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(54) OBSTACLE AVOIDANCE METHOD AND SYSTEM DURING AUTOMATIC DRIVING OF VEHICLE, AND VEHICLE

(57) Disclosed are an obstacle avoidance method and system during automatic driving of a vehicle, and the vehicle. The method comprises: providing a road environment model within a pre-set range near a vehicle (S1); if there are a plurality of obstacles in the current driving lane within the pre-set range, acquiring, according to the road environment model, the position and size of a first adjacent obstacle (A), the position and size of a second adjacent obstacle (B), the width of the current driving lane and the obstacle distance between the first adjacent obstacle (A) and the second adjacent obstacle (B) in a driving direction of the current driving lane, and acquiring the speed of the vehicle (S2); determining, according to the position and size of the first obstacle (A), the position and size of the second obstacle (B), the speed of the vehicle and the obstacle distance, whether the vehicle can bypass the first adjacent obstacle (A) and the second adjacent obstacle (B) in the current driving lane and pass (S3); and carrying out obstacle avoidance control on the vehicle (S4). Whether the vehicle can pass is determined according to the positions and sizes of the obstacles on the current driving road, and thus the vehicle is controlled.

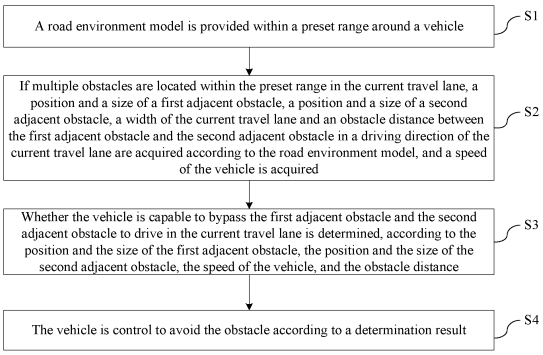

FIG. 1

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Description

CROSS REFERENCE OF RELATED APPLICATION

[0001] This application is based on and claims priority to Chinese Patent Application No. 201811637024.2, filed on December 29, 2018, and Chinese Patent Application No. 201811637022.3, filed December 29, 2018, both of which are hereby incorporated by reference in their entireties.

FIELD

[0002] The present application relates to the technical field of vehicle automatic driving, and in particular to a method and a system for avoiding an obstacle in a vehicle automatic driving process and a vehicle.

BACKGROUND

[0003] Vehicle driverless technology refers to sensing a road environment through a vehicle-mounted sensing system, automatically planning a driving route, and controlling the vehicle to drive. When the vehicle is automatically driven, if an obstacle is located in the current travel lane, obstacle information needs to be acquired and the vehicle is controlled to avoid the obstacle. Therefore, there is a need for a technique for avoiding obstacles in an autonomous driving process.

SUMMARY

[0004] In view of the above, a first object of the present application is to provide a method for avoiding an obstacle in a vehicle automatic driving process. The method can determine whether the vehicle can pass a current lane according to a position and a size of the obstacle in the current lane, so as to control the vehicle to drive.

[0005] To achieve the above object, technical solutions of the present application are implemented as follows.

[0006] A method for avoiding an obstacle in a vehicle automatic driving process includes: providing a road environment model within a preset range around a vehicle, wherein the road environment model includes a lane position, a lane width, and a size and a position of the obstacle within the preset range around the vehicle; in a case of a plurality of obstacles within the preset range in a current travel lane, acquiring a position and a size of a first adjacent obstacle, a position and a size of a second adjacent obstacle, a width of the current travel lane, and an obstacle distance between the first adjacent obstacle and the second adjacent obstacle in a driving direction of the current travel lane, and acquiring a speed of the vehicle; and determining whether the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle, the speed of the vehicle, and the obstacle distance; and controlling the vehicle to avoid the obstacle according to a determination result, wherein the first adjacent obstacle is an obstacle closest to the vehicle in the driving direction of the current travel lane, and the second adjacent obstacle is an obstacle closest to the first adjacent obstacle in the driving direction of the current travel lane.

[0007] In a possible implementation, the controlling the vehicle to avoid the obstacle according to a determination result includes: in a case that the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, controlling the vehicle to avoid the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane.

[0008] In a possible implementation, the controlling the vehicle to avoid the obstacle according to a determination result further includes: in a case that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, controlling the vehicle to change a lane to avoid the obstacle.

[0009] In a possible implementation, the determining whether the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle, the speed of the vehicle and the obstacle distance includes: acquiring a passage width at the first adjacent obstacle according to the position and the size of the first adjacent obstacle and the width of the current travel lane; determining that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the passage width at the first adjacent obstacle is less than the first preset safe passage width; acquiring a passage width at the second adjacent obstacle according to the position and the size of the second adjacent obstacle and the width of the current travel lane, in a case that the passage width at the first adjacent obstacle is greater than the first preset safe passage width; determining that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the passage width at the second adjacent obstacle is less than the first preset safe passage width; acquiring a vehicle position through the first adjacent obstacle and a vehicle position through the second adjacent obstacle, in a case that the passage width at the second adjacent obstacle is greater than the first preset safe passage width; determining whether the vehicle is capable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, according to the vehicle position through the first adjacent obstacle, the vehicle position through the second adjacent obstacle, the speed of the vehicle, and the obstacle distance; determining that the vehicle is ca-

pable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the vehicle is capable to drive from the vehicle location through the first adjacent obstacle to the vehicle location through the second adjacent obstacle; and determining that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the vehicle is incapable to drive from the vehicle location through the first adjacent obstacle to the vehicle location through the second adjacent obstacle.

[0010] In a possible implementation, the determining whether the vehicle is capable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, according to the vehicle position through the first adjacent obstacle, the vehicle position through the second adjacent obstacle, the speed of the vehicle, and the obstacle distance includes: setting the vehicle position through the first adjacent obstacle as a starting point, and the vehicle position through the second adjacent obstacle as an end point, determining whether the vehicle is capable to drive at a constant speed or a reduced speed from the start point to the end point at the obstacle distance; determining that the vehicle is capable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, if the vehicle is capable to drive at the constant speed or at the reduced speed from the starting point to the end point at the obstacle distance; and determining that the vehicle is incapable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, if the vehicle is incapable to drive at the constant speed or at the reduced speed from the starting point to the end point at the obstacle distance.

