

CLAIMS

1. A deep learning based license plate identification method, comprising:

(i) extracting features of an original captured image by using a single shot multi-box detector to obtain a target license plate image, wherein extracting features of the original captured image includes:

(a) performing normalization processing on the original captured image by using a trained single shot multi-box detector to obtain an original license plate image;

(b) performing multi-scale feature extraction on the original license plate image including:

(I) inputting the original license plate image into each convolutional layer to obtain multiple layers of feature maps, each convolutional layer corresponding to a detector and a classifier; and

(II) performing feature extraction on the multiple layers of feature maps using default boxes with different ratios to output classification results of the default boxes from the detector and the classifier of each convolutional layer;

(c) processing the classification results of the default boxes by using non-maximum suppression to obtain the target license plate image;

(ii) correcting the target license plate image to obtain a corrected license plate image; and

(iii) identifying the corrected license plate image by using a bi-directional long short-term memory model to obtain target license plate information.

2. The deep learning based license plate identification method according to claim 1, wherein prior to (i)(a), the method further comprises: pre-training the single shot multi-box detector, and storing the trained single shot multi-box detector;

wherein pre-training the single shot multi-box detector comprises:

obtaining the original captured image for training the single shot multi-box detector;

recognizing a license plate position by using a rectangular box to obtain a ground truth box;

determining a positive sample and a negative sample based on the intersection-over-union between the default box and the ground truth box; and

training the single shot multi-box detector by using the positive sample and the negative sample to obtain the trained single shot multi-box detector.

3. The deep learning based license plate identification method according to claim 1, wherein processing classification results of the default boxes by using non-maximum suppression to obtain the target license plate image in (i)(c) comprises:

selecting a default box with a largest classification result as a target box from the classification results of the default boxes;

deleting corresponding default boxes whose intersection-over-union with the target box is greater than a certain threshold;

selecting the default box with the largest classification result from retained default boxes whose intersection-over-union with the target box is not greater than the certain threshold as a new target box;

obtaining the target license plate image based on the new target box.

4. The deep learning based license plate identification method according to claim 1, wherein correcting the target license plate image to obtain the corrected license plate image in (ii) comprises:

obtaining a license plate contour in the target license plate image;

obtaining an offset angle of the license plate contour, and determining whether the offset angle is larger than a predetermined offset value;

performing rotation, affine transformation, and uniform size processing on the license plate contour to obtain a corrected license plate image if the offset angle is larger than the predetermined offset value; and

performing uniform size processing on the license plate contour to obtain the corrected license plate image if the offset angle is not larger than the predetermined offset value.

5. The deep learning based license plate identification method according to claim 4, wherein obtaining the license plate contour in the target license plate image comprises:

obtaining a color similarity between a license plate area and an edge area in the target license plate image;

determining whether the color similarity is greater than a predetermined similarity or not;

taking the license plate area as the license plate contour if the color similarity is greater than the predetermined similarity; and

performing gray-scale processing, Sobel operator, binarization, and closing operations on the target license plate image to obtain the license plate contour if the color similarity is not greater than the predetermined similarity.

6. The deep learning based license plate identification method according to claim 1, wherein identifying the corrected license plate image by using the bi-directional long short-term memory model to obtain target license plate information in (iii) comprises:

cutting the corrected license plate image to obtain a plurality of strip features map;

extracting features of the plurality of strip features map by using the convolutional layer, obtaining a feature sequence formed by splicing the plurality of the strip feature maps;

identifying characters of the feature sequence by using the bi-directional long short-term memory model to obtain a character feature; and

processing the character feature by using a translation layer to obtain the target license plate information.

7. A deep learning based license plate identification device, comprising:

(i) a license plate detection module for extracting features of an original captured image by using a single shot multi-box detector to obtain a target license plate image, wherein the license plate detection module comprises:

(a) a normalization processing unit for performing normalization processing on the original captured image by using a trained single shot multi-box detector to obtain an original license plate image;

(b) a feature extraction unit for performing multi-scale feature extraction on the original license plate image including:

(I) inputting the original license plate image into convolutional layers to obtain layers of feature maps, each convolutional layer corresponding to a detector and a classifier; and

(II) performing feature extraction on the layers of feature maps using default boxes with different ratios to output classification results of the default boxes from the detector and the classifier of each convolutional layer; and

(c) a result selection unit for processing the classification results of the default boxes by using non-maximum suppression to obtain the target license plate image;

(ii) a license plate correction module for correcting the target license plate image to obtain a corrected license plate image; and

(iii) a license plate identification module for identifying the corrected license plate image by using a bi-directional long short-term memory model to obtain target license plate information.

8. The deep learning based license plate identification device according to claim 7, wherein

the license plate correction module comprises:

a contour obtaining unit for obtaining a license plate contour in the target license plate image;

an angle comparing unit for obtaining an offset angle of the license plate contour, and determining whether the offset angle is larger than a predetermined offset value;

a first correction unit for performing rotation, affine transformation, and uniform size processing on the license plate contour to obtain the corrected license plate image when the offset angle is larger than the predetermined offset value; and

a second correction unit for performing uniform size processing on the license plate contour to obtain the corrected license plate image when the offset angle is not larger than the predetermined offset value; and

the license plate identification module comprises:

a feature map obtaining unit for cutting the corrected license plate image to obtain a plurality of strip features maps;

a feature sequence obtaining unit for extracting features of the plurality of strip features map by using the convolutional layer, obtaining a feature sequence formed by splicing the plurality of the strip feature maps;

a character feature obtaining unit for identifying characters of the feature sequence by using the bi-directional long short-term memory model to obtain a character feature; and

a license plate information obtaining unit for processing the character feature by using a translation layer to obtain the target license plate information.

