Turtle species identification design based on CNN

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Abstract. In order to realize automatic identification of turtle species, a CNN-based animal identification method based on Tensorflow is proposed. After preprocessing the image, the images are input into CNN for automatic classification and recognition. The accuracy rate is good for the common turtles.

1. Introduction
There are about 220 species of turtle in the world, and 33 species in China [1]. Turtles are highly sought after by humans due to their edible, medicinal and ornamental value. However, humans' recognition of turtle species is still very insufficient.

Artificial Neural Networks are derived from Biological Neural Networks. Analogous to Biological Neural Networks, artificial Neural Networks replace neurons with nodes to form a huge network that can process information. As psychologist W.S.McCulloch and mathematical logician Wapitis MP model, F.Rosenblatt put forward perception machine, Physicist j.j. Hopfield of California institute of technology put forward Hopfield neural mesh model and continuous time Hopfield neural network model successively[1], Aihara based on previous derivation and the experiment, a chaotic neuron model was put forward., Hochreiter and Schmidhuber proposed and improved a series of models such as long-term and short-term memory network, and the artificial neural network has been rapidly developed[2]. In 2012, Krizhevsky et al.[3] proposed the AlexNet recognition method, which won the first place in the image classification competition of large image database ImageNet[4], surpassing the second place by a huge margin of 11% in accuracy, attracting much attention of CNN[5]. Subsequently, new CNN models were proposed continuously. On this basis, CNN is more and more widely used, such as MNIST digital recognition, which can even achieve performance close to human [6]. In this paper, the self-made turtle species data set was used for experiments, and the CNN model including two convolutional layers and a full connection layer was used for training. LRN regularization was added in the two-layer convolutional network, and softmax classifier was used for classification to achieve the recognition effect.

2. CNN neural network recognition algorithm
Convolutional Neural Network (CNN) is a feedforward Neural Network, which is characterized by its ability to respond to surrounding units and is often applied in image processing. They include input layer, convolutional layer, pooling layer, fully connected layer, output layer and output layer.

2.1. Input layer
Through the input layer, the data and tags related to the input pictures can be converted into the TensorFlow format that supports subsequent applications using tf.cast. Convert the resulting data in
Tensorflow format to an input queue. Since the size of images is sensitive to CNN, the resize method is used to change the size of images to ensure their tidiness and fitness, and the mean value of all images is subtracted to standardize them, so as to prepare for later training.

2.2. Convolutional layer
The convolution layer takes up most of the computation of the whole network, which is generally multiple feature extraction layers composed of two-dimensional feature graphs. Its main function is to extract the feature graph of the input layer by convolution operation of the input image data. Each layer of CNN is the decision model of \( y = wx + b \), and equation (1) is as follows:

\[
x^l_j = f (\sum_{i \in M_j} x^{l-1}_j * w^l_{ij} + b^l_j)
\]

(1)

Where \( l \) represents the number of layers, \( j \) represents the number of neurons in this layer, \( x^l_j \) represents the \( j \)th neuron in the \( l \) layer, and \( f \) is the excitation function of this layer. \( w^l_{ij} \) represents the convolution kernel matrix of the \( i \)-th neuron in the \( l-1 \) layer to the \( j \)th neuron in the \( l \) layer, and \( b^l_j \) represents the bias of the \( j \)th neuron in the \( l \) layer. The excitation function used in this paper is ReLu function, as shown in equation (2):

\[
\text{Relu}(x) = \max(0, x)
\]

(2)

2.3. Pooling layer
Pooling layer is also known as under-sampling layer. Its main function is to reduce the dimension of features and reduce the number of parameters, so as to minimize overfitting and provide fault tolerance of the model. The two commonly used pooling methods are mean pooling and Max pooling. This paper adopts the maximum pooling method.

2.4. Regularization
In order to reduce the overfitting of the model and improve the generalization ability of the model, the regularization operation of LRN is added after the pooling layer, and the formula is as follows in equation (3):

\[
b^l_{i,x,y} = \frac{a^l_{i,x,y}}{\left( k + \alpha \sum_{j = \max(0,i-n/2)}^{\min(N-1,i+n/2)} (a^l_{i,x,y})^2 \right)^{\beta}}
\]

(3)

Where \( N \) represents the number of convolution kernel, \( i \) represents the \( i \)-th convolution kernel, and \( a^l_{i,x,y} \) represents the value of the \( i \)-th convolution kernel in the position of picture \((x,y)\) after convolution. So, \( b^l_{i,x,y} \) represents the value of an LRN operation.

2.5. Fully connected layer
Each neuron in the full connection layer is connected with all the neurons in the previous layer, and the extracted feature information is integrated. In this paper, softmax function is adopted.

2.6. The algorithm structure
The algorithm structure is as shown in figure1.
After inputting and preprocessing of the input layer, enter the convolution layer for convolution operation, and then enter the pooling layer for maximum pooling operation, and then perform regularization. After the completion, enter the next convolution layer, also carry out pooling and regularization, and finally enter the full connection layer and softmax classifier, and finally output the result.

### 3. Experimental results and analysis

In this experiment, self-made data set was used for testing, and the pictures of common turtle species were obtained from the Internet by crawlers as the test set. In this paper, in order to simplify the manual workload, score data set test and calibration were carried out by manual calibration, which was divided into three data sets: egg turtle, flame turtle and Chinese grass turtle. The testing results are shown in Table 1.

| The data set   | The number | Identification number | accuracy  |
|---------------|------------|-----------------------|-----------|
| Turtle egg    | 110        | 90                    | 81.41%    |
| Flame turtle  | 107        | 87                    | 82.04%    |
| The grass turtle | 106    | 91                    | 90.38%    |

To sum up, the detection results show that the recognition rate of the three kinds of common turtles is over 80%. On the one hand, the errors are caused by insufficient training sets, few training samples, and insufficient extraction dimensions of multidimensional features in the deep learning algorithm, which leads to insufficient generalization ability. In addition, there were some pictures of humans picking up turtles in the training set, and human hands also had a certain influence on the results.

### 4. Conclusion

Represented by CNN, a series of neural network model has been widely used, but in a turtle species identification as an example of the application of animal recognition still has great space for development, this paper used nowadays has been widely applied in the field of image detection and CNN networks, through regularization and a series of processing to achieve a precision of turtle
species identification, such as turtles specific animal species identification provides a new train of thought.

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