. Shekhawat RS, et al. “Review of image processing approaches for detecting plant diseases.” IET Image Process 14.8 (2020): 1427-1439.

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