

determining that the matching classifier includes a second classifier configured to recognize a scenario where the indicator lights are located; and recognizing, by means of the second classifier, an image feature of the target region where the target object is located, to determine information about the scenario where the indicator lights are located.

5 In some possible implementations, recognizing, based on the detection result of the target object, the target region where the target object in the input image is located, to obtain indication information of the target object comprises:

determining, in response to the case where the type of the target object is a circular spot light or a pedestrian light, that the matching classifier includes a third classifier configured to
10 recognize a color attribute of the circular spot light or the pedestrian light; and

recognizing, by means of the third classifier, an image feature of the target region where the target object is located, to determine the color attribute of the circular spot light or the pedestrian light.

In some possible implementations, recognizing, based on the detection result of the target
15 object, the target region where the target object in the input image is located, to obtain indication information of the target object comprises:

determining, in response to the case where the type of the target object is an arrow light, that the matching classifier includes a fourth classifier configured to recognize a color attribute of the arrow light, and a fifth classifier configured to recognize a direction attribute of the
20 arrow light; and

recognizing, by means of the fourth classifier and the fifth classifier, an image feature of the target region where the target object is located, to determine the color attribute and the direction attribute of the arrow light, respectively.

In some possible implementations, recognizing, based on the detection result of the target
25 object, the target region where the target object in the input image is located, to obtain indication information of the target object comprises:

determining, in response to the case where the type of the target object is a digit light, that the matching classifier includes a sixth classifier configured to recognize a color attribute of the digit light, and a seventh classifier configured to recognize a numerical attribute of the digit
30 light; and

recognizing, by means of the sixth classifier and the seventh classifier, an image feature of the target region where the target object is located, to determine the color attribute and the numerical attribute of the digit light, respectively.

In some possible implementations, in response to the case where the input image includes
35 at least two indicator light bases, the method further comprises:

determining, for a first indicator light base, an indicator light in a lighted state matching the first indicator light base; the first indicator light base being one of the at least two indicator light bases; and

combining indication information of the first indicator light base and indication information of the indicator light in a lighted state matching the first indicator light base to obtain combined indication information.

In some possible implementations, determining an indicator light in a lighted state matching the first indicator light base comprises:

determining, based on the position of the target region where the target object is located in the detection result of the target object, a first area of an intersection between the target region where the at least one indicator light in a lighted state is located and the target region where the first indicator light base is located, and a second area of the target region where the at least one indicator light in a lighted state is located; and

determining, in response to the case where a ratio between the first area between a first indicator light in a lighted state and the first indicator light base, and the second area of the first indicator light in a lighted state is greater than a given area threshold, that the first indicator light in a lighted state matches the first indicator light base;

wherein the first indicator light in a lighted state is one of the at least one indicator light in a lighted state.

According to a second aspect of the present disclosure, there is provided a driving control method, comprising:

capturing a driving image by an image capturing apparatus in an intelligent driving apparatus;

executing the method for recognizing indication information of indicator lights according to the first aspect on the driving image to obtain indication information of the driving image; and

generating a control instruction for the intelligent driving apparatus based on the indication information.

According to a third aspect of the present disclosure, there is provided a device for recognizing indication information of indicator lights, comprising:

an acquiring module configured to acquire an input image;

a ~~detecting~~-determining module configured to determine a detection result of a target object based on the input image, the target object including at least one of an indicator light base and an indicator light in a lighted state, and the detection result including a type of the target object and a position of the target region where the target object in the input image is located; and

least two candidate regions, or based on the intermediate detection result of each candidate region and the first position of each candidate region; and

take the predicted type of the target object in the target region as the type of the target object, and take the first position of the target region as the position of the target region where the target object is located, to obtain a detection result of the target object.

In some possible implementations, the determining module is further configured to determine, in the case where the detection result of the target object includes only a detection result corresponding to an indicator light base, that the indicator light is in a fault state; and

determine, in the case where the detection result of the target object includes only a detection result of an indicator light in a lighted state, that the scenario state in which the input image is captured is a dark state.

In some possible implementations, the recognizing module is further configured to determine a classifier matching the target object based on the type of the target object in the detection result of the target object; and

recognize, by means of a matching classifier, an image feature of the target region in the input image to obtain indication information of the target object.

In some possible implementations, the recognizing module is further configured to determine, in response to the case where the type of the target object is an indicator light base, that the matching classifier includes a first classifier configured to recognize an arrangement mode of indicator lights in the indicator light base; and recognize, by means of the first classifier, an image feature of the target region where the target object is located, to determine the arrangement mode of indicator lights in the indicator light base; and/or

determine that the matching classifier includes a second classifier configured to recognize a scenario where the indicator lights are located; and recognize, by means of the second classifier, an image feature of the target region where the target object is located, to determine information about the scenario where the indicator lights are located.

