

CLAIMS

1. A face posture analysis method, comprising:

obtaining a face key point of a face image; and

inputting the face key point of the face image into a neural network, and obtaining face posture information of the face image output by the neural network,

wherein the neural network is obtained by using a training manner comprising:

obtaining training data from a training data set, wherein the training data comprises the face key point of the face image sample and the face posture annotation information of the face image sample;

inputting the face key point of the face image sample in the training data into a to-be-trained neural network, and obtaining face posture information of the face image sample output by the to-be-trained neural network; and

performing supervised learning on the to-be-trained neural network by using a difference between the face posture information of the face image sample output by the to-be-trained neural network and the face posture annotation information of the face image sample in the training data as guidance information.

2. The method according to claim 1, wherein the face posture information comprises at least one of:

X-axis rotation information, Y-axis rotation information, or Z-axis rotation information.

3. The method according to claim 1 or 2, wherein the obtaining a face key point of a face image comprises:

obtaining the face key point of the face image by using a convolutional neural network,

wherein the inputting the face key point of the face image into a neural

network comprises:

performing normalization processing on coordinates of the face key point of the face image, and inputting a face key point subjected to the normalization processing into the neural network.

4. The method according to any one of claims 1 to 3, wherein the neural network is obtained through pre-training based on training data that comprises a face key point of a face image sample and face posture annotation information of the face image sample,

wherein the neural network comprises at least two fully connected layers with a rectified linear unit and one fully connected layer that is used as an output layer.

5. The method according to any one of claims 2 to 4, wherein

the X-axis rotation information comprises an angle of rotation around an X-axis; and/or

the Y-axis rotation information comprises an angle of rotation around a Y-axis; and/or

the Z-axis rotation information comprises an angle of rotation around a Z-axis.

6. The method according to any one of claims 1 to 5, further comprising:

processing the face image according to the face posture information of the face image, wherein

the processing comprises at least one of face recognition, face changing processing, face beautification processing, facial makeup processing, face image rendering processing, face state detection processing, expression detection processing, fine positioning processing of organs, or driving state determination processing.

7. The method according to claim 1, wherein the training data in the training data set is generated by:

obtaining the face key point of the face image sample; and

determining the face posture annotation information of the face image sample by using a three-dimensional face model according to the face key point of the face image sample; wherein

the face key point of the face image sample and the face posture annotation information of the face image sample are used as one piece of training data in the training data set.

8. The method according to claim 7, wherein the determining face posture annotation information of the face image sample by using a three-dimensional face model according to the face key point of the face image sample comprises:

adjusting at least one parameter of the three-dimensional face model according to a gradient descent method, to optimize a sum of distances between the face key point of the face image sample and two-dimensional face key points obtained by projecting face key points of a three-dimensional face model subjected to parameter adjustment, so as to determine the face posture annotation information of the face image sample,

wherein the adjusting the at least one parameter of the three-dimensional face model comprises:

adjusting at least one of a position of the three-dimensional face model, a posture of the three-dimensional face model, or an expression of the three-dimensional face model.

9. The method according to any one of claims 1 to 8, wherein the training data in the training data set is generated by:

obtaining one piece of training data in the training data set, performing coordinate transformation on a face key point of a face image sample in the piece of training data, and performing corresponding transformation on face posture annotation information of the face image sample in the piece of training data

according to the coordinate transformation of the face key point of the face image sample; and

adding a face key point of the face image sample subjected to the coordinate transformation and face posture annotation information of the face image sample subjected to the corresponding transformation to the training data set as a new piece of training data.

10. The method according to claim 9, wherein when a face is set to a front face, both the X-axis rotation information and the Y-axis rotation information of the face key point indicate that there is no rotation of the face, and the performing coordinate transformation on a face key point of the face image sample in the piece of training data, and performing corresponding transformation on face posture annotation information of the face image sample in the piece of training data according to the coordinate transformation of the face key point of the face image sample comprises:

performing mirroring processing on an X-axis coordinate of the face key point of the face image sample in the piece of training data, and separately negating X-axis rotation information and Y-axis rotation information in the face posture annotation information of the face image sample in the piece of training data, or

wherein the performing coordinate transformation on a face key point of the face image sample in the piece of training data, and performing corresponding transformation on face posture annotation information of the face image sample in the piece of training data according to the coordinate transformation of the face key point of the face image sample comprises:

rotating coordinates of the face key point of the face image sample in the piece of training data by a predetermined angle in two dimensions, and adjusting Z-axis rotation information in the face posture annotation information of the face image sample in the piece of training data according to the predetermined angle.

