CLAIMS

1. A computer-implemented method for vehicle damage identification, comprising:

obtaining a vehicle damage picture to be identified;

inputting the vehicle damage picture into a plurality of pre-trained target detection models respectively, and obtaining corresponding detection results from the plurality of target detection models as a detection result set, wherein the detection result set comprises candidate bounding boxes detected by the plurality of target detection models and category prediction results of the candidate bounding boxes;

for any first candidate bounding box of the candidate bounding boxes, determining an integrated feature vector of the first candidate bounding box according to at least an association relationship between the first candidate bounding box and other candidate bounding boxes, wherein the association relationship includes one or more of a bounding box content association relationship, a location association relationship, and a category prediction result association relationship; and

separately inputting integrated feature vectors corresponding to the candidate bounding boxes into a pre-trained classification model, and optimizing the detection result set according to output results of the classification model.

2. The method according to claim 1, wherein the other candidate bounding boxes include a second candidate bounding box, and the association relationship includes a bounding box content association relationship; and

determining an integrated feature vector of the first candidate bounding box comprises:

obtaining a convolution feature vector of each candidate bounding box, wherein the convolution feature vector is used to represent a picture content feature in a corresponding bounding box;

determining a content association feature between the first candidate bounding box and the second candidate bounding box based on a first convolution feature vector corresponding to the first candidate bounding box and a second convolution feature vector corresponding to the second candidate bounding box; and

determining, according to at least the content association feature, the integrated feature vector of the first candidate bounding box.

3. The method according to claim 2, wherein determining a content association feature between the first candidate bounding box and the second candidate bounding box comprises at least one of:

calculating a dot product of the first convolution feature vector and the second convolution feature vector, and determining the content association feature based on the dot product; and

calculating a distance between the first convolution feature vector and the second convolution feature vector, and determining the content association feature based on the distance, wherein the distance includes a cosine distance or a Euclidean distance.

4. The method according to claim 1, wherein the other candidate bounding boxes include a second candidate bounding box, and the association relationship includes a location association relationship; and

determining an integrated feature vector of the first candidate bounding box comprises:

determining a location association feature between the first candidate bounding box and the second candidate bounding box based on a location parameter of the first candidate bounding box and a location parameter of the second candidate bounding box; and

determining, according to at least the location association feature, the integrated feature vector of the first candidate bounding box.

5. The method according to claim 4, wherein the location association feature includes one or more of a center-to-center distance, an IoU ratio, an area ratio, and an inclusion relationship.

6. The method according to claim 1, wherein the other candidate bounding boxes include a second candidate bounding box, and the association relationship includes a category prediction result association relationship; and

determining an integrated feature vector of the first candidate bounding box comprises:

determining a prediction result association feature between the first candidate bounding box and the second candidate bounding box based on a first prediction result corresponding to the first candidate bounding box and a second prediction result corresponding to the second candidate bounding box; and

determining, according to at least the prediction result association feature, the integrated feature vector of the first candidate bounding box.

7. The method according to claim 6, wherein the first prediction result includes a first category and a first confidence, the second prediction result includes a second category and a second confidence, and the prediction result association feature includes: whether the first category is the same as the second category, and a difference between the first confidence and the second confidence.

8. The method according to claim 1, wherein the other candidate bounding boxes include one or more of the following: candidate bounding boxes having a center-to-center distance from the first candidate bounding box falling within a predetermined threshold, and a predetermined number of candidate bounding boxes ranked based on a center-to-center distance from the first candidate bounding box.

9. The method according to claim 1, wherein the classification model includes one of a GBDT model, an SVM model, and a DNN based classification model.

10. The method according to claim 1, wherein optimizing the detection result set according to output results of the classification model comprises:

removing the first candidate bounding box from the detection result set when an output result of the classification model for the first candidate bounding box is an abnormal bounding box.