In some possible implementations, the recognizing module is further configured to determine, in response to the case where the type of the target object is a circular spot light or a pedestrian light, that the matching classifier includes a third classifier configured to recognize a color attribute of the circular spot light or the pedestrian light; and

recognize, by means of the third classifier, an image feature of the target region where the target object is located, to determine the color attribute of the circular spot light or the pedestrian light.

In some possible implementations, the recognizing module is further configured to determine, in response to the case where the type of the target object is an arrow light, that the

of execution of the steps should depend on the functions and possible inherent logics of the steps. Without departing from the logics, the different implementations provided in the present disclosure may be combined with each other.

It should be understandable that without violating the principle and the logics, the above method embodiments described in the present disclosure may be combined with one another to form a combined embodiment, which, due to limited space, will not be repeatedly described in the present disclosure.

In addition, the present disclosure further provides a device for recognizing indication information of indicator lights, a driving control device, an electronic apparatus, a computer readable storage medium, and a program, which are all capable of realizing any one of the methods for recognizing indication information of indicator lights and/or the driving control methods provided in the present disclosure. For the corresponding technical solutions and descriptions which will not be repeated, reference may be made to the corresponding descriptions of the method.

FIG. 10 shows a block diagram of a device for recognizing indication information of indicator lights according to an embodiment of the present disclosure. As shown in FIG. 10, the device for recognizing indication information of indicator lights comprises:

- an acquiring module 10 configured to acquire an input image;

- a ~~detecting~~-determining module 20 configured to determine a detection result of a target object based on the input image, the target object including at least one of an indicator light base and an indicator light in a lighted state, and the detection result including a type of the target object and a position of the target region where the target object in the input image is located; and

- a recognizing module 30 configured to recognize, based on the detection result of the target object, the target region where the target object in the input image is located, to obtain indication information of the target object.

In some possible implementations, the determining module is further configured to:

- extract an image feature of the input image;

- determine, based on the image feature of the input image, a first position of each candidate region in at least one candidate region of the target object;

- determine an intermediate detection result of each candidate region based on an image feature at a first position corresponding to each candidate region of the input image, the intermediate detection result including a predicted type of the target object and the prediction probability that the target object is the predicted type; the predicted type being any one of an indicator light base and N types of indicator lights in a lighted state, N being a positive integer; and

In some possible implementations, the recognizing module is further configured to determine a classifier matching the target object based on the type of the target object in the detection result of the target object; and

recognize, by means of a matching classifier, an image feature of the target region in the input image to obtain indication information of the target object.

In some possible implementations, the recognizing module is further configured to determine, in the case where the type of the target object is an indicator light base, that the matching classifier includes a first classifier configured to recognize an arrangement mode of indicator lights in the indicator light base; recognize, by means of the first classifier, an image feature of the target region where the target object is located, to determine the arrangement mode of indicator lights in the indicator light base; and/or

determine that the matching classifier includes a second classifier configured to recognize a scenario where the indicator lights are located; recognize, by means of the second classifier, an image feature of the target region where the target object is located, to determine information about the scenario where the indicator lights are located.

In some possible implementations, the recognizing module is further configured to determine, in the case where the type of the target object is a circular spot light or a pedestrian light, that the matching classifier includes a third classifier configured to recognize a color attribute of the circular spot light or the pedestrian light; and

recognize, by means of the third classifier, an image feature of the target region where the target object is located, to determine the color attribute of the circular spot light or the pedestrian light.

In some possible implementations, the recognizing module is further configured to determine, in the case where the type of the target object is an arrow light, that the matching classifier includes a fourth classifier configured to recognize a color attribute of the arrow light, and a fifth classifier configured to recognize a direction attribute of the arrow light; and

recognize, by means of the fourth classifier and the fifth classifier, an image feature of the target region where the target object is located, to determine the color attribute and the direction attribute of the arrow light, respectively.

In some possible implementations, the recognizing module is further configured to determine, in the case where the type of the target object is a digit light, that the matching classifier includes a sixth classifier configured to recognize a color attribute of the digit light, and a seventh classifier configured to recognize a numerical attribute of the digit light; and

CLAIMS

1. A method for recognizing indication information of an indicator light, comprising:
acquiring an input image;

5 determining a detection result of a target object based on the input image, the target object including at least one of an indicator light base and an indicator light in a lighted state, and the detection result including a type of the target object and a position of a target region where the target object is located in the input image; and

10 recognizing, based on the detection result of the target object, the target region where the target object is located in the input image to obtain the indication information of the target object.