[0011] In a possible implementation, after the providing a road environment model within a preset range around the vehicle, the method further includes: acquiring the position and the size of the first adjacent obstacle, the position and size of the second adjacent obstacle, the width of the current travel lane according to the road environment model, in the case of the plurality of obstacles within the preset range in the current travel lane; acquiring a comprehensive passage width, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle and the width of the current travel lane; controlling the vehicle to straight drive between the first adjacent obstacle and the second adjacent obstacle, in a case that the comprehensive passage width is less than the second preset safe passage width; wherein in a case that the first adjacent obstacle and the second adjacent obstacle are both close to a same side of the current travel lane, the comprehensive passage width is a smaller value of a passage width at the first adjacent obstacle and a passage width at the second adjacent obstacle; and in a case that the first adjacent obstacle and the second adjacent obstacle are close to different sides of the current travel lane, the comprehensive passage width is a shortest distance between the first adjacent obstacle and the second adjacent obstacle in a left-right direction of the current travel lane.

[0012] In a possible implementation, after the providing the road environment model within the preset range around the vehicle, the method further includes: in a case of one obstacle within the preset range in the current travel lane, acquiring a position and a size of the obstacle according to the road environment model, acquiring a lane width of the current travel lane; acquiring a passage width at the obstacle according to the position and the size of the obstacle and the width of the current travel lane; and controlling the vehicle to avoid the obstacle in the current travel lane, in a case that the passage width at the obstacle is greater than a third preset safe passage width.

[0013] In a possible implementation, the providing a road environment model within a preset range around the vehicle includes: acquiring position information of the vehicle, a position and a size of the obstacle in the current travel lane, and information on the lane position and the lane width within the preset range around the vehicle; and generating the road environment model according to the position information of the vehicle, the position and the size of the obstacle in the current travel lane, and the information on the lane position and the lane width within the preset range around the vehicle.

[0014] Compared with the conventional technology, the method for avoiding the obstacle in the vehicle automatic driving process has the following advantages.

[0015] The method for avoiding the obstacle in the vehicle automatic driving process includes: firstly, generating a road environment model within a preset range around the vehicle. Lane lines of all lanes, and a position and a size of an obstacle in the current travel lane are provided in the road environment model. When multiple obstacles are located within an effective detection range of the current lane, whether the vehicle is capable to bypass two obstacles to drive in the current travel lane is determined, according to the passage widths of the two obstacles closest to the vehicle, the obstacle distance between the two obstacles in a driving direction of the vehicle, and the speed of the vehicle, so as to control the vehicle to drive. When only one obstacle is located within the effective detection range of the current travel lane, whether a passage width at the obstacle is available for the vehicle to avoid the obstacle is determined, so as to control the vehicle to drive.

[0016] Another object of the present application is to provide a system for avoiding an obstacle in a vehicle automatic driving process. The system can determine whether the vehicle can pass the current travel lane according to a position and a size of the obstacle in the current travel lane, so as to control the vehicle to drive.

[0017] To achieve the above object, the technical solutions of the present application are implemented as follows.

[0018] A system for avoiding an obstacle in a vehicle automatic driving process includes: a road environment model providing module configured to provide a road environment model within a preset range around a vehicle, wherein the road environment model includes a lane position, a lane width, and a size and a position of the obstacle within the preset range around the vehicle; the control module configured to in a case that a plurality of obstacles within the preset range in a current travel lane is determined according to the road environment model, acquire, according to the road environment model, a position and a size of a first adjacent obstacle, a position and a size of a second adjacent obstacle, a width of the current travel lane, and an obstacle distance between the first adjacent obstacle and the second adjacent obstacle in a driving direction of the current travel lane, and acquire a speed of the vehicle; determine whether the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle, the speed of the vehicle and the obstacle distance; and control the vehicle to avoid the obstacle according to a determination result, wherein the first adjacent obstacle is an obstacle closest to the vehicle in the driving direction of the current travel lane, and the second adjacent obstacle is an obstacle closest to the first adjacent obstacle in the driving direction of the current travel lane.

[0019] In a possible implementation, the control module is further configured to control the vehicle to avoid the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle in the current travel lane.

[0020] In a possible implementation, the control module is further configured to control the vehicle to change a lane to avoid the obstacle, in a case that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane.

[0021] In a possible implementation, the control module is further configured to acquire a passage width at the first adjacent obstacle according to the position and the size of the first adjacent obstacle and the width of the current travel lane; determine that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the passage width at the first adjacent obstacle is less than the first preset safe passage width; acquire a passage width at the second adjacent obstacle according to the position and the size of the second adjacent obstacle and the width of the current travel lane, in a case that the passage width at the first adjacent obstacle is greater than the first preset safe passage width; determine that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the passage width at the second adjacent obstacle is less than the first preset safe passage width; acquire a vehicle position through the first adjacent obstacle and a vehicle position through the second adjacent obstacle, in a case that the passage width at the second adjacent obstacle is greater than the first preset safe passage width; determine whether the vehicle is capable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, according to the vehicle position through the first adjacent obstacle, the vehicle position through the second adjacent obstacle, the speed of the vehicle, and the obstacle distance; determine that the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the vehicle is capable to drive from the vehicle location through the first adjacent obstacle to the vehicle location through the second adjacent obstacle; and determine that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the vehicle is incapable to drive from the vehicle location through the first adjacent obstacle to the vehicle location through the second adjacent obstacle.

[0022] In a possible implementation, the control module is further configured to set the vehicle position through the first adjacent obstacle as a starting point, and the vehicle position through the second adjacent obstacle as an end point; determine whether the vehicle is capable to drive at a constant speed or a reduced speed from the starting point to the end point at the obstacle distance; determine that the vehicle is capable to drive from the vehicle location through the first adjacent obstacle to the vehicle location through the second adjacent obstacle, in a case that the vehicle is capable to drive at the constant speed or the reduced speed from the start point to the end point at the obstacle distance; and determine that the vehicle is incapable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, in a case that the vehicle is incapable to drive at the constant speed or at the reduced speed from the starting point to the end point at the obstacle distance.

