Crop Pest Image Classification and Recognition Based on Significance Detection and BOW Model

Meng-jiao ZHANG, Jing-wen XU*, Xing CHEN and Xiang-na KONG
College of Resources, Sichuan Agricultural University, Chengdu, China
*Corresponding author

Keywords: Crop pests, Significance detection, BOW, SVM.

Abstract. In order to reduce the interference of background information on target recognition, and improve the accuracy of classification and recognition, this paper proposes a method based on significance detection and BOW model to classify and identify 22 kinds of crop pest images. First, smooth the image by bilateral filtering. Then use GBVS (graphic-based visual saliency) method to calculate the saliency map, and extract the surf feature from the region of interest and built the BOW model. Finally, use SVM (support vector machine) to train classifier. The experimental results show that the classification accuracy of the proposed method is nearly 10% higher than that of the traditional BOW model.

Introduction

Computer vision technology is an emerging technology with the development of science and technology. It is an important research direction and field of artificial intelligence. Secondly, with the deterioration of ecological environment and global warming, the growing environment of crops becomes more and more fragile, and crop pest control becomes more and more difficult. In this context, the combination of computer vision technology and crop pest control has become a focus of agricultural scholars.

BOW first appeared in the field of text research. With the development of research and artificial intelligence, it has been widely used in computer vision [1,2]. In an image, the effective information is only a small part, people are only interested in this small part of the area. Significance detection is to extract the part of an image that people are interested in and contains a large amount of target information. At present, commonly used significance detection algorithms are: AC, FT, HC, LC, ITTI, GBVS[3,4]. Secondly, through the review of relevant literature, it is concluded that the research on the application of image processing and identification technology to crop pests mainly includes three aspects, namely, the segmentation of disease and insect pest images, the classification and identification of disease and insect pest images, and the feature extraction of disease and insect pest images[5-7]. However, most of the research objects of the current method are targeted at single diseases and insect pests, these methods has poor universality. Therefore, this paper takes 22 kinds of common crop pest images as the sample database, in order to realize the classification and identification of pests based on significance detection and BOW.

Related Methods and Work

Significance Detection

Significance detection is a process of locating the most interesting region in an image by certain algorithm. In this paper, GBVS method is adopted to calculate the significance graph. Firstly, feature extraction is used to calculate Gauss pyramid. Secondly, for each layer of the pyramid, each pixel is taken as a node, and an undirected graph is established according to the difference in gray contrast between pixels and the Euclidean distance between positions as the connection weight. Then the weight matrix is connected and normalized to form a Markov transition matrix. The matrix is iterated for several times until the Markov chain is distributed smoothly, and the initial
significance graph is obtained. Finally, the initial significance map is normalized to obtain the final visual significance map.

**Image Classification and Recognition Based on BOW**

At first, BOW was proposed to solve the problem of document classification. It is widely used in computer vision in recent years. For an image, we can think of it as a bag composed of several disordered visual words, and visual words refer to the characteristics of the image. SVM (support vector machine) is a recognition pattern for supervised classification. It is a binary classification algorithm that supports both linear classification and nonlinear classification. The basic idea of classification is to use the maximum interval for classification. In this paper, linear classification is adopted. Linear separable SVM is a line that can divide data correctly and have the largest interval.

**Region of Interest Extract**

**Image Smoothing**

Because the sample training set in this paper mainly comes from the network collection, many images have noise, such as overexposure, shadow occlusion, and watermark, so it is necessary to smooth the image before significance detection. In this paper, bilateral filtering was used to remove the image, and the effect was shown in Fig. 1. On the one hand, bilateral filtering preserves the edge information of the image to the maximum extent; on the other hand, it achieves a good purpose of noise reduction on the premise that the information is not destroyed.

**Significance Detection**

GBVS algorithm is a new kind of bottom-up significant testing model, which can differentiate between foreground and background section, but most of the background image is complex, the target area obscured phenomenon, so some significance of the image detection effect has certain error, but basically most significant areas of the image can be accurately detected.

**Threshold Segmentation**

In the significance graph, the target part is highlighted, the background is shown in black part, and the binary graph is obtained by threshold segmentation. In the calculation of binary graph, the foreground and background can be distinguished effectively by the best threshold obtained by the method of variance between the largest classes. Finally, the region of interest of the image is calculated by combining the binary image with the image after desiccation, as shown in Fig.1.

![Figure 1. Region of interest extract](image.png)
Analysis of Experimental Results

The Experimental Samples

Experimental samples of this article includes 22 classes pests: Golden apple snails, Crickets, Agrotis ypsilon, Dolycoris baccarum, Locusta migratoria manilensis, Henosepilachna vigintioctomaculata, Prodenia litura, Echinocnemus squamous, Rice leaf roller, Achatina fulica, Big green bugs, Anoplophora chinensis, Gryllotalpa unispina, Pleonomus canliculatus, Greenhouse whitefly, Acrida chinensis, Rice spines bugs, Rice planthopper, Meadow moth, Thrips, Scarabs,and Phyllotreta vittata fabricius. There were 100 samples from each pest group, and 22 groups were 2,200 in total. The image size is 128*128, as shown in Fig.2.

Comparison of Different Features

The clustering effect of k-means algorithm is determined by the value of K, as shown in Fig.3. When K is 1200, the classification and recognition accuracy is the best, the average classification accuracy reached 60.27%. When K value is below 900, with the increase of K value, the average classification accuracy shows a rising trend as a whole. When K value is greater than 1200, the average classification accuracy decreases with the increase of K value. At this time, excessive K value does not improve the accuracy of classification and recognition, but causes the huge complexity of visual dictionary, thus affecting the performance of classification and recognition.

Optimization of K Value

In order to discuss the influence of characteristics on the classification and identification of crop pest images, in the same experimental environment, sift and surf features of the original images and regions of interest were extracted respectively. According to Fig.3, with the same training sample size and dictionary size, the trend of average classification accuracy of crop pests was expressed as "surf + this article method > sift + this article method >surf+ traditional BOW>sift+ traditional BOW".

Different Method Comparison

To verify the effectiveness of the proposed method, the traditional BOW is compared with the method in this paper in the same experimental environment, and the results are shown in Fig. 3. When K value is 1200, the average classification and recognition accuracy of traditional BOW method reaches the highest of 51.19%. However, in this paper, by combining significance detection and BOW, the average classification accuracy reaches the highest of 60.27%, which is 9.08% higher than the classification accuracy of traditional BOW.
Summary

In practice, most pest images contain a large amount of interference information. Therefore, this paper proposes to extract the region of interest of the image by significance detection, and then construct BOW model. The experimental results show that the accuracy of the method is 9.08% higher than that of the traditional BOW model. However, the experimental method in this paper has certain pertinence, and it cannot be widely applied to other fields at present. Secondly, only 22 species of pests were collected in this paper, and the species of samples should be expanded next.

References