2. The method according to claim 1, wherein determining the detection result of the target object based on the input image comprises:

extracting an image feature of the input image;

15 determining, based on the image feature of the input image, a first position of each candidate region in at least one candidate region of the target object;

determining an intermediate detection result of each candidate region based on an image feature at a first position corresponding to each candidate region in the input image, the intermediate detection result including a predicted type of the target object and a prediction probability that the target object is the predicted type, the predicted type being any one of an indicator light base and N types of indicator lights in a lighted state, N being a positive integer; and

20 determining the detection result of the target object based on the intermediate detection result of each candidate region in the at least one candidate region and the first position of each candidate region.

3. The method according to claim 2, wherein determining the intermediate detection result of each candidate region based on the image feature at the first position corresponding to each candidate region in the input image comprises:

30 classifying, for each candidate region, the target object in the candidate region based on the image feature at the first position corresponding to the candidate region, and obtaining the prediction probability that the target object is each of at least one preset type, wherein the preset type includes at least one of an indicator light base and N types of indicator lights in a lighted state, N being a positive integer; and

taking a preset type with the highest prediction probability in the at least one preset type as the predicted type of the target object in the candidate region, and obtaining a prediction probability of the predicted type.

4. The method according to claim 2 or 3, wherein before determining the detection result of the target object based on the intermediate detection result of each candidate region in the at least one candidate region and the first position of each candidate region, the method further comprises:

determining a position deviation of the first position of each candidate region based on the image feature of the input image; and

adjusting the first position of each candidate region according to the position deviation corresponding to each candidate region.

5. The method according to any one of claims 2 to 4, wherein determining the detection result of the target object based on the intermediate detection result of each candidate region in the at least one candidate region and the first position of each candidate region comprises:

filtering, in response to the case where there are at least two candidate regions of the target object, the target region from the at least two candidate regions, based on the intermediate detection result of each candidate region in the at least two candidate regions, or based on the intermediate detection result of each candidate region and the first position of each candidate region; and

taking the predicted type of the target object in the target region as the type of the target object, and taking the first position of the target region as the position of the target region where the target object is located, to obtain the detection result of the target object.

6. The method according to any one of claims 1 to 5, wherein after determining the detection result of the target object based on the input image, the method further comprises at least one of:

determining, in response to the case where the detection result of the target object includes only a detection result corresponding to an indicator light base, that the indicator light is in a fault state; and

determining, in response to the case where the detection result of the target object includes only a detection result corresponding to an indicator light in a lighted state, that the scenario state in which the input image is captured is a dark state.

7. The method according to any one of claims 1 to 6, wherein recognizing, based on the detection result of the target object, the target region where the target object is located in the input image to obtain the indication information of the target object comprises:

determining a classifier matching the target object based on the type of the target object in the detection result of the target object; and

recognizing, by means of a matching classifier, the image feature of the target region in the input image to obtain the indication information of the target object.

5 8. The method according to claim 7, wherein recognizing, based on the detection result of the target object, the target region where the target object is located in the input image to obtain the indication information of the target object comprises:

10 determining, in response to the case where the type of the target object is an indicator light base, that the matching classifier includes a first classifier configured to recognize an arrangement mode of indicator lights in the indicator light base, and recognizing, by means of the first classifier, the image feature of the target region where the target object is located, to determine the arrangement mode of the indicator lights in the indicator light base; and/or

15 determining that the matching classifier includes a second classifier configured to recognize a scenario where the indicator light is located, and recognizing, by means of the second classifier, the image feature of the target region where the target object is located, to determine information about the scenario where the indicator light is located.

9. The method according to claim 7 or 8, wherein recognizing, based on the detection result of the target object, the target region where the target object is located in the input image to obtain the indication information of the target object comprises:

20 determining, in response to the case where the type of the target object is a circular spot light or a pedestrian light, that the matching classifier includes a third classifier configured to recognize a color attribute of the circular spot light or the pedestrian light; and

25 recognizing, by means of the third classifier, the image feature of the target region where the target object is located to determine the color attribute of the circular spot light or the pedestrian light.

10. The method according to any one of claims 7 to 9, wherein recognizing, based on the detection result of the target object, the target region where the target object is located in the input image to obtain the indication information of the target object comprises:

30 determining, in response to the case where the type of the target object is an arrow light, that the matching classifier includes a fourth classifier configured to recognize a color attribute of the arrow light and a fifth classifier configured to recognize a direction attribute of the arrow light; and

35 recognizing, by means of the fourth classifier and the fifth classifier, the image feature of the target region where the target object is located, to determine the color attribute and the direction attribute of the arrow light respectively.

