CLAIMS

1. A driving state analysis method, comprising:

performing fatigue state detection and distraction state detection for a driver on a driver image to obtain a fatigue state detection result and a distraction state detection result; and

in response to at least one of the fatigue state detection result and the distraction state detection result satisfying a predetermined alarm condition, outputting alarm information satisfying the predetermined alarm condition;

wherein in response to at least one of the fatigue state detection result and the distraction state detection result satisfying the predetermined alarm condition, outputting the alarm information satisfying the predetermined alarm condition comprises:

outputting prompt/warning information corresponding to the fatigue state detection result when the fatigue state detection result is a fatigue state;

outputting prompt/warning information corresponding to the distraction state detection result when the distraction state detection result is a distraction state; and

outputting prompt/warning information corresponding to the fatigue state detection result when the fatigue state detection result is a fatigue state and the distraction state detection result is a distraction state.

2. The method according to claim 1, further comprising at least one of:

suppressing alarm information corresponding to other detection results that satisfy the predetermined alarm condition within a preset period of time after outputting the alarm information corresponding to the fatigue state detection result; or

suppressing the alarm information corresponding to other detection results that satisfy the predetermined alarm condition within a preset period of time after outputting the alarm information corresponding to the distraction state detection result.

3. The method according to claim 1 or claim 2, wherein the method further comprises: before performing fatigue state detection and distraction state detection for the driver on the driver image,

determining whether a deviation angle of a head location of the driver in the driver image exceeds a preset range;

in response to determining that the deviation angle of the head location of the driver exceeds the preset range, performing distraction state detection for the driver on the driver image to obtain the distraction state detection result; and

in response to determining that the deviation angle of the head location of the driver does not exceed the preset range, performing fatigue state detection and distraction state detection for the driver on the driver image to obtain the fatigue state detection result and the distraction state detection result.

4. The method according to any one of claims 1 to 3, wherein performing fatigue state detection and distraction state detection for the driver on the driver image comprises:

performing head pose detection, eye state detection, and/or mouth state detection on the driver image to obtain head pose information, eye state information, and/or mouth state information;

determining a parameter value of an index for representing the fatigue state of the driver and a parameter value of an index for representing the distraction state of the

driver according to the head pose information, the eye state information, and/or the mouth state information;

determining the fatigue state detection result of the driver according to the parameter value of the index for representing the fatigue state of the driver; and

determining the distraction state detection result of the driver according to the parameter value of the index for representing the distraction state of the driver;

wherein determining the parameter value of the index for representing the fatigue state of the driver and the parameter value of the index for representing the distraction state of the driver according to the head pose information, the eye state information, and/or the mouth state information comprises at least one of:

determining the head location of the driver in the driver image according to the head pose information to obtain head location information, and obtaining a parameter value of a head location deviation degree according to the head location information within a period of time;

determining face orientation of the driver in the driver image according to the head pose information to obtain face orientation information, and obtaining a parameter value of a face orientation deviation degree according to the face orientation information within a period of time;

determining a gaze direction of the driver in the driver image according to the head pose information to obtain gaze direction information, and obtaining a parameter value of a gaze direction deviation degree according to the gaze direction information within a period of time;

determining an eye region image in the driver image according to the face key points, obtaining gaze direction information of the driver in the eye region image

based on a sixth neural network, and obtaining a parameter value of a gaze direction deviation degree according to the gaze direction information within a period of time;

obtaining a parameter value of a daze degree according to the eye state information within a period of time;

determining the head location of the driver in the driver image according to the head pose information to obtain the head location information, and obtaining a parameter value of a nap degree according to the head location information within a period of time;

obtaining a parameter value of an eye closure degree according to the eye state information within a period of time;

obtaining a parameter value of a blink degree according to the eye state information within a period of time; or

obtaining a parameter value of a yawning degree according to the mouth state information within a period of time;

wherein the index for representing the fatigue state of the driver comprises any one or more of the following: the nap degree, the eye closure degree, the blink degree, or the yawning degree; and

the index for representing the distraction state of the driver comprises any one or more of the following: the head location deviation degree, the face orientation deviation degree, the gaze direction deviation degree, or the daze degree.

5. The method according to claim 4, further comprising:

presetting the reference gaze direction; or

taking an average gaze direction determined based on first N driver image frames

in a video comprising the driver image as the reference gaze direction, wherein N is an integer greater than 1;

wherein obtaining the parameter value of the gaze direction deviation degree according to the gaze direction information within the period of time comprises:

obtaining the parameter value of the gaze direction deviation degree according to a deviation angle of the gaze direction information within the period of time relative to a reference gaze direction.