11. An apparatus for vehicle damage identification, comprising:

an obtaining unit, configured to obtain a vehicle damage picture to be identified;

a detecting unit, configured to input the vehicle damage picture into a plurality of pre-trained target detection models respectively, and obtain corresponding detection results from the plurality of target detection models as a detection result set, wherein the detection result set comprises candidate bounding boxes detected by the plurality of target detection models and category prediction results of the candidate bounding boxes;

an integrating unit, configured to, for any first candidate bounding box of the candidate bounding boxes, determine an integrated feature vector of the first candidate bounding box according to at least an association relationship between the first candidate bounding box and other candidate bounding boxes, wherein the association relationship includes one or more of a bounding box content association relationship, a location association relationship, and a category prediction result association relationship; and

an optimizing unit, configured to separately input integrated feature vectors corresponding to the candidate bounding boxes into a pre-trained classification model, and optimize the detection result set according to output results of the classification model.

12. The apparatus according to claim 11, wherein the other candidate bounding boxes include a second candidate bounding box, and the association relationship includes a bounding box content association relationship; and

the integrating unit further comprises:

a convolution feature obtaining module, configured to obtain a convolution feature vector of each candidate bounding box, wherein the convolution feature vector is used to represent a picture content feature in a corresponding bounding box;

an association feature determining module, configured to determine a content association feature between the first candidate bounding box and the second candidate bounding box based on a first convolution feature vector corresponding to the first candidate bounding box and a second convolution feature vector corresponding to the second candidate bounding box; and

an integrated feature determining module, configured to determine the integrated feature vector of the first candidate bounding box according to at least the content association feature.

13. The apparatus according to claim 12, wherein the association feature determining module is configured to perform at least one of:

calculating a dot product of the first convolution feature vector and the second convolution feature vector, and determining the content association feature based on the dot product; and

calculating a distance between the first convolution feature vector and the second convolution feature vector, and determining the content association feature based on the distance, wherein the distance includes a cosine distance or a Euclidean distance.

14. The apparatus according to claim 11, wherein the other candidate bounding boxes include a second candidate bounding box, and the association relationship includes a location association relationship; and

the integrating unit is configured to:

determine a location association feature between the first candidate bounding box and the second candidate bounding box based on a location parameter of the first candidate bounding box and a location parameter of the second candidate bounding box; and

determine, according to at least the location association feature, the integrated feature vector of the first candidate bounding box.

15. The apparatus according to claim 14, wherein the location association feature includes one or more of a center-to-center distance, an IoU ratio, an area ratio, and an inclusion relationship.

16. The apparatus according to claim 11, wherein the other candidate bounding boxes include a second candidate bounding box, and the association relationship includes a category prediction result association relationship; and

the integrating unit is configured to:

determine a prediction result association feature between the first candidate bounding box and the second candidate bounding box based on a first prediction result corresponding to the first candidate bounding box and a second prediction result corresponding to the second candidate bounding box; and

determine, according to at least the prediction result association feature, the integrated feature vector of the first candidate bounding box.

17. The apparatus according to claim 16, wherein the first prediction result includes a first category and a first confidence, the second prediction result includes a second category and a second confidence, and the prediction result association feature includes: whether the first category is the same as the second category, and a difference between the first confidence and the second confidence.

18. The apparatus according to claim 11, wherein the other candidate bounding boxes include one or more of the following: candidate bounding boxes having a center-to-center distance from the first candidate bounding box falling within a predetermined threshold, and a predetermined number of candidate bounding boxes ranked based on a center-to-center distance from the first candidate bounding box.

19. The apparatus according to claim 11, wherein the classification model includes one of a GBDT model, an SVM model, and a DNN based classification model.

20. The apparatus according to claim 11, wherein the optimizing unit is configured to:

remove the first candidate bounding box from the detection result set when an output result of the classification model for the first candidate bounding box is an abnormal bounding box.

21. A computing device, comprising a memory and a processor, wherein the memory stores executable codes, and when the processor executes the executable codes, the method of any one of claims 1-10 is implemented.