CLAIMS

1. A vehicle door unlocking method, comprising:

obtaining a distance between a target object outside a vehicle and the vehicle by means of at least one distance sensor provided in the vehicle;

in response to the distance satisfying a predetermined condition, waking up and controlling an image sensor in an image collection module provided in the vehicle to collect a first image of the target object, and collecting, by a depth sensor in the image collection module, a first depth map corresponding to the first image;

performing face recognition based on the first image and a pre-registered face feature;

updating a depth value of a depth invalidation pixel in the first depth map based on the first image to obtain a second depth map;

determining a spoofing detection result of the target object based on the first image and the second depth map; and

in response to successful face recognition and spoofing detection, sending a vehicle door unlocking instruction to at least one vehicle door lock of the vehicle.

2. The method according to claim 1, wherein the predetermined condition comprises at least one of the following:

the distance is less than a predetermined distance threshold;

a duration in which the distance is less than the predetermined distance threshold reaches a predetermined time threshold; or

the distance obtained in the duration indicates that the target object is proximate to the vehicle.

3. The method according to claim 1 or 2, wherein the at least one distance sensor comprises a Bluetooth distance sensor,

obtaining the distance between the target object outside the vehicle and the vehicle by means of the at least one distance sensor provided in the vehicle comprises:

establishing a Bluetooth pairing connection between an external device and the

Bluetooth distance sensor, and

in response to a successful Bluetooth pairing connection, obtaining a first distance between the target object with the external device and the vehicle by means of the Bluetooth distance sensor; or

wherein the at least one distance sensor comprises an ultrasonic distance sensor,

obtaining the distance between the target object outside the vehicle and the vehicle by means of the at least one distance sensor provided in the vehicle comprises:

obtaining a second distance between the target object and the vehicle by means of the ultrasonic distance sensor provided on an outside of the vehicle; or

wherein the at least one distance sensor comprises: a Bluetooth distance sensor and an ultrasonic distance sensor,

obtaining the distance between the target object outside the vehicle and the vehicle by means of the at least one distance sensor provided in the vehicle comprises: establishing the Bluetooth pairing connection between the external device and the Bluetooth distance sensor; in response to a successful Bluetooth pairing connection, obtaining the first distance between the target object with the external device and the vehicle by means of the Bluetooth distance sensor; and obtaining the second distance between the target object and the vehicle by means of the ultrasonic distance sensor, and

in response to the distance satisfying the predetermined condition, waking up and controlling the image sensor in the image collection module provided in the vehicle to collect the first image of the target object comprises: in response to the first distance and the second distance satisfying the predetermined condition, waking up and controlling the image sensor in the image collection module provided in the vehicle to collect the first image of the target object.

4. The method according to claim 3, wherein the predetermined condition comprises a first predetermined condition and a second predetermined condition,

the first predetermined condition comprises at least one of the following: the first distance is less than a predetermined first distance threshold; the duration in which the first distance is less than the predetermined first distance threshold reaches the predetermined time threshold; or the

first distance obtained in the duration indicates that the target object is proximate to the vehicle,

the second predetermined condition comprises: the second distance is less than a predetermined second distance threshold; the duration in which the second distance is less than the predetermined second distance threshold reaches the predetermined time threshold; and the second distance threshold is less than the first distance threshold; and/or

wherein in response to the first distance and the second distance satisfying the predetermined condition, waking up and controlling the image sensor in the image collection module provided in the vehicle to collect the first image of the target object comprises:

in response to the first distance satisfying the first predetermined condition, waking up a face recognition system provided in the vehicle, and

in response to the second distance satisfying the second predetermined condition, controlling the image sensor in the image collection module to collect the first image of the target object by means of a waked-up face recognition system.

5. The method according to any one of claims 2 to 4, wherein the distance sensor is an ultrasonic distance sensor; the predetermined distance threshold is determined according to a calculated distance threshold reference value and a predetermined distance threshold offset value; the distance threshold reference value represents a reference value of a distance threshold between an object outside the vehicle and the vehicle; and the distance threshold offset value represents an offset value of the distance threshold between the object outside the vehicle and the vehicle.

6. The method according to claim 5, wherein the predetermined distance threshold is equal to a difference between the distance threshold reference value and the predetermined distance threshold offset value; and/or

wherein the distance threshold reference value is a minimum value of an average distance value after the vehicle is turned off and a maximum vehicle door unlocking distance, wherein the average distance value after the vehicle is turned off represents an average value of distances between the object outside the vehicle and the vehicle within a

specified time period after the vehicle is turned off; and/or

wherein the distance threshold reference value is periodically updated.

7. The method according to any one of claims 2 to 6, wherein the distance sensor is an ultrasonic distance sensor; the predetermined time threshold is determined according to a calculated time threshold reference value and a time threshold offset value, wherein the time threshold reference value represents a reference value of a time threshold at which a distance between the object outside the vehicle and the vehicle is less than the predetermined distance threshold, and the time threshold offset value represents an offset value of the time threshold at which the distance between the object outside the vehicle and the vehicle is less than the predetermined distance threshold.