[0023] In a possible implementation, the control module is further configured to acquire the position and the size of the first adjacent obstacle, the position and size of the second adjacent obstacle, the width of the current travel lane according to the road environment model, in the case of the plurality of obstacles within the preset range in the current travel lane; acquire a comprehensive passage width, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle and the width of the current travel lane; and control the vehicle to straight drive between the first adjacent obstacle and the second adjacent obstacle, in a case that the comprehensive passage width is less than a second preset safe passage width,

wherein in a case that the first adjacent obstacle and the second adjacent obstacle are both close to a same side of the current travel lane, the comprehensive passage width is a smaller value of a passage width at the first adjacent obstacle and a passage width at the second adjacent obstacle; and in a case that the first adjacent obstacle and the second adjacent obstacle are close to different sides of the current travel lane, the comprehensive passage width is a shortest distance between the first adjacent obstacle and the second adjacent obstacle in a left-right direction of the current travel lane.

[0024] In a possible implementation, the control module is further configured to in a case of one obstacle within the preset range in the current travel lane, acquire a position and a size of the obstacle; acquire a passage width at the obstacle according to the position and the size of the obstacle and the width of the current travel lane; and control the vehicle to change a lane, in a case that the passage width at the obstacle is less than a second preset safe passage width.

[0025] The system for avoiding the obstacle in the vehicle automatic driving process has the same advantage over the conventional technology as the method for avoiding the obstacle in the vehicle automatic driving process, which will not be further described herein.

[0026] Another object of the present application is to provide a vehicle. The vehicle may determine whether a current travel lane can be passed, according to a position and a size of an obstacle in the current travel lane.

[0027] To achieve the above object, the technical solutions of the present application are implemented as follows.

[0028] A vehicle is provided, in which the system for avoiding the obstacle in the vehicle automatic driving process as described in the above embodiment is applied.

[0029] The vehicle has the same advantage over the conventional technology as the system for avoiding the obstacle in the vehicle automatic driving process, which will not be further described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The accompanying drawings, which form a part of this application, serve to provide a further understanding of the present application, and are intended to be illustrative of the present application and are not intended to be unduly limiting of this application. In the drawings:

FIG. 1 is a flowchart of a method for avoiding an obstacle in a vehicle automatic driving process according to an embodiment of the present application;

FIG. 2 is a schematic diagram of two obstacles closest to an ego vehicle in a current travel lane according to an embodiment of the present application;

FIG. 3 is a flowchart of a method for avoiding an obstacle in a vehicle automatic driving process according to an embodiment of the present application;

FIG. 4 is a schematic diagram of two obstacles closest to an ego vehicle in a current travel lane according to another embodiment of the present application;

FIG. 5 is a schematic diagram of two obstacles closest to an ego vehicle in a current travel lane according to yet another embodiment of the present application;

FIG. 6 is a schematic diagram of one obstacle in a current travel lane according to an embodiment of the present application; and

FIG. 7 is a block diagram of a system for avoiding an obstacle in a vehicle automatic driving process according to an embodiment of the present application.

DETAILED DESCRIPTION

[0031] It should be noted that, without conflict, the embodiments and features in the present application may be combined with each other.

[0032] The present application will now be described in detail with reference to the accompanying drawings.

[0033] FIG. 1 is a flow chart of a method for avoiding an obstacle in a vehicle automatic driving process according to an embodiment of the present application.

[0034] As shown in FIG. 1, a method for avoiding an obstacle in a vehicle automatic driving process according to an embodiment of the present application includes the following steps.

[0035] In S1, a road environment model is provided within a preset range around a vehicle. The road environment model includes a lane position and a lane width, and a size and a position of the obstacle within the preset range around the vehicle.

[0036] In an embodiment of the present application, the step S1 specifically includes: acquiring position information of the vehicle, a position and a size of an obstacle in a current travel lane, and information on a lane position and a lane width within the preset range around the vehicle; and generating the road environment model according to the position information of the vehicle, the position and the size of the obstacle in the current travel lane, and the information on the lane position and the lane width within the preset range around the vehicle.

[0037] In particular, the vehicle is provided with an environmental sensing system. Instead of the driver sensory system, the environmental sensing system acquire, by different sensors, current driving environment information, such as, a road, the location of the vehicle, and the size and the location of the obstacle. The above environment information is screened, correlated, tracked,

filtered and the like, so as to obtain more accurate information such as road information, and the position and the size of the object target. Finally, the road environment model is generated. The road environment model outputs in real time information on the lane position and lane width within the preset range (e.g., 200 meters) behind and before the vehicle, as well as the sizes and the positions of all vehicles and obstacles within this range.

[0038] In S2, if multiple obstacles are located within the preset range in the current travel lane, a position and a size of a first adjacent obstacle, a position and a size of a second adjacent obstacle, a width of the current travel lane and an obstacle distance between the first adjacent obstacle and the second adjacent obstacle in a driving direction of the current travel lane are acquired according to the road environment model, and a speed of the vehicle is acquired. The first adjacent obstacle is an obstacle closest to the vehicle in the driving direction of the current travel lane, and the second adjacent obstacle is an obstacle closest to the first adjacent obstacle in the driving direction of the current travel lane.

[0039] FIG. 2 is a schematic diagram of two obstacles closest to an ego vehicle in the current travel lane according to an embodiment of the present application. As shown in FIG. 2, in an embodiment of the present application, the obstacle distance between the first adjacent obstacle A and the second adjacent obstacle B is L1.

[0040] In S3, whether the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane is determined, according to the position and the size of the first adjacent obstacle A, the position and the size of the second adjacent obstacle B, the speed of the vehicle, and the obstacle distance L1.

[0041] In an embodiment of the present application, the step S3 specifically includes the following steps.

[0042] In S3-1: a passage width D1 at the first adjacent obstacle A is acquired according to the position, the size of the first adjacent obstacle A and the width of the current travel lane.

