

LANE LINE-BASED INTELLIGENT DRIVING CONTROL METHOD AND APPARATUS, AND ELECTRONIC DEVICE

The present disclosure is Singapore national phase of International application Serial No. PCT/CN2019/087622 filed on May 20, 2019, which claims priority to Chinese Patent Application No. CN201810551908.X, filed with the Chinese Patent Office on May 31, 2018, and entitled "LANE LINE-BASED INTELLIGENT DRIVING CONTROL METHOD AND APPARATUS, AND ELECTRONIC DEVICE". The contents each of the above-referenced applications are incorporated herein by reference in their entirety for all purposes.

BACKGROUND

Lane line detection is a key technology in automatic driving and assisted driving. With this technology, lane lines on a road where a vehicle is traveling can be detected, thereby determining the current position of the vehicle and providing key information for next warning.

SUMMARY

The embodiments of the present disclosure provide a technical solution of lane line-based intelligent driving control.

The embodiments of the present disclosure provide a lane line-based intelligent driving control method, including:

- obtaining a lane line detection result of a vehicle traveling environment;

- determining, according to a traveling state of a vehicle and the lane line detection result, an estimated distance of traveling out of a lane line by the vehicle and/or estimated time of traveling out of the lane line by the vehicle; and

- performing intelligent driving control on the vehicle according to the estimated distance and/or the estimated time.

According to another aspect of the embodiments of the present disclosure, a lane line-based intelligent driving control apparatus is provided, including:

- an obtaining module, configured to obtain a lane line detection result of a vehicle traveling environment;

- a determination module, configured to determine, according to a traveling state of a vehicle and the lane line detection result, an estimated distance of traveling out of a lane line by the vehicle and/or estimated time of traveling out of the lane line by the vehicle; and

- a control module, configured to perform intelligent driving control on the vehicle according to the estimated distance and/or the estimated time.

According to yet another aspect of the embodiments of the present disclosure, an

CLAIMS

1. A lane line-based intelligent driving control method, characterized by comprising:

obtaining a lane line detection result of a vehicle traveling environment;

determining, according to a traveling state of the vehicle and the lane line detection result, an estimated distance by which the vehicle travels out of the lane line and/or estimated time during which the vehicle travels out of the lane line; and

performing intelligent driving control on the vehicle according to the estimated distance and/or the estimated time.

2. The method according to claim 1, wherein the obtaining a lane line detection result of a vehicle traveling environment comprises:

obtaining the lane line detection result by detecting the lane line in the vehicle traveling environment based on a neural network;

wherein the obtaining the lane line detection result by detecting the lane line in the vehicle traveling environment based on a neural network comprises:

performing semantic segmentation on an image comprising the vehicle traveling environment through the neural network to output a lane line probability map, the lane line probability map being used for representing a probability value that each of one or more pixel points in the image belongs to the lane line; and

determining a region where the lane line is located according to the lane line probability map, the region being included in the lane line detection result.

3. The method according to claim 2, wherein the performing semantic segmentation on an image comprising the vehicle traveling environment through the neural network to output a lane line probability map comprises:

performing feature extraction on the image through the neural network to obtain a feature map; and

performing semantic segmentation on the feature map through the neural network to obtain lane line probability maps of N lane lines, a pixel value of each pixel point in the lane line probability map of each lane representing the probability value that the corresponding pixel point in the image belongs to the lane line, and the value of N being an integer greater than 0.

4. The method according to claim 3, wherein the performing semantic segmentation on the feature map through the neural network to obtain lane line probability maps of N lane lines comprises:

performing semantic segmentation on the feature map through the neural network to obtain probability maps of N+1 channels, the N+1 channels respectively corresponding to the N lane lines and a background; and

obtaining the lane line probability maps of the N lane lines from the probability maps of the N+1 channels.

5. The method according to claim 4, wherein

when the value of N is 2, the N+1 channels correspond to a background, a left lane line, and a right lane line, respectively; or

when the value of N is 3, the N+1 channels correspond to the background, the left lane line, a middle lane line, and the right lane line, respectively; or

when the value of N is 4, the N+1 channels correspond to the background, a lane line at the left of the left lane line, the left lane line, the right lane line, and a lane line at the right of the right lane line, respectively.

