Review of Crop Disease and Pest Image Recognition Technology

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Abstract. Throughout the history of agricultural development, crop diseases and pests have been one of the main obstacles hindering the development of agricultural economy, which not only caused irreversible economic losses to farmers, but also hindered the development of economic and social. The crop pets and diseases identification system based on digital image processing technology has the characteristics of fast, accurate and real-time, which can assist farmers to take effective control measures in time. In this paper, we have done some review on different digital image processing techniques to detect the plant diseases. We compared traditional machine learning and deep learning and discussed the future research trends and directions.

1. Introduction

With the development of the economy and society, the environment has become worse and worse, the occurrence of diseases and the variation of bacteria affect people's lives all the time. The incidence of crop diseases and insect pests is increasing. The higher the rate, the more complex the disease is, the measures to prevent crop diseases are gradually put on the agenda, and it is particularly important to find the disease in time and diagnose the disease and then make corresponding remedial measures. The traditional method of manually detecting pests and diseases depends entirely on the farmer's own experience, or asks experts to come to the door. Such methods are slow, inefficient, costly, subjective, low-accuracy, and time-insensitive. With the rise of the Internet industry, the use of information technology has provided new methods and ideas for improving the identification efficiency of crop pests and diseases. Crop pest and disease image recognition technology refers to the use of image processing technology to identify crop pests and diseases. Image recognition technology is used to classify and identify images to enhance recognition efficiency and speed. The cost is small and the accuracy is high. In order to improve the accuracy and speed of image recognition, experts and scholars at home and abroad have made a lot of research, making an indelible contribution to the agricultural production of farmers and the development of agricultural economy.

2. Traditional image processing technology

Traditional image processing technology has been the mainstream technology until the wave of deep learning has not yet emerged. As shown in Figure 1, it includes graphics collection, image preprocessing, image segmentation, feature extraction, and classifier classification.
2.1. Image collection
Image collection work is generally performed by using an electronic device such as a video camera or a mobile phone to shoot a diseased leaf. Generally, it is chosen to shoot during the day or in good light to ensure that the pictures are clearly visible.

2.2. Image preprocessing
Image preprocessing includes image enhancement and noise reduction. The methods of noise reduction are mainly include median filtering and mean filtering. Image enhancement is performed by image binarization and histogram equalization in order to remove uncorrelated noise and highlight related parts.

2.3. Image segmentation
Image segmentation is the technique and process of dividing an image into specific regions with unique properties and proposing objects of interest. It is a key step from image processing to image analysis. Image segmentation has always been one of the most challenging tasks in digital graphics processing. The existing image segmentation methods are mainly divided into the following categories: threshold-based segmentation methods, region-based segmentation methods, edge-based segmentation methods, and segmentation methods based on specific theories.

In [1], the author used edge detection techniques to segment RGB images. In [2], the author used the histogram threshold segmentation method of optimal threshold to successfully separate the diseased leaf from the background and the effect was good. In [3], the author used statistical mode for image segmentation. In [4], the author used the fuzzy C-means algorithm to segment the color space, and the effect is significant. In [5], the author converted RGB to HIS, where H is the hue, I is the intensity, and S is the saturation value, which is segmented using the K-means clustering technique. In [6], the author used the maximum inter-class variance method to segment the color graphics, segment the intensity of the image (I), and improve the accuracy of the classification.

At present, most of the researches on traditional image segmentation methods are based on simple backgrounds and pictures with good illumination conditions, which are quite different from the complex conditions in the field. In the future, new segmentation algorithms should be studied to segment disease images of complex backgrounds. The use of multiple segmentation strategies to work together will be the development trend of research.

2.4. Feature extraction
Feature extraction refers to the use of a computer to extract image information and determine whether a point of each image belongs to an image feature. Feature extraction includes the description of features and the extraction of features. The result of feature extraction is to divide the points on the image into different subsets, which tend to belong to isolated points, continuous curves, or continuous regions. The main feature extraction methods include morphological feature extraction, color feature extraction and texture feature extraction.

2.4.1. Morphological feature extraction. In [7], in the research of image recognition of stored grain pests, the author extracted multiple morphological features for the binarized image of grain worms, and calculated the optimal features of seven features such as area and perimeter by optimization algorithm. Subspace. Experiments show that with this extraction method, the recognition rate is over 95%. In [8], the author applied the theory of invariant moments to feature extraction, defines the parameters of invariant moments, and extracts the morphological features of wheat leaf disease images. The author applied this method to the identification of wheat diseases, which has a good effect.

2.4.2. Color feature extraction. The following examples show how to format a number of different figure/caption combinations. The color feature is a global feature based on image pixel points. The color feature extraction method is also a commonly used method in image extraction of crop pests and
diseases. In [9], the author used the RGB color system to perform feature extraction on diseased leaves for classification. In [10], the author extracted the histogram statistics of R, G, B, H, I, and S, which are represented by two color systems of RGB and HIS, in the process of research on wheat. Experimental results show that this feature extraction method effectively extracted image features and increased recognition accuracy. This proves that the color feature extraction method is also efficient and feasible. The color feature extraction method is intuitive and efficient, but the orientation of the image and the size and other changes are not sensitive and do not represent the target in the image well. Local features have their limitations in agricultural image recognition research.