11. The method according to any one of claims 7 to 10, wherein recognizing, based on the detection result of the target object, the target region where the target object is located in the input image to obtain the indication information of the target object comprises:

determining, in response to the case where the type of the target object is a digit light, that the matching classifier includes a sixth classifier configured to recognize a color attribute of the digit light and a seventh classifier configured to recognize a numerical attribute of the digit light; and

recognizing, by means of the sixth classifier and the seventh classifier, the image feature of the target region where the target object is located, to determine the color attribute and the numerical attribute of the digit light respectively.

12. The method according to any one of claims 1 to 11, wherein in response to the case where the input image includes at least two indicator light bases, the method further comprises:

determining, for a first indicator light base, an indicator light in a lighted state matching the first indicator light base, the first indicator light base being one of the at least two indicator light bases; and

combining indication information of the first indicator light base and indication information of the indicator light in a lighted state matching the first indicator light base to obtain combined indication information.

13. The method according to claim 12, wherein determining the indicator light in a lighted state matching the first indicator light base comprises:

determining, based on the position of the target region where the target object is located in the detection result of the target object, a first area of an intersection between the target region where at least one indicator light in a lighted state is located and the target region where the first indicator light base is located, and a second area of the target region where the at least one indicator light in a lighted state is located; and

determining, in response to the case where a ratio between the first area between a first indicator light in a lighted state and the first indicator light base and the second area of the first indicator light in a lighted state is greater than a given area threshold, that the first indicator light in a lighted state matches the first indicator light base,

wherein the first indicator light in a lighted state is one of the at least one indicator light in a lighted state.

14. A driving control method, comprising:

capturing a driving image by an image capturing apparatus in an intelligent driving apparatus;

executing the method for recognizing indication information of the indicator light according to any one of claims 1 to 13 on the driving image to obtain indication information for the driving image; and

generating a control instruction for the intelligent driving apparatus based on the indication information.

15. A device for recognizing indication information of an indicator light, comprising:

an acquiring module configured to acquire an input image;

a detecting module configured to determine a detection result of a target object based on the input image, the target object including at least one of an indicator light base and an indicator light in a lighted state, and the detection result including a type of the target object and a position of a target region where the target object is located in the input image; and

a recognizing module configured to recognize, based on the detection result of the target object, the target region where the target object is located in the input image, to obtain the indication information of the target object.

16. The device according to claim 15, wherein the determining module is further configured to:

extract an image feature of the input image;

determine, based on the image feature of the input image, a first position of each candidate region in at least one candidate region of the target object;

determine an intermediate detection result of each candidate region based on an image feature at a first position corresponding to each candidate region in the input image, the intermediate detection result including a predicted type of the target object and a prediction probability that the target object is the predicted type, the predicted type being any one of an indicator light base and N types of indicator lights in a lighted state, N being a positive integer; and

determine the detection result of the target object based on the intermediate detection result of each candidate region in the at least one candidate region and the first position of each candidate region.

17. The device according to claim 16, wherein the determining module is further configured to:

classify, for each candidate region, the target object in the candidate region based on the image feature at the first position corresponding to the candidate region, and obtain the prediction probability that the target object is each of at least one preset type, wherein the preset type includes at least one of an indicator light base and N types of indicator lights in a lighted state, N being a positive integer; and

take a preset type with the highest prediction probability in the at least one preset type as the predicted type of the target object in the candidate region, and obtain the prediction probability of the predicted type.

18. ~~The device according to claim 16 or 17, wherein the determining module is further configured to: before determining the detection result of the target object based on the intermediate detection result of each candidate region in the at least one candidate region and the first position of each candidate region,~~

~~determine a position deviation of the first position of each candidate region based on the image feature of the input image; and~~

~~adjust the first position of each candidate region according to the position deviation corresponding to each candidate region.~~

19. ~~The device according to any one of claims 16 to 18, wherein the determining module is further configured to:~~

~~filter, in the case where there are at least two candidate regions of the target object, the target region from the at least two candidate regions, based on the intermediate detection result of each of the at least two candidate regions, or based on the intermediate detection result of each candidate region and the first position of each candidate region; and~~

~~take the predicted type of the target object in the target region as the type of the target object, and take the first position of the target region as the position of the target region where the target object is located, to obtain the detection result of the target object.~~

20. ~~The device according to any one of claims 15 to 19, wherein the determining module is further configured to:~~