[0043] In S3-2, if the passage width D1 at the first adjacent obstacle A is less than a first preset safe passage width, it is determined that the vehicle is incapable to bypass the first adjacent obstacle A and the second adjacent obstacle B to drive in the current travel lane. The first preset safe passage width is set to ensure that the vehicle can safely pass through a road with the obstacle. For example, the first preset safe passage width is 2.8m (a vehicle width is 2m, and a redundancy width threshold is 0.8m).

[0044] In S3-3, if the passage width D1 at the first adjacent obstacle A is greater than the first preset safe passage width, a passage width D2 at the second adjacent obstacle B is acquired according to the position and the size of the second adjacent obstacle B and the width of the current travel lane.

[0045] In S3-4, if the passage width D2 at the second adjacent obstacle B is less than the first preset safe passage width, it is determined that the vehicle is incapable to bypass the first adjacent obstacle A and the second adjacent obstacle B to drive in the current travel lane.

[0046] In S3-5, if the passage width at the second adjacent obstacle B is greater than the first preset safe passage width, a vehicle position passing through the first adjacent obstacle A and a vehicle position passing through the second adjacent obstacle B are obtained.

[0047] In S3-6, according to the vehicle position passing through the first adjacent obstacle A, the vehicle position passing through the second adjacent obstacle B, the speed of the vehicle and the obstacle distance L1, it is determined whether the vehicle can is capable to drive from the vehicle position passing through the first adjacent obstacle A to the vehicle position passing through the second adjacent obstacle B.

[0048] In an embodiment of the present application, the steps S3-6 specifically include the following steps.

[0049] In S3-6-1,: the vehicle position passing through the first adjacent obstacle A is set as a starting point, the vehicle position passing through the second adjacent obstacle B is set as an end point, and it is determined whether the vehicle is capable to drive at a constant speed or a reduced speed from the start point to the end point at the obstacle distance.

[0050] Specifically, when the first adjacent obstacle A and the second adjacent obstacle B are close to different sides of the current travel lane (as shown in FIG. 2), the starting point is an intermediate point of a passable road (with a lane width D1) of the current travel lane at a boundary point of the first adjacent obstacle A in the driving direction; and the end point is an intermediate point of a passable road (with a lane width D2) of the current travel lane at a closest point of the second adjacent obstacle B in the driving direction.

[0051] If the first adjacent obstacle A and the second adjacent obstacle B are close to the same side of the current driving road, the starting point is similarly an intermediate point of a passable road (with a lane width D1) of the current travel lane at a boundary point of the first adjacent obstacle A in the driving direction; and the end point is an intermediate point of a passable road (with a lane width D2) of the current travel lane at a closest point of the second adjacent obstacle B in the driving direction.

[0052] In S3-6-2, it is determined that the vehicle is capable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, if the vehicle is capable to drive at the constant speed or at the reduced speed from the starting point to the end point at the obstacle distance.

[0053] When the first adjacent obstacle A and the second adjacent obstacle B are close to different sides of the left side and the right side of the current travel lane (as shown in FIG. 2), in the case that the speed of the vehicle is controlled, whether the vehicle can drive from the starting point to the end point is determined by controlling the wheel to turn to the obstacle distance L1. Sec-

ondly, in the case of controlling the vehicle to decelerate, whether the vehicle can drive from the starting point to the end point is determined by controlling the wheel to turn to the obstacle distance L1. That is, when the speed of the vehicle is not so fast or the obstacle distance L1 is large, the vehicle may avoid the first adjacent obstacle A and the second adjacent obstacle B.

[0054] When the first adjacent obstacle A and the second adjacent obstacle B are close to the same side of the left side and the right side of the current driving road, it is only necessary to ensure that the vehicle can pass through a position of the smaller one of the passage width at the first adjacent obstacle A and the passage width at the second adjacent obstacle B, without considering the obstacle distance L1.

[0055] In S3-6-3, if the vehicle is incapable to drive at the constant speed or at the reduced speed from the starting point to the end point at the obstacle distance, it is determined that the vehicle is incapable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle.

[0056] In S3-7, if it is determined that the vehicle is capable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, it is determined that the vehicle is capable to avoid the first and second adjacent obstacles to drive in the current travel lane.

[0057] In S3-8, if it is determined that the vehicle is incapable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, it is determined that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle in the current travel lane.

[0058] In S4, the vehicle is control to avoid the obstacle according to a determination result.

[0059] As shown in FIG. 3, in an embodiment of the present invention, the step S4 (i.e., the vehicle is control to avoid the obstacle according to a determination result) further includes: step S4-1: if the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, controlling the vehicle to avoid the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane.

[0060] Further, as shown in FIG. 3, the step S4 (i.e., the vehicle is control to avoid the obstacle according to a determination result) further includes: step S4-2, if the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, controlling the vehicle to change a lane to avoid the obstacle.

[0061] In an embodiment of the present application, after the step S1, the method further includes the following steps.

[0062] If there are multiple obstacles within the preset range in the current travel lane, the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle and the width of the current travel lane are acquired according to the road environment model.

[0063] A comprehensive passage width is acquired according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle, and the width of the current travel lane.

[0064] FIG. 4 is a schematic diagram of two obstacles closest to an ego vehicle in a current travel lane according to another embodiment of the present application. As shown in FIG. 4, when the first adjacent obstacle A and the second adjacent obstacle B are close to different sides of the left side and the right side of the current travel lane, the comprehensive passage width Dz is a shortest distance between the first adjacent obstacle A and the second adjacent obstacle B in the current travel lane in a direction perpendicular to the driving direction. When Dz > the second preset safe passage width, the vehicle is controlled to straight drive between the first adjacent obstacle A and the second adjacent obstacle B.

[0065] FIG. 5 is a schematic diagram of two obstacles closest to an ego vehicle in a current travel lane according to yet another embodiment of the present application. As shown in FIG. 5, when the first adjacent obstacle A and the second adjacent obstacle B are both close to the same side of the current travel lane, the comprehensive passage width is a smaller one of the first passage width D1 and the second passage width D2. In this example, the comprehensive passage width is D1, and the vehicle is controlled to straight drive between the first adjacent obstacle A and the second adjacent obstacle B.

