Chapter 7
Parasite Detection From Digital Images Using Deep Learning

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ABSTRACT

Parasitosis is a disease caused by parasites that could infect humans, animals, or plants. The parasites include mites, ascariasis, liver flukes, and malaria. The methods to detect parasites include pathological examination, immunological examination, and imaging examination. In this chapter, parasitic infections are detected from digital images acquired from a microscope, which will look for the possible infection caused by worms or eggs in a sample, such as mites and malaria. Rapid and accurate classification and detection of parasites will be very helpful for fast diagnosis and treatment. In this chapter, a malaria detection method is deployed by using deep learning based on TensorFlow and achieved 0.73 mAP@0.5IOU. Even if it does not seem to be a perfect performance, in the limited time and resources, the results are still valuable. The future work could port the model to mobile phones for image detection, which would bring much more convenience and portability.

INTRODUCTION

Along with the popularization and development of computer vision, visual object recognition has been applied in intelligent monitoring, car plate recognition, animal and plant recognition in many aspects, and the medical field is also a hot topic for

discussion. For example, during the period of COVID-19, Alibaba's team deployed image analysis technology to assist in the diagnosis of CT image of patients and achieved satisfactory outcomes. Therefore, a fast and simple image recognition method is expected, which is able to automatically analyse digital images taken from the microscope so as to identify possible malaria infections with a well-trained object detection model. The parasite detection is expected faster and easier than ever before, thus it can serve our community better.

Malaria is able to be identified by microscopic blood tests. Usually, these tests require skilled professionals to observe and look for suspected worm or eggs under a microscope, the accuracy of results usually depends on professional laboratories or the professionalism and experience of the laboratory staff. In the leakage of professionals and equipment, diagnostic accuracy could be reduced or omitted, it could result to unpredictable consequences for patients.

Visual object recognition is the core issue in computer vision. Visual object detection is dependent on the feature expression in digital image processing. Lecun et al. proposed a convolutional neural network (CNN) in 1989 and successfully applied it to image recognition (LeCun, et al. 1989). CNN network has achieved remarkable progress in the field of object recognition, the model based on CNN in the ImageNet LSVRC-2010 has achieved the best error rate of 15.3% (Krizhevsky, Sutskever & Hinton, 2012).

CNN network is effectively classified images, because its network structure is highly optimized for 2D and 3D images, which could effectively be trained by using 2D features. The CNN includes two parts which are extractor and classifier. Each layer in the network takes use of a differentiable function to extract and transfer data from present layer to the next. The CNN net is mainly composed of three types of layers: Convolution, max pooling, and classification. By superimposing these layers, a complete CNN model will be constructed (Alom, et al., 2019). The process of object detection is to extract the feature maps through convolutions, the extracted features from the convolutional layer will reduce the problem of overfitting (Lu & Zhang, 2016).

The activation function is like a simulation of how human's brain works. A neuron receives an electrical signal and fires electrical signal. If the incoming electrical signal is not strong enough, the neuron will not react at all; but if the electrical signal is stronger than a threshold, then the neuron will react and send electrical signals to other neurons. Multilayer neural networks are usually a highly nonlinear model, the rectification usually introduces a nonlinear function (also known as activation function), which is applied to the convolution layer. Nonlinear functions mainly include logistic function, Tanh function, sigmoid function and ReLU, etc. (Hadji & Wildes, 2018). Sigmoid is a nonlinear activation function, its mathematical form is

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