11. A driving state monitoring method, comprising:

obtaining, by using a face posture analysis method according to any one of claims 1 to 10, face posture information of a face image of a driver captured by an in-vehicle camera; and

determining a driving state of the driver according to face posture information of the face image of the driver in a period of time, wherein the driving state comprises at least one of a distracted driving state or a fatigue driving state.

12. The method according to claim 11, further comprising:

determining an eye opening/closing action of the driver according to a face key point of the face image of the driver in the period of time;

the determining a driving state of a driver according to face posture information of the face image of the driver in a period of time comprises:

determining the driving state of the driver according to the face posture information of the face image of the driver in the period of time and an eye opening/closing action, or

wherein the method further comprises:

determining a mouth opening/closing action of the driver according to a face key point of the face image of the driver in the period of time; and

the determining a driving state of a driver according to face posture information of the face image of the driver in a period of time comprises:

determining the driving state of the driver according to the face posture information of the face image of the driver in the period of time and the mouth opening/closing action.

13. The method according to claim 11, further comprising:

obtaining a hand key point of the face image of the driver; and

determining a staying state of the driver's hand on a face area according to the

face key point and the hand key point of the face image of the driver in the period of time;

the determining a driving state of a driver according to the face posture information of the face image of the driver in a period of time comprises:

determining the driving state of the driver according to the face posture information of the face image of the driver in the period of time and the staying state.

14. The method according to claim 11, further comprising:

determining a face orientation of the driver according to the face key point of the face image of the driver in the period of time;

the determining a driving state of a driver according to the face posture information of the face image of the driver in a period of time comprises:

determining the driving state of the driver according to the face posture information of the face image of the driver in the period of time and the face orientation.

15. The method according to any one of claims 11 to 14, wherein after the determining the driving state of the driver, the method further comprises:

in response to the driving state of the driver satisfying a predetermined alarm condition, performing at least one of the following operations:

outputting alarm prompt information; or

sending information to a cloud server or a predetermined associated communication terminal, wherein the sent information comprises at least one of the following information: the driving state of the driver or at least one frame of face image of the driver corresponding to the driving state of the driver.

16. A face posture analysis apparatus, comprising:

a key point obtaining module, configured to obtain a face key point of a face

image; and

a posture obtaining module, configured to input the face key point of the face image into a neural network, and obtain face posture information of the face image output by the neural network,

wherein the neural network is obtained by using a training manner comprising:

obtaining training data from a training data set, wherein the training data comprises the face key point of the face image sample and the face posture annotation information of the face image sample;

inputting the face key point of the face image sample in the training data into a to-be-trained neural network, and obtaining face posture information of the face image sample output by the to-be-trained neural network; and

performing supervised learning on the to-be-trained neural network by using a difference between the face posture information of the face image sample output by the to-be-trained neural network and the face posture annotation information of the face image sample in the training data as guidance information.

17. A driving state monitoring apparatus, comprising:

obtaining, by using the face posture analysis apparatus according to claim 16, face posture information of a face image of a driver captured by an in-vehicle camera; and

a driving state determining module, configured to determine a driving state of the driver according to the face posture information of the face image of the driver in a period of time, wherein the driving state comprises at least one of a distracted driving state or a fatigue driving state.

18. An electronic device, comprising:

a memory, configured to store computer programs; and

a processor, configured to: execute the computer programs stored in the

memory, wherein the computer programs, when being executed by the processor, implement the face posture analysis method, comprising:

obtaining a face key point of a face image; and

inputting the face key point of the face image into a neural network, and obtaining face posture information of the face image output by the neural network,

wherein the neural network is obtained by using a training manner comprising:

obtaining training data from a training data set, wherein the training data comprises the face key point of the face image sample and the face posture annotation information of the face image sample;

inputting the face key point of the face image sample in the training data into a to-be-trained neural network, and obtaining face posture information of the face image sample output by the to-be-trained neural network; and

performing supervised learning on the to-be-trained neural network by using a difference between the face posture information of the face image sample output by the to-be-trained neural network and the face posture annotation information of the face image sample in the training data as guidance information.

19. A computer-readable storage medium, having computer programs stored thereon, wherein the computer programs, when being executed by a processor, implement the method according to any one of claims 1 to 15.