[0066] If the comprehensive passage width is greater than the second preset safe passage width, the vehicle is controlled to straight drive between the first adjacent obstacle and the second adjacent obstacle. The second preset safe passage width is set to ensure that the vehicle can safely pass through the road at the obstacle. In an example, the second preset safe passage width is 2.8m (a vehicle width is 2m, and a redundancy width threshold is 0.8m).

[0067] FIG. 6 is a schematic diagram of one obstacle in a current travel lane according to an embodiment of the present application. As shown in FIG. 6, in an embodiment of the present application, after the step S1, the method further includes: if one obstacle M is located in the current travel lane within the preset range, a position and a size of the obstacle, and the lane width of the current travel lane are acquired. According to the position and the size of the obstacle M and the lane width of the current travel lane, a passage width D3 at the obstacle M is acquired. If D3 is greater than the third preset safe passage width, the vehicle is controlled to avoid the obstacle M in the current lane. In an example, the third preset safe passage width is 2.8m (the vehicle width is 2m, and the redundancy width threshold is 0.8m).

[0068] The method for avoiding the obstacle in the vehicle automatic driving process includes: firstly, generating a road environment model within a preset range

around the vehicle. Lane lines of all lanes, and a position and a size of an obstacle in the current travel lane are provided on the road environment model. When multiple obstacles are located in the effective detection range of the current lane, whether the vehicle is capable to bypass two obstacles to drive in the current travel lane is determined, according to the passage widths of the two obstacles closest to the vehicle, the obstacle distance between the two obstacles in a driving direction of the vehicle, and the speed of the vehicle, so as to control the vehicle to drive. When only one obstacle is located within the effective detection range of the current travel lane, whether a passage width at the obstacle is available for the vehicle to avoid the obstacle is determined, so as to control the vehicle to drive.

[0069] FIG. 7 is a block diagram of a system for avoiding an obstacle in a vehicle automatic driving process according to an embodiment of the present application. As shown in FIG. 7, a system for avoiding an obstacle in a vehicle automatic driving process according to an embodiment of the present application includes a road environment model providing module 610 and a control module 620.

[0070] The road environment model providing module 610 is configured to provide a road environment model within a preset range around the vehicle. The road environment model includes a lane location and a lane width, and a size and a position of the obstacle within a preset range around the vehicle. The control module 620 is configured to when multiple obstacles within the preset range in a current travel lane are determined according to the road environment model, acquire, according to the road environment model, a position and a size of a first adjacent obstacle, a position and a size of a second adjacent obstacle, a width of the current travel lane, and an obstacle distance between the first adjacent obstacle and the second adjacent obstacle in a driving direction of the current travel lane, and acquire a speed of the vehicle; determine whether the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle, the speed of the vehicle and the obstacle distance; and control the vehicle to avoid the obstacle according to a determination result. The first adjacent obstacle is an obstacle closest to the vehicle in the driving direction of the current travel lane, and the second adjacent obstacle is an obstacle closest to the first adjacent obstacle in the driving direction of the current travel lane.

[0071] In an embodiment of the present application, the control module 620 is specifically configured to control the vehicle to avoid the first adjacent obstacle and the second adjacent obstacle in the current travel lane when the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle in the current travel lane.

[0072] In an embodiment of the present application, the control module 620 is specifically configured to control the vehicle to change a lane to avoid the obstacle, when the vehicle is incapable to bypass the first and second adjacent obstacles to drive in the current travel lane.

[0073] In an embodiment of the present application, the control module 620 is specifically configured to obtain a passage width at the first adjacent obstacle according to the position and the size of the first adjacent obstacle and the width of the current travel lane; determine that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the passage width at the first adjacent obstacle is less than the first preset safe passage width; acquire a passage width at the second adjacent obstacle according to the position and the size of the second adjacent obstacle and the width of the current travel lane, in a case that the passage width at the first adjacent obstacle is greater than the first preset safe passage width; determine that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the passage width at the second adjacent obstacle is less than the first preset safe passage width; acquire a vehicle position through the first adjacent obstacle and a vehicle position through the second adjacent obstacle, in a case that the passage width at the second adjacent obstacle is greater than the first preset safe passage width; determine whether the vehicle is capable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, according to the vehicle position through the first adjacent obstacle, the vehicle position through the second adjacent obstacle, the speed of the vehicle, and the obstacle distance; determine that the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the vehicle is capable to drive from the vehicle location through the first adjacent obstacle to the vehicle location through the second adjacent obstacle; and determine that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the vehicle is incapable to drive from the vehicle location through the first adjacent obstacle to the vehicle location through the second adjacent obstacle.

[0074] In an embodiment of the present application, the control module 620 is further configured to set the vehicle position through the first adjacent obstacle as a starting point, and the vehicle position through the second adjacent obstacle as an end point; determine whether the vehicle is capable to drive at a constant speed or a reduced speed from the starting point to the end point at the obstacle distance; determine that the vehicle is capable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, if the vehicle is capable to drive at the constant speed or the reduced speed from the start point to the end point at the obstacle distance; and de-

termine that the vehicle incapable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, if the vehicle is incapable to drive at the constant speed or the reduced speed from the start point to the end point at the obstacle distance.

[0075] In an embodiment of the present application, the control module 620 is further configured to acquire the position and the size of the first adjacent obstacle, the position and size of the second adjacent obstacle, the width of the current travel lane according to the road environment model, in the case of multiple obstacles within the preset range in the current travel lane; acquire a comprehensive passage width, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle and the width of the current travel lane; control the vehicle to straight drive between the first adjacent obstacle and the second adjacent obstacle, in a case that the comprehensive passage width is greater than the second preset safe passage width. When the first adjacent obstacle and the second adjacent obstacle are both close to the same side of the current travel lane, the comprehensive passage width is a smaller value of a passage width at the first adjacent obstacle and a passage width at the second adjacent obstacle. When the first adjacent obstacle and the second adjacent obstacle are close to different sides of the current travel lane, the comprehensive passage width is a shortest distance between the first adjacent obstacle and the second adjacent obstacle in a left-right direction of the current travel lane.