6. The method according to any one of claims 3 to 5, wherein the determining a region where the lane line is located according to the lane line probability map of one lane line comprises:

selecting pixel points having a probability value greater than a first preset threshold from the lane line probability map of the lane line;

performing maximum connected region search in the lane line probability map based on the selected pixel points to locate a set of pixel points belonging to the lane line; and

determining the region where the lane line is located based on the set of pixel points belonging to the lane line.

7. The method according to claim 6, wherein the determining the region where the lane line is located based on the set of pixel points belonging to the lane line comprises:

determining a sum of the probability values of all the pixel points in the set of pixel points belonging to the lane line to obtain a confidence score of the lane line; and

when the confidence score is greater than a second preset threshold, using the region where

the set of pixel points is formed as the region where the lane line is located.

8. The method according to any one of claims 2 to 7, further comprising:

preprocessing an original image comprising the vehicle traveling environment; and

performing the semantic segmentation on the image comprising the vehicle traveling environment through the neural network comprises: performing, through the neural network, the semantic segmentation on the image obtained by the preprocessing, and / or

the determining, according to a traveling state of a vehicle and the lane line detection result, an estimated distance by which the vehicle travels out of a lane line and/or estimated time during which the vehicle travels out of the lane line comprises:

performing curve fitting on the pixel points in the region where each of the lane lines is located, to obtain lane line information of each of the lane lines, the lane line information comprising a distance from at least one point on the lane line to the vehicle; and

determining the estimated distance by which the vehicle travels out of the lane line and/or the estimated time during which the vehicle travels out of the lane line according to the traveling state of the vehicle and the lane line information of the lane line.

9. The method according to claim 8, wherein the performing curve fitting on the pixel points in the region where the lane line is located, to obtain the lane line information of the lane line comprises:

selecting multiple pixel points from the region where one of the lane lines is located;

converting the multiple pixel points from a camera coordinate system where the camera is located into a world coordinate system, to obtain coordinates of the multiple pixel points in the world coordinate system; and

performing curve fitting on the multiple pixel points in the world coordinate system according to the coordinates of the multiple pixel points in the world coordinate system, to obtain the lane line information of the lane line, and / or

after obtaining the lane line information of the lane line,

performing a filtering with respect to parameters in the lane line information of the lane line; and

the determining the estimated distance by which the vehicle travels out of the lane line

and/or the estimated time during which the vehicle travels out of the lane line according to the traveling state of the vehicle and the lane line information of the lane line comprises: determining the estimated distance by which the vehicle travels out of the lane line and/or the estimated time during which the vehicle travels out of the lane line according to the traveling state of the vehicle and lane line information of the lane line obtained by the filtering.

10. The method according to claim 9, wherein the performing a filtering with respect to parameters in the lane line information of the lane line comprises:

performing Kalman filtering on parameter values of the parameters in the lane line information according to the parameter values of the parameters in the lane line information and parameter values of parameters in historical lane line information of the lane line obtained based on a previous frame image, the previous frame image being a frame image with detection timing prior to that of the image in a video including the image.

11. The method according to claim 10, wherein before performing Kalman filtering on the parameter values of the parameters in the lane line information, the method further comprises:

selecting the lane line information in which the parameter values of the parameters in the lane line information change with respect to the parameter values of corresponding parameters in the historical lane line information and the differences between the parameter values of the parameters in the lane line information and the parameter values of the corresponding parameters in the historical lane line information are less than a third preset threshold, to serve as effective lane line information for Kalman filtering.

12. The method according to any one of claims 8 to 11, wherein the determining, according to the traveling state of the vehicle and the lane line detection result, the estimated distance by which the vehicle travels out of the lane line comprises:

determining an estimated distance between the vehicle and the lane line based on a position of the vehicle in a world coordinate system and the lane line information of the lane line, the traveling state of the vehicle comprising the position of the vehicle in the world coordinate system, and / or

determining, according to the traveling state of the vehicle and the lane line detection result, the estimated time during which the vehicle travels out of the lane line comprises:

determining the estimated time during which the vehicle travels out of the lane line

according to a speed of the vehicle, a position of the vehicle in a world coordinate system, and the lane line information of the lane line, the traveling state of the vehicle comprising the speed of the vehicle and the position of the vehicle in the world coordinate system.