2.4.3. Texture feature extraction. The following examples show how to format a number of different figure/caption combinations. Texture feature is also a global feature, which means recurring local patterns and their alignment rules. The extraction is the research central issue of the image feature extraction field. In [11], the authors used color symbiosis matrix (CCM) which based on the HIS chromaticity space to extract the texture features of citrus leaves, and used the least square matrix to construct the classifier. The recognition accuracy of the experiment reached 96%. In [12], the author used spatial gray-scale co-occurrence matrix extracts the texture feature of corn disease image, combined with wavelet transform to enhance wavelet decomposition texture map. The experiment achieved good results.

2.4.4. Feature extraction method combining form, color and texture. In [13], the author proposed to extract the color characteristics of cucumber downy mildew disease, extract the characteristics of disease texture using gray level co-occurrence matrix, and extract the morphological features of the lesions. The experimental results proved the validity of the combination of the three. In [14], the authors extracted the color features by calculating the one-to-third-order matrix of the histogram of the HSV color system of the corn disease leaves and extracted the texture features of the image by calculating the gray level co-occurrence matrix. Then authors used these extracted features to construct a classifier for recognition, and the effect is remarkable.

2.5. Image classification and recognition

The classification and recognition of images refers to the process of constructing a classifier with extracted image features to achieve target recognition. Classification and recognition is the final step of the whole image processing. The ultimate goal is to effectively identify the disease. The high accuracy of classification and recognition is the goal that experts and scholars at home and abroad have been striving for. Among the classification methods, there are SVM (Support Vector Machine), neural network and fuzzy clustering.

In [15], the author improved the genetic algorithm and used the improved algorithm to classify and identify the diseased leaves of soybeans. The accuracy of the final classification identification reached more than 90%. In [16], the author used the compensated fuzzy neural network to train and identify the extracted color features, and constructed a pest and disease recognition model. The experimental results show that the model has a good recognition effect. In [17], the author proposed an SVM algorithm based on balanced decision tree, which achieved a good classification effect. In [18], the author used radial basis to identify and identify cotton pests, and the recognition accuracy of the experiment reached 88%. In [19], the author extracted the morphology, texture and color feature of rice disease images, and then used stepwise discriminant analysis to classify and identify images, the final accuracy rate reached 97.2%. In [20], the author proposed to use regional growth method to classify and recognize on the basis of hyperspectral image, and the experimental effect was remarkable.

At present, the difficulty in classification and identification of crop pests and diseases is that crop diseases show different symptoms in different growth stages. However, the current classification and recognition algorithms have low recognition efficiency and have great limitations. Most of the
diseases are classified when they are obvious. The disadvantage is that the universality is poor, and the recognition and classification effect on complex images is poor.

3. Image recognition technology in deep learning

The craze for deep learning has been enduring for a long time in recent years. The emergence of deep learning has reduced people's workload, so that people don't pay too much attention to how to improve the efficiency of image segmentation and feature extraction. Give all the work to the machine to do. Complex network structure and huge data samples are its biggest features. The emergence of deep learning technology provides a powerful technical guarantee for image recognition.

In [21], the authors trained a convolutional neural network using 54306 ill and healthy plant leaves collected under controlled conditions, and used trained model to identify 14 crops and 26 diseases with an accuracy of 99.35%. In [22], the authors proposed a concept of a deep learning meta-architecture that combines Faster R-CNN, SSD, RFCN, and feature extractors such as vgg net and resnet. The classification and recognition effect by this method is remarkable. In [23], the authors used a deep convolutional network to train image classification recognition models. Experiments show that the classification effect is significant. In [24], the author proposed a model based on deep convolutional neural network to identify rice diseased leaves, achieving an accuracy of 95.48%, and this accuracy is much higher than the traditional machine learning model. In [25], the authors used Faster R-CNN to perform brown spot, blisters, and brown spot on tea. The preliminary results of the model showed that the average accuracy of the three diseases were 63.58%, 81.08%, and 64.71%.

4. Results and discussion

This paper reviews the literature on image processing technology based on traditional machine learning and deep learning. The purpose of this paper is to show the reader some techniques and progress in the field of image processing as well as to compare the advantages and disadvantages of traditional machine learning and deep learning in the field of image processing. However, most of the images recognized by traditional machine learning methods and deep learning methods are clear pictures taken with high-definition cameras. These pictures are not extensive. Most of the crop growers are farmers, and their means of catching pests and diseases are taken by their own mobile phone cameras, which has a disadvantage is that their mobile phones are basically ordinary mobile phones with low configuration and pixels. The picture taken with such equipment is relatively low-definition, these pictures are difficult to upload to the expert system for identification, and the recognition accuracy is lower. Therefore, future image processing techniques should focus more on images with complex backgrounds and blurred textures, improving the accuracy of recognizing such images.

5. Conclusion

This paper reviews the literature on image processing technology based on traditional machine learning and image processing recognition technology based on deep learning. Then compares the advantages and disadvantages of these two research methods. Although there are many research results in the field of image recognition, but there are still many problems need to be solved. Moreover, the effects of these studies in practical applications are not significant. Future research on image recognition should focus on images of pests and diseases with complex backgrounds randomly found in farmland, improving existing algorithms, and using the advantages of deep learning to identify images.

All in all, using image recognition technology to help farmers or growers identify pests and diseases has far-reaching and bright prospects for safeguarding agricultural production and promoting agricultural economic development.
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