[0076] In an embodiment of the present application, the control module 620 is further configured to in a case of one obstacle within the preset range in the current travel lane, acquire a position and a size of the obstacle, acquire a passage width at the obstacle according to the position and the size of the obstacle and the width of the current travel lane, and control the vehicle to change a lane, in a case that the passage width at the obstacle is less than the second preset safe passage width.

[0077] In the system for avoiding the obstacle in the vehicle automatic driving process, a road environment model within a preset range around the vehicle is generated. Lane lines of all lanes, and a position and a size of an obstacle in the current travel lane are provided in the road environment model. When multiple obstacles are located within the effective detection range of the current lane, whether the vehicle is capable to bypass two obstacles to drive in the current travel lane is determined, according to the passage widths of the two obstacles closest to the vehicle, the obstacle distance between the two obstacles in a driving direction of the vehicle, and the speed of the vehicle, so as to control the vehicle to drive. When only one obstacle is located in the effective detection range of the current travel lane, whether a passage width at the obstacle is available for the vehicle to avoid the obstacle is determined, so as to control the vehicle to drive.

[0078] It should be noted that the specific implementation mode of the system for avoiding the obstacle in the vehicle automatic driving process according to the embodiment of the present application is similar to the specific implementation mode of the method for avoiding the obstacle in the vehicle automatic driving process according to the embodiment of the present application. The specific description can refer to the description of the method embodiment. In order to reduce the redundancy, the description is not repeated herein.

[0079] Further, a vehicle is provided according to an embodiment of the present application, in which the system for avoiding the obstacle in the vehicle automatic driving process in any one of the above embodiments is applied. The vehicle may determine whether a current travel lane can be passed, according to a position and a size of an obstacle in the current travel lane.

[0080] In addition, other configurations and effects of vehicles according to embodiments of the present application are known to those of ordinary skill in the art, which will not be repeated herein to reduce redundancy.

[0081] The above description only shows preferred embodiments of the present application, which will not be used to limit the application. Any modification, replacement, and improvement made within the spirit and scope of this application shall be included in the protection scope of this application.

Claims

1. A method for avoiding an obstacle in a vehicle automatic driving process, comprising:

   providing a road environment model within a preset range around a vehicle, wherein the road environment model comprises a lane position, a lane width, and a size and a position of the obstacle within the preset range around the vehicle;

   in a case of a plurality of obstacles within the preset range in a current travel lane, acquiring a position and a size of a first adjacent obstacle, a position and a size of a second adjacent obstacle, a width of the current travel lane, and an obstacle distance between the first adjacent obstacle and the second adjacent obstacle in a driving direction of the current travel lane, according to the road environment model; and acquiring a speed of the vehicle;

   determining whether the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle, the speed of the vehicle, and the obstacle distance; and

   controlling the vehicle to avoid the obstacle ac-

cording to a determination result,
wherein the first adjacent obstacle is an obstacle closest to the vehicle in the driving direction of the current travel lane, and the second adjacent obstacle is an obstacle closest to the first adjacent obstacle in the driving direction of the current travel lane.

2. The method for avoiding the obstacle in the vehicle automatic driving process as claimed in claim 1, wherein the controlling the vehicle to avoid the obstacle according to a determination result comprises:
in a case that the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, controlling the vehicle to avoid the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane.

3. The method for avoiding the obstacle in the vehicle automatic driving process as claimed in claim 1 or 2, wherein the controlling the vehicle to avoid the obstacle according to a determination result further comprises:
in a case that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, controlling the vehicle to change an lane to avoid the obstacle.

4. The method for avoiding the obstacle in the vehicle automatic driving process as claimed in any one of claims 1 to 3, wherein the determining whether the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle, the speed of the vehicle, and the obstacle distance further comprises:

acquiring a passage width at the first adjacent obstacle according to the position and the size of the first adjacent obstacle and the width of the current travel lane;
determining that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the passage width at the first adjacent obstacle is less than the first preset safe passage width;
acquiring a passage width at the second adjacent obstacle according to the position and the size of the second adjacent obstacle and the width of the current travel lane, in a case that the passage width at the first adjacent obstacle is greater than the first preset safe passage width;
determining that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the passage width at the second adjacent obstacle is less than the first preset safe passage width;
acquiring a vehicle position through the first adjacent obstacle and a vehicle position through the second adjacent obstacle, in a case that the passage width at the second adjacent obstacle is greater than the first preset safe passage width;
determining whether the vehicle is capable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, according to the vehicle position through the first adjacent obstacle, the vehicle position through the second adjacent obstacle, the speed of the vehicle, and the obstacle distance;
determining that the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the vehicle is capable to drive from the vehicle location through the first adjacent obstacle to the vehicle location through the second adjacent obstacle; and
determining that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the vehicle is incapable to drive from the vehicle location through the first adjacent obstacle to the vehicle location through the second adjacent obstacle.

5. A method for avoiding the obstacle in the vehicle automatic driving process as claimed in claim 4, wherein the determining whether the vehicle is capable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, according to the vehicle position through the first adjacent obstacle, the vehicle position through the second adjacent obstacle, the speed of the vehicle, and the obstacle distance further comprises:

setting the vehicle position through the first adjacent obstacle as a starting point, and the vehicle position through the second adjacent obstacle as an end point, and determining whether the vehicle is capable to drive at a constant speed or a reduced speed from the start point to the end point at the obstacle distance;
determining that the vehicle is capable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, in a case that the vehicle is capable to drive at the constant speed or at the reduced speed from the starting point

to the end point at the obstacle distance; and
determining that the vehicle is incapable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, in a case that the vehicle is incapable to drive at the constant speed or at the reduced speed from the starting point to the end point at the obstacle distance.