6. The method according to claim 4, wherein obtaining the parameter value of the daze degree according to the eye state information within the period of time comprises:

determining that the driver is in a daze state when the eyes of the driver are in an eye open state for a preset period of daze time according to the eye state information; and

obtaining the parameter value of the daze degree according to the eye state information within the period of time, wherein the period of time comprises the preset period of daze time.

7. The method according to claim 4, wherein obtaining the parameter value of the nap degree according to the head location information within the period of time comprises:

determining that the driver is in a nap state when the head location of the driver has a deviation degree with respect to a preset reference head location reaching a preset deviation range within a first preset period of time and returns to the preset reference head location within a second preset period of time according to the head location information; and

obtaining the parameter value of the nap degree according to the head location information within the period of time, wherein the period of time comprises the first preset period of time and the second preset period of time.

8. The method according to claim 4, wherein obtaining the parameter value of the yawning degree according to the mouth state information within the period of time comprises:

determining that the driver completes a yawn action when the time that the mouth of the driver changes from a mouth closed state to a mouth open state and then returns to the mouth closed state is within a preset time range according to the mouth state information; and

obtaining the parameter value of the yawning degree according to the mouth state information within the period of time, wherein the period of time comprises the time that the mouth of the driver changes from the mouth closed state to the mouth open state and then returns to the mouth closed state.

9. The method according to claim 4, wherein determining the distraction state detection result of the driver according to the parameter value of the index for representing the distraction state of the driver comprises:

determining that the distraction state detection result of the driver is a distraction state when any one or more of the parameter values of the indexes for representing the distraction state of the driver satisfy a predetermined distraction condition; wherein the predetermined distraction condition comprises multiple distraction level conditions;

determining that the distraction state detection result of the driver is the distraction

state when any one or more of the parameter values of the indexes for representing the distraction state of the driver satisfy the predetermined distraction condition comprises:

determining a distraction state level according to the distraction level condition satisfied by the parameter value of the index for representing the distraction state of the driver; and

taking the determined distraction state level as the distraction state detection result of the driver;

or

determining the fatigue state detection result of the driver according to the parameter value of the index for representing the fatigue state of the driver comprises:

determining that the fatigue state detection result of the driver is a fatigue state when any one or more of the parameter values of the indexes for representing the fatigue state of the driver satisfy a predetermined fatigue condition; wherein the predetermined fatigue condition comprises multiple fatigue level conditions;

determining that the fatigue state detection result of the driver is the fatigue state when any one or more of the parameter values of the indexes for representing the fatigue state of the driver satisfy the predetermined fatigue condition comprises:

determining a fatigue state level according to the fatigue level condition satisfied by the parameter value of the index for representing the fatigue state of the driver; and

taking the determined fatigue state level as the fatigue state detection result of the driver.

10. The method according to any one of claims 1 to 9, further comprising:

performing predetermined distraction action detection on the driver image to determine whether a predetermined distraction action occurs;

in response to determining that the predetermined distraction action occurs, obtaining the parameter value of the index for representing the distraction degree of the driver according to a determination result indicating whether the predetermined distraction action occurs within a period of time; and

determining a detection result of the predetermined distraction action of the driver according to the parameter value of the index for representing the distraction degree of the driver;

wherein the predetermined distraction action comprises any one or more of the following: a smoking action, a drinking action, an eating action, a calling action, an entertainment action, or a makeup action.

11. The method according to claim 10, wherein performing predetermined distraction action detection on the driver image to determine whether the predetermined distraction action occurs comprises:

extracting a feature of the driver image;

extracting multiple candidate boxes that may comprise the predetermined distraction action based on the feature;

determining an action target box based on the multiple candidate boxes, wherein the action target box comprises a local region of a face and an action interaction object; and

performing classification detection on the predetermined distraction action based on the action target box to determine whether the predetermined distraction action

occurs.

12. The method according to claim 11, wherein the local region of the face comprises any one or more of the following: a mouth region, an ear region, or an eye region;

the action interaction object comprises any one or more of the following: a container, a cigarette, a mobile phone, food, a tool, a beverage bottle, eyeglasses, or a mask; and

the action target box further comprises a hand bounding box.

