ABSTRACT

Wheat is one of the most important crops in the world, and wheat diseases have a great impact on wheat yield. Therefore, the detection of wheat diseases is of great significance for monitoring wheat growth, managing production, and predicting yield. However, traditional methods are time-consuming and have low detection accuracy, which seriously restricts the development of smart agriculture. The development of deep learning methods provides a new way for wheat disease detection. Therefore, this study proposes a wheat disease detection model based on deep learning, aiming to improve the accuracy of the wheat disease detection model.

(1) A wheat disease dataset was constructed. Firstly, to increase the diversity of wheat disease data, five wheat disease datasets, Furasiam Head, Loose_Smut, Powdery_Mildew, Rust_Leaf, and Healthy were collected. Secondly, a wheat disease image dataset was constructed using data enhancement technology, including a total of 11,510 images of healthy and diseased wheat. Finally, the wheat disease dataset was divided into a training set, validation set, and test set according to 7:2:1.

(2) A wheat disease detection model based on YOLOv5-ShuffleNetv2 was proposed. Firstly, the constructed wheat disease dataset was used to train, verify and test with YOLOv5m, YOLOv5s, and YOLOv5-Lite models, and the model YOLOv5m with the best detection effect was selected. Secondly, the original backbone network part of YOLOv5m was replaced by the ShuffleNetv2 structure. Finally, the detection effect of the model before and after the improvement was compared. The experimental results showed that the wheat disease detection based on the YOLOv5m model is better than YOLOv5m-ShuffleNetv2.

(3) A wheat disease detection model based on YOLOv5m-SE was proposed. To further improve the ability to extract detailed information on wheat diseases in the field, an improved wheat disease detection model based on YOLOv5m was proposed. Firstly, the SE (Squeeze and Excitation) attention module was introduced into the feature extraction network part of the YOLOv5m model, aiming to enhance the spatial details and dependencies of wheat disease features. Secondly, the wheat disease detection effect was compared between the YOLOv5m-SE model and the YOLOv5m, Faster RCNN, and SSD models, aiming to verify the effectiveness of the optimized model. Finally, ablation experiments were carried out on the YOLOv5m-SE model. Experimental results showed that the model proposed in this study has higher accuracy and precision.