6. The method for avoiding the obstacle in the vehicle automatic driving process as claimed in any one of claims 1 to 5, wherein after the providing a road environment model within a preset range around the vehicle, the method further comprises:

acquiring the position and the size of the first adjacent obstacle, the position and size of the second adjacent obstacle, the width of the current travel lane according to the road environment model, in the case of the plurality of obstacles within the preset range in the current travel lane;
acquiring a comprehensive passage width, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle and the width of the current travel lane;
controlling the vehicle to straight drive between the first adjacent obstacle and the second adjacent obstacle, in a case that the comprehensive passage width is greater than the second preset safe passage width;
wherein in a case that the first adjacent obstacle and the second adjacent obstacle are both close to a same side of the current travel lane, the comprehensive passage width is a smaller value of a passage width at the first adjacent obstacle and a passage width at the second adjacent obstacle; and in a case that the first adjacent obstacle and the second adjacent obstacle are close to different sides of the current travel lane, the comprehensive passage width is a shortest distance between the first adjacent obstacle and the second adjacent obstacle in a left-right direction of the current travel lane.

7. The method for avoiding the obstacle in the vehicle automatic driving process as claimed in any one of claims 1 to 6, wherein after the providing the road environment model within the preset range around the vehicle, the method further comprises:

in a case of one obstacle within the preset range in the current travel lane, acquiring a position and a size of the obstacle according to the road environment model, and acquiring a lane width of the current travel lane;
acquiring a passage width at the obstacle according to the position and the size of the obstacle and the width of the current travel lane; and
controlling the vehicle to avoid the obstacle in the current travel lane, in a case that the passage width at the obstacle is greater than a third preset safe passage width.

8. The method for avoiding the obstacle in the vehicle automatic driving process as claimed in any one of claims 1 to 7, wherein the providing the road environment model within the preset range around the vehicle further comprises:

acquiring position information of the vehicle, a position and a size of the obstacle in the current travel lane, and information on the lane position and the lane width within the preset range around the vehicle; and
generating the road environment model according to the position information of the vehicle, the position and the size of the obstacle in the current travel lane, and the information on the lane position and the lane width within the preset range around the vehicle.

9. A system for avoiding an obstacle in a vehicle automatic driving process, comprising:

a road environment model providing module configured to provide a road environment model within a preset range around the vehicle, wherein the road environment model comprises a lane position, a lane width, and a size and a position of the obstacle within the preset range around the vehicle; and
a control module configured to in a case that a plurality of obstacles within the preset range in a current travel lane is determined according to the road environment model, acquire, according to the road environment model, a position and a size of a first adjacent obstacle, a position and a size of a second adjacent obstacle, a width of the current travel lane, and an obstacle distance between the first adjacent obstacle and the second adjacent obstacle in a driving direction of the current travel lane, and acquire a speed of the vehicle; determine whether the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle, the speed of the vehicle and the obstacle distance; and control the vehicle to avoid the obstacle according to a determination result,
wherein the first adjacent obstacle is an obstacle closest to the vehicle in the driving direction of the current travel lane, and the second adjacent

obstacle is an obstacle closest to the first adjacent obstacle in the driving direction of the current travel lane.

10. The system for avoiding the obstacle in the vehicle automatic driving process as claimed in claim 9, wherein the control module is further configured to control the vehicle to avoid the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle in the current travel lane.

11. The system for avoiding the obstacle in the vehicle automatic driving process as claimed in any one of claims 9 or 10, wherein the control module is further configured to control the vehicle to change a lane to avoid the obstacle, in a case that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane.

12. The system for avoiding the obstacle in the vehicle automatic driving process as claimed in any one of claims 9 to 11, wherein the control module is further configured to acquire a passage width at the first adjacent obstacle according to the position and the size of the first adjacent obstacle and the width of the current travel lane; determine that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the passage width at the first adjacent obstacle is less than the first preset safe passage width; acquire a passage width at the second adjacent obstacle according to the position and the size of the second adjacent obstacle and the width of the current travel lane, in a case that the passage width at the first adjacent obstacle is greater than the first preset safe passage width; determine that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the passage width at the second adjacent obstacle is less than the first preset safe passage width; acquire a vehicle position through the first adjacent obstacle and a vehicle position through the second adjacent obstacle, in a case that the passage width at the second adjacent obstacle is greater than the first preset safe passage width; determine whether the vehicle is capable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, according to the vehicle position through the first adjacent obstacle, the vehicle position through the second adjacent obstacle, the speed of the vehicle, and the obstacle distance; determine that the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the vehicle is capable to drive from the vehicle location through the first adjacent obstacle to the vehicle location through the second adjacent obstacle; and determine that the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, in a case that the vehicle is incapable to drive from the vehicle location through the first adjacent obstacle to the vehicle location through the second adjacent obstacle.

13. The system for avoiding the obstacle in the vehicle automatic driving process as claimed in claim 12, wherein the control module is further configured to set the vehicle position through the first adjacent obstacle as a starting point, and the vehicle position through the second adjacent obstacle as an end point; determine whether the vehicle is capable to drive at a constant speed or a reduced speed from the starting point to the end point at the obstacle distance; determine that the vehicle is capable to drive from the vehicle location through the first adjacent obstacle to the vehicle location through the second adjacent obstacle, in a case that the vehicle is capable to drive at the constant speed or the reduced speed from the start point to the end point at the obstacle distance; and determine that the vehicle is incapable to drive from the vehicle position through the first adjacent obstacle to the vehicle position through the second adjacent obstacle, in a case that the vehicle is incapable to drive at the constant speed or at the reduced speed from the starting point to the end point at the obstacle distance.

14. The system for avoiding the obstacle in the vehicle automatic driving process as claimed in any one of claims 9 to 13, wherein the control module is further configured to acquire the position and the size of the first adjacent obstacle, the position and size of the second adjacent obstacle, the width of the current travel lane according to the road environment model, in the case of the plurality of obstacles within the preset range in the current travel lane; acquire a comprehensive passage width, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle and the width of the current travel lane; and control the vehicle to straight drive between the first adjacent obstacle and the second adjacent obstacle, in a case that the comprehensive passage width is greater than a second preset safe passage width,
wherein in a case that the first adjacent obstacle and the second adjacent obstacle are both close to a same side of the current travel lane, the comprehensive passage width is a smaller value of a passage width at the first adjacent obstacle and a passage width at the second adjacent obstacle; and in a case that the first adjacent obstacle and the second adja-

cent obstacle are close to different sides of the current travel lane, the comprehensive passage width is a shortest distance between the first adjacent obstacle and the second adjacent obstacle in a left-right direction of the current travel lane.