13. The method according to claim 11, wherein performing predetermined distraction action detection on the driver image to determine whether the predetermined distraction action occurs comprises:

performing face detection on the driver image by means of an eighth neural network to obtain a face bounding box;

extracting feature information of the face bounding box; and

determining whether the smoking action occurs by means of the eighth neural network according to the feature information of the face bounding box.

14. The method according to claim 11, wherein performing predetermined distraction action detection on the driver image to determine whether the predetermined distraction action occurs comprises:

performing preset target object detection corresponding to the eating action/drinking action/calling action/entertainment action/makeup action on the driver image by means of a ninth neural network to obtain a bounding box of a preset target

object, wherein the preset target object comprises hands, mouth, eyes, and the action interaction object, and the action interaction object comprises any one or more types of the following: a container, food, an electronic device, or cosmetics; and

determining whether the predetermined distraction action occurs according to the bounding box of the preset target object, wherein the determination result of whether the predetermined distraction action occurs comprises one of the following: no eating action/drinking action/calling action/entertainment action/makeup action occurs; the eating action occurs; the drinking action occurs; the calling action occurs; the entertainment action occurs; and the makeup action occurs.

15. The method according to claim 11, wherein the action target box further comprises a hand bounding box;

determining whether the predetermined distraction action occurs according to the bounding box of the preset target object comprises:

determining whether the predetermined distraction action occurs according to whether the hand bounding box, a mouth bounding box, an eye bounding box, and an action interaction object bounding box are detected, whether the hand bounding box overlaps the action interaction object bounding box, the type of the action interaction object, and whether the distance between the action interaction object bounding box and the mouth bounding box or the eye bounding box satisfies a preset condition.

16. The method according to claim 15, wherein determining whether the predetermined distraction action occurs according to whether the hand bounding box overlaps the action interaction object bounding box, and whether the distance between the action

interaction object bounding box and the mouth bounding box or the eye bounding box satisfies the preset condition comprises at least one of:

in response to determining that the hand bounding box overlaps the action interaction object bounding box, the type of the action interaction object is a container or food, and the action interaction object bounding box overlaps the mouth bounding box, determining that the eating action, driving action or makeup action occurs; or

in response to determining that the hand bounding box overlaps the action interaction object bounding box, the type of the action interaction object is an electronic device, and the minimum distance between the action interaction object bounding box and the mouth bounding box is less than a first preset distance, or the minimum distance between the action interaction object bounding box and the eye bounding box is less than a second preset distance, determining that the entertainment action or calling action occurs.

17. The method according to claim 15, further comprising at least one of:

in response to determining that the hand bounding box, the mouth bounding box, and any action interaction object bounding box are not detected simultaneously, and the hand bounding box, the eye bounding box, and any action interaction object bounding box are not detected simultaneously, determining that the determination result of whether the predetermined distraction action occurs is that no eating action, drinking action, calling action, entertainment action, and makeup action is detected;

in response to determining that the hand bounding box does not overlap the action interaction object bounding box, determining that the determination result of whether the predetermined distraction action occurs is that no eating action, drinking action,

calling action, entertainment action, and makeup action is detected; or

in response to determining that the type of the action interaction object is a container or food, and the action interaction object bounding box does not overlap the mouth bounding box, and/or, the type of the action interaction object is an electronic device, and the minimum distance between the action interaction object bounding box and the mouth bounding box is not less than the first preset distance, or the minimum distance between the action interaction object bounding box and the eye bounding box is not less than the second preset distance, determining that the determination result of whether the predetermined distraction action occurs is that no eating action, drinking action, calling action, entertainment action, and makeup action is detected.

18. The method according to claim 10, further comprising:

in response to the fatigue state detection result, the distraction state detection result, and the detection result of the predetermined distraction action satisfying the predetermined alarm condition, outputting alarm information of the fatigue state detection result that satisfies the predetermined alarm condition; or

in response to the fatigue state detection result and the detection result of the predetermined distraction action satisfying the predetermined alarm condition, outputting alarm information of the fatigue state detection result that satisfies the predetermined alarm condition.

19. An electronic device, comprising:

a memory, configured to store a computer program; and

a processor, configured to execute the compute program stored in the memory,

wherein when the computer program is executed, the method according to any one of claims 1 to 18 is implemented.

20. A computer-readable storage medium having a computer program stored thereon, wherein when the computer program is executed by a processor, the method according to any one of claims 1 to 18 is implemented.