9. The deep learning based license plate identification device according to claim 8, wherein the contour obtaining unit comprises:

a similarity obtaining subunit for obtaining a color similarity between a license plate area and an edge area in the target license plate image;

a similarity comparing subunit for determining whether the color similarity is greater than a predetermined similarity;

a first contour obtaining subunit for taking the license plate area as the license plate contour when the color similarity is greater than the predetermined similarity; and

a second contour obtaining subunit, for performing gray-scale processing, Sobel operator, binarization, and closing operations on the target license plate image to obtain the license plate contour when the color similarity is not greater than the predetermined similarity.

10. A terminal equipment, the equipment comprises a memory, a processor, and a computer program which is stored in the memory and can be operated on the processor, wherein the processor implements following steps when executing the computer program:

(i) extracting features of an original captured image by using a single shot multi-box detector to obtain a target license plate image, wherein extracting features of the original captured image includes:

(a) performing normalization processing on the original captured image by using a trained single shot multi-box detector to obtain an original license plate image;

(b) performing multi-scale feature extraction on the original license plate image including:

(I) inputting the original license plate image into convolutional layers to obtain layers of feature maps, each convolutional layer corresponding to a detector and a classifier; and

(II) performing feature extraction on the layers of feature maps using default boxes with different ratios to output classification results of the default boxes from the detector and the classifier of each convolutional layer;

(c) processing the classification results of the default boxes by using non-maximum suppression to obtain the target license plate image;

(ii) correcting the target license plate image to obtain a corrected license plate image; and

(iii) identifying the corrected license plate image by using a bi-directional long short-term memory model to obtain target license plate information.

11. The terminal equipment according claim 10, wherein correcting the target license plate image to obtain the corrected license plate image in (ii) comprises:

obtaining a license plate contour in the target license plate image;

obtaining an offset angle of the license plate contour, and determining whether the offset angle is larger than a predetermined offset value;

performing rotation, affine transformation, and uniform size processing on the license plate contour to obtain a corrected license plate image if the offset angle is larger than the predetermined offset value; and

performing uniform size processing on the license plate contour to obtain the corrected license plate image if the offset angle is not larger than the predetermined offset value.

12. The terminal equipment according claim 11, wherein obtaining the license plate contour in the target license plate image comprises:

obtaining a color similarity between a license plate area and an edge area in the target license plate image;

determining whether the color similarity is greater than a predetermined similarity;

taking the license plate area as the license plate contour if the color similarity is greater than the predetermined similarity; and

performing gray-scale processing, Sobel operator, binarization, and closing operations on the target license plate image to obtain the license plate contour if the color similarity is not greater than the predetermined similarity.

13. The terminal equipment according claim 10, wherein using the bi-directional long short-term memory model to identify the corrected license plate image to obtain the target license plate information in (iii) comprises:

cutting the corrected license plate image to obtain a plurality of strip features map;

extracting features of the plurality of strip features map by using the convolutional layer, obtaining a feature sequence formed by splicing the plurality of the strip feature maps;

identifying characters of the feature sequence by using the bi-directional long short-term memory model to obtain a character feature; and

processing the character feature by using a translation layer to obtain the target license plate information.

14. A computer readable storage medium, the computer readable storage medium stores a computer program, wherein the computer program implements following steps when the computer program is executed by a processor:

(i) extracting features of an original captured image by using a single shot multi-box detector to obtain a target license plate image, wherein extracting features of the original captured image includes:

(a) performing normalization processing on the original captured image by using a trained single shot multi-box detector to obtain an original license plate image;

(b) performing multi-scale feature extraction on the original license plate image including:

(I) inputting the original license plate image into convolutional layers to obtain layers of feature maps, each convolutional layer corresponding to a detector and a classifier; and

(II) performing feature extraction on the layers of feature maps using default boxes with different ratios to output classification results of the default boxes from the detector and the classifier of each convolutional layer;

(c) processing the classification results of the default boxes by using non-maximum suppression to obtain the target license plate image;

(ii) correcting the target license plate image to obtain a corrected license plate image; and

(iii) identifying the corrected license plate image by using a bi-directional long short-term memory model to obtain target license plate information.

15. The computer readable storage medium according to claim 14, wherein correcting the target license plate image to obtain the corrected license plate image in (ii) comprises:

obtaining a license plate contour in the target license plate image;

obtaining an offset angle of the license plate contour, and determining whether the offset angle is larger than a predetermined offset value;

performing rotation, affine transformation, and uniform size processing on the license plate contour to obtain a corrected license plate image if the offset angle is larger than the predetermined offset value; and

performing uniform size processing on the license plate contour to obtain the corrected license plate image if the offset angle is not larger than the predetermined offset value.

16. The computer readable storage medium according to claim 15, wherein obtaining the license plate contour in the target license plate image comprises:

obtaining a color similarity between a license plate area and an edge area in the target license plate image;

determining whether the color similarity is greater than a predetermined similarity;

taking the license plate area as the license plate contour if the color similarity is greater than the predetermined similarity; and

performing gray-scale processing, Sobel operator, binarization, and closing operations on the target license plate image to obtain the license plate contour if the color similarity is not greater than the predetermined similarity.

17. The computer readable storage medium according to claim 14, wherein identifying the corrected license plate image by using the bi-directional long short-term memory model to obtain the target license plate information in (iii) comprises:

cutting the corrected license plate image to obtain a plurality of strip features map;

extracting features of the plurality of strip features map by using the convolutional layer, obtaining a feature sequence formed by splicing the plurality of the strip feature maps;

identifying characters of the feature sequence by using the bi-directional long short-term memory model to obtain a character feature; and

processing the character feature by using a translation layer to obtain the target license plate information.