8. The method according to claim 7, wherein the predetermined time threshold is equal to a sum of the time threshold reference value and the time threshold offset value; and/or

wherein the time threshold reference value is determined according to one or more of a horizontal detection angle of the ultrasonic distance sensor, a detection radius of the ultrasonic distance sensor, an object size, and an object speed.

9. The method according to claim 8, further comprising:

determining alternative reference values corresponding to different types of objects according to different types of object sizes, different types of object speeds, the horizontal detection angle of the ultrasonic distance sensor, and the detection radius of the ultrasonic distance sensor; and

determining a maximum value among the alternative reference values corresponding to the different types of objects as the time threshold reference value.

10. The method according to claim 9,

wherein updating the depth value of the depth invalidation pixel in the first depth map based on the first image to obtain the second depth map comprises:

determining depth prediction values and associated information of a plurality of pixels in the first image based on the first image, wherein the associated information of the plurality of pixels indicates a degree of association between the plurality of pixels, and

updating the depth value of the depth invalidation pixel in the first depth map based on the depth prediction values and associated information of the plurality of pixels to obtain the second depth map.

11. The method according to claim 10, wherein updating the depth value of the depth invalidation pixel in the first depth map based on the depth prediction values and associated information of the plurality of pixels to obtain the second depth map comprises:

determining the depth invalidation pixel in the first depth map,

obtaining a depth prediction value of the depth invalidation pixel and depth prediction values of a plurality of surrounding pixels of the depth invalidation pixel from the depth prediction values of the plurality of pixels,

obtaining the degree of association between the depth invalidation pixel and the plurality of surrounding pixels of the depth invalidation pixel from the associated information of the plurality of pixels, and

determining an updated depth value of the depth invalidation value based on the depth prediction value of the depth invalidation pixel, the depth prediction values of the plurality of surrounding pixels of the depth invalidation pixel, and the degree of association between the depth invalidation pixel and the surrounding pixels of the depth invalidation pixel; and/or

wherein determining the depth prediction values of the plurality of pixels in the first image based on the first image comprises:

determining the depth prediction values of the plurality of pixels in the first image based on the first image and the first depth map; and/or

wherein determining the associated information of the plurality of pixels in the first image based on the first image comprises:

inputting the first image to a degree-of-association detection neural network for processing to obtain the associated information of the plurality of pixels in the first image.

12. The method according to claim 11, wherein determining the updated depth value of the depth invalidation value based on the depth prediction value of the depth invalidation

pixel, the depth prediction values of the plurality of surrounding pixels of the depth invalidation pixel, and the degree of association between the depth invalidation pixel and the surrounding pixels of the depth invalidation pixel comprises:

determining a depth association value of the depth invalidation pixel based on the depth prediction values of the surrounding pixels of the depth invalidation pixel and the degree of association between the depth invalidation pixel and the plurality of surrounding pixels of the depth invalidation pixel; and

determining the updated depth value of the depth invalidation pixel based on the depth prediction value and the depth association value of the depth invalidation pixel.

13. The method according to any one of claims 1 to 12, wherein updating the depth value of the depth invalidation pixel in the first depth map based on the first image to obtain the second depth map comprises:

performing target detection on the first image to obtain a region where the target object is located;

performing key point detection on an image of the region where the target object is located to obtain the key point information of the target object in the first image;

obtaining the image of the target object from the first image based on the key point information of the target object; and

updating the depth value of the depth invalidation pixel in the first depth map based on the image of the target object to obtain the second depth map.

14. The method according to any one of claims 1 to 13, wherein updating the depth value of the depth invalidation pixel in the first depth map based on the first image to obtain the second depth map comprises:

obtaining a depth map of the target object from the first depth map, and

updating the depth map of the target object based on the first image to obtain the second depth map; and/or

wherein determining the spoofing detection result of the target object based on the first image and the second depth map comprises:

inputting the first image and the second depth map to a spoofing detection neural network for processing to obtain the spoofing detection result of the target object; and/or

wherein determining the spoofing detection result of the target object based on the first image and the second depth map comprises:

performing feature extraction processing on the first image to obtain first feature information,

performing feature extraction processing on the second depth map to obtain second feature information,

performing fusion processing on the first feature information and the second feature information to obtain third feature information,

obtaining a probability that the target object is non-spoofing based on the third feature information, and

determining the spoofing detection result of the target object according to the probability that the target object is non-spoofing.

15. An electronic device, comprising:

a processor; and

a memory configured to store processor-executable instructions;

wherein the processor is configured to execute the method according to any one of claims 1 to 14.

16. A computer-readable storage medium, having computer program instructions stored thereon, wherein when the computer program instructions are executed by a processor, the method according to any one of claims 1 to 14 is implemented.

17. A computer program, comprising a computer-readable code, wherein when run in an electronic device, the computer-readable code is executed by a processor in the electrode device to implement the method according to any one of claims 1 to 14.