13. The method according to any one of claims 1 to 12, wherein the performing intelligent driving control on the vehicle according to the estimated distance and/or the estimated time comprises:

comparing the estimated distance and/or the estimated time with at least one predetermined threshold; and

performing, when a result of the comparison satisfies one or more preset conditions, intelligent driving control corresponding to the satisfied preset conditions, the intelligent driving control comprising: automatic driving control and/or assisted driving control.

14. The method according to claim 13, wherein the automatic driving control comprises any one or more of the following: braking, deceleration, traveling direction changing, lane line keeping, and driving mode switching control, and / or

performing the assisted driving control on the vehicle comprises: performing lane line departure warning; or, performing lane line keeping prompt.

15. The method according to claim 13 or 14, wherein when there are multiple preset conditions, the degrees of the intelligent driving control corresponding to the multiple preset conditions are gradually increased.

16. The method according to claim 15, wherein the performing, when a result of the comparison satisfies one or more preset conditions, intelligent driving control corresponding to the satisfied preset conditions comprises:

performing lane line departure prompt on the vehicle when the estimated distance is less than or equal to a fourth preset threshold and is greater than a fifth preset threshold; or

performing lane line departure prompt on the vehicle when the estimated time is less than or equal to a sixth preset threshold and is greater than a seventh preset threshold; or

performing lane line departure prompt on the vehicle when the estimated distance is less than or equal to the fourth preset threshold and is greater than the fifth preset threshold, and the estimated time is less than or equal to the sixth preset threshold and is greater than the seventh preset threshold;

wherein the lane line departure warning comprises the lane line departure prompt; the fifth preset threshold is less than the fourth preset threshold, and the seventh preset threshold is less than the sixth preset threshold.

17. The method according to claim 16, wherein the performing, when a result of the comparison satisfies one or more preset conditions, intelligent driving control corresponding to the satisfied preset conditions further comprises:

performing automatic driving control and/or lane line departure alerting on the vehicle when the estimated distance is less than or equal to the fifth preset threshold; or

performing automatic driving control and/or lane line departure alerting on the vehicle when the estimated time is less than or equal to the seventh preset threshold; or

performing automatic driving control and/or lane line departure alerting on the vehicle when the estimated distance is less than or equal to the fifth preset threshold and the estimated time is less than or equal to the seventh preset threshold;

wherein the lane line departure warning comprises the lane line departure alerting.

18. The method according to claim 17, wherein

the performing automatic driving control and/or lane line departure alerting on the vehicle when the estimated distance is less than or equal to the fifth preset threshold comprises: performing automatic driving control and/or lane line departure alerting on the vehicle when the estimated distances determined based on the image and a historical frame image are less than or equal to the fifth preset threshold, the historical frame image comprising at least one frame image with detection timing prior to that of the image in a video including the image; or

the performing automatic driving control and/or lane line departure alerting on the vehicle when the estimated time is less than or equal to the seventh preset threshold comprises: performing automatic driving control and/or lane line departure alerting on the vehicle when the estimated times determined based on the image and the historical frame image are less than or equal to the seventh preset threshold; or

the performing automatic driving control and/or lane line departure alerting on the vehicle when the estimated distance is less than or equal to the fifth preset threshold and the estimated time is less than or equal to the seventh preset threshold comprises: performing automatic driving control and/or lane line departure alerting on the vehicle when the estimated distances

determined based on the image and the historical frame image are less than or equal to the fifth preset threshold, and the estimated times determined based on the image and the historical frame image are less than or equal to the seventh preset threshold.

19. An electronic device, comprising:

a memory, configured to store a computer program; and

a processor, configured to execute the computer program stored in the memory, and implement the method according to any one of claims 1 to 18 when the computer program is executed.

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.