~~determine, in the case where the detection result of the target object includes only a detection result corresponding to an indicator light base, that the indicator light is in a fault state; and~~

~~determine, in the case where the detection result of the target object includes only a detection result corresponding to an indicator light in a lighted state, that the scenario state in which the input image is captured is a dark state.~~

21. ~~The device according to any one of claims 15 to 20, wherein the recognizing module is further configured to:~~

~~determine a classifier matching the target object based on the type of the target object in the detection result of the target object; and~~

~~recognize, by means of a matching classifier, the image feature of the target region in the input image, to obtain the indication information of the target object.~~

22. The device according to claim 21, wherein the recognizing module is further configured to:—

determine, in the case where the type of the target object is an indicator light base, that the matching classifier includes a first classifier configured to recognize an arrangement mode of indicator lights in the indicator light base, and recognize, by means of the first classifier, the image feature of the target region where the target object is located, to determine the arrangement mode of the indicator lights in the indicator light base; and/or

determine that the matching classifier includes a second classifier configured to recognize a scenario where the indicator light is located, and recognize, by means of the second classifier, the image feature of the target region where the target object is located, to determine information about the scenario where the indicator light is located.

23. The device according to claim 21 or 22, wherein the recognizing module is further configured to:—

determine, in the case where the type of the target object is a circular spot light or a pedestrian light, that the matching classifier includes a third classifier configured to recognize a color attribute of the circular spot light; and

recognize, by means of the third classifier, the image feature of the target region where the target object is located, to determine the color attribute of the circular spot light or the pedestrian light.

24. The device according to any one of claims 21 to 23, wherein the recognizing module is further configured to:—

determine, in the case where the type of the target object is an arrow light, that the matching classifier includes a fourth classifier configured to recognize a color attribute of the arrow light, and a fifth classifier configured to recognize a direction attribute of the arrow light; and

recognize, by means of the fourth classifier and the fifth classifier, the image feature of the target region where the target object is located, to determine the color attribute and the direction attribute of the arrow light, respectively.

25. The device according to any one of claims 21 to 24, wherein the recognizing module is further configured to:—

determine, in the case where the type of the target object is a digit light, that the matching classifier includes a sixth classifier configured to recognize a color attribute of the digit light, and a seventh classifier configured to recognize a numerical attribute of the digit light; and

recognize, by means of the sixth classifier and the seventh classifier, the image feature of the target region where the target object is located, to determine the color attribute and the numerical attribute of the digit light, respectively.

26. The device according to any one of claims 15 to 25, wherein the device further comprises a matching module configured to: in the case where the input image includes at least two indicator light bases;

determine, for a first indicator light base, an indicator light in a lighted state matching the first indicator light base, the first indicator light base being one of the at least two indicator light bases; and

combine indication information of the first indicator light base and indication information of the indicator light in a lighted state matching the first indicator light base to obtain combined indication information.

27. The device according to claim 26, wherein the matching module is further configured to:

determine, based on the position of the target region where the target object is located in the detection result of the target object, a first area of an intersection between the target region where at least one indicator light in a lighted state is located and the target region where the first indicator light base is located, and a second area of the target region where the at least one indicator light in a lighted state is located; and

determine, in the case where a ratio between the first area between a first indicator light in a lighted state and the first indicator light base and the second area of the first indicator light in a lighted state is greater than a given area threshold, that the first indicator light in a lighted state matches the first indicator light base;

wherein the first indicator light in a lighted state is one of the at least one indicator light in a lighted state.

28. A driving control device, comprising:

an image capturing module disposed in an intelligent driving apparatus and configured to capture a driving image of the intelligent driving apparatus;

an image processing module configured to execute the method for recognizing indication information of the indicator light according to any one of claims 1 to 13 on the driving image to obtain indication information of the driving image; and

a control module configured to generate a control instruction for the intelligent driving apparatus based on the indication information.

29. An electronic apparatus, comprising:

a processor; and

a memory configured to store processor-executable instructions;

wherein the processor is configured to invoke instructions stored in the memory to execute the method according to any one of claims 1 to 13 or execute the method according to claim 14.

5 ~~30~~19. A non-transitory computer readable storage medium having computer program instructions stored thereon, wherein the computer program instructions, when executed by a processor, implement the method according to any one of claims 1 to 13 or implement the method according to claim 14.

10 ~~31~~20. A computer program, comprising a computer readable code, wherein when the computer readable code operates in an electronic apparatus, a processor in the electronic apparatus executes instructions for implementing the method according to any one of claims 1 to 13 or implementing the method according to claim 14.