15. The system for avoiding the obstacle in the vehicle automatic driving process as claimed in any one of claims 9 to 14, the control module is further configured to in a case of one obstacle within the preset range in the current travel lane, acquire a position and a size of the obstacle; acquire a passage width at the obstacle according to the position and the size of the obstacle and the width of the current travel lane; and control the vehicle to change a lane, in a case that the passage width at the obstacle is less than the second preset safe passage width.

16. A vehicle, comprising the system for avoiding the obstacle in the vehicle automatic driving process as claimed in any one of claims 9 to 15.

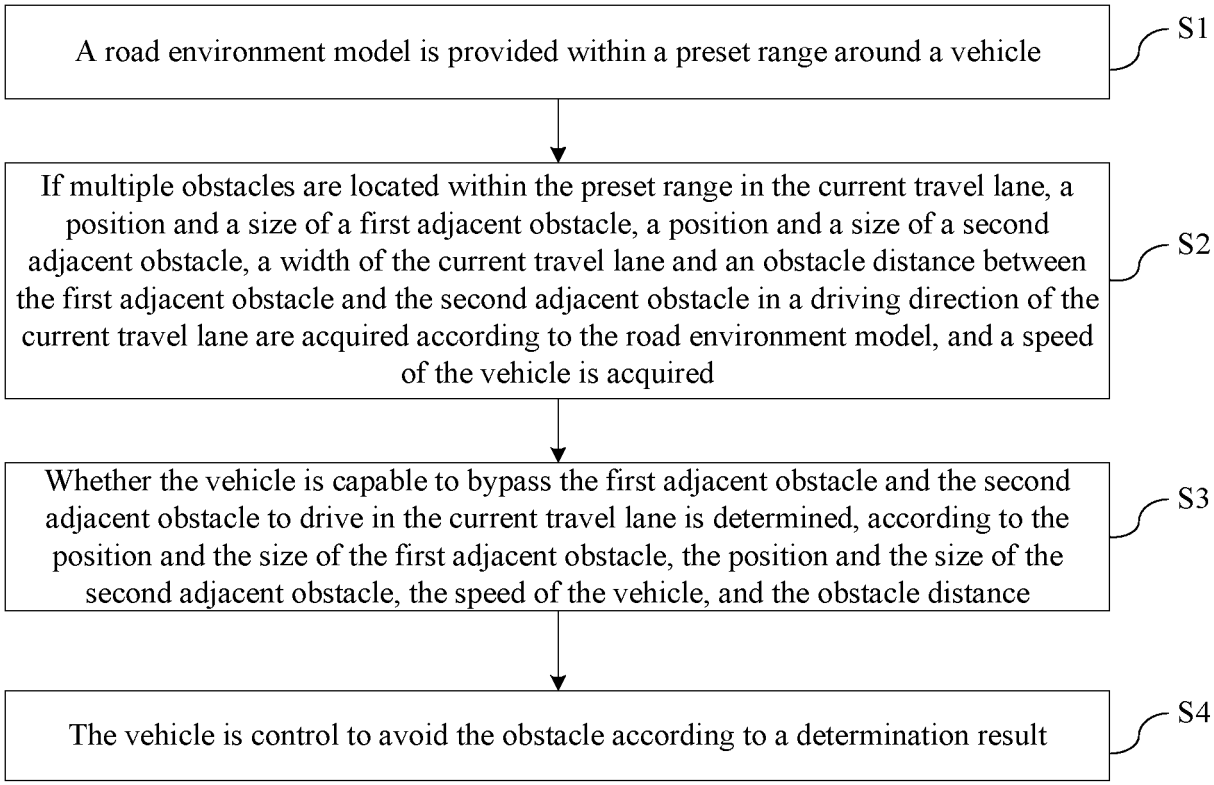
A road environment model is provided within a preset range around a vehicle
S1
If multiple obstacles are located within the preset range in the current travel lane, a position and a size of a first adjacent obstacle, a position and a size of a second adjacent obstacle, a width of the current travel lane and an obstacle distance between the first adjacent obstacle and the second adjacent obstacle in a driving direction of the current travel lane are acquired according to the road environment model, and a speed of the vehicle is acquired
S2
Whether the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane is determined, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle, the speed of the vehicle, and the obstacle distance
S3
The vehicle is control to avoid the obstacle according to a determination result
S4

FIG. 1

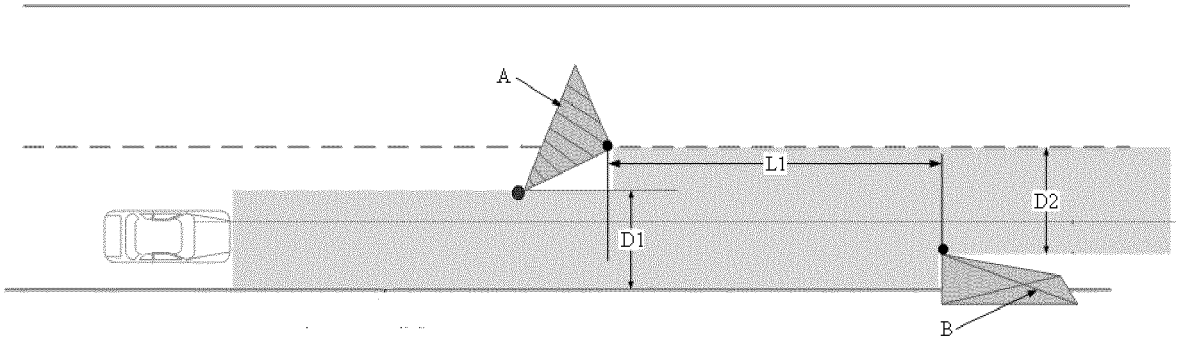
A
L1
D2
D1
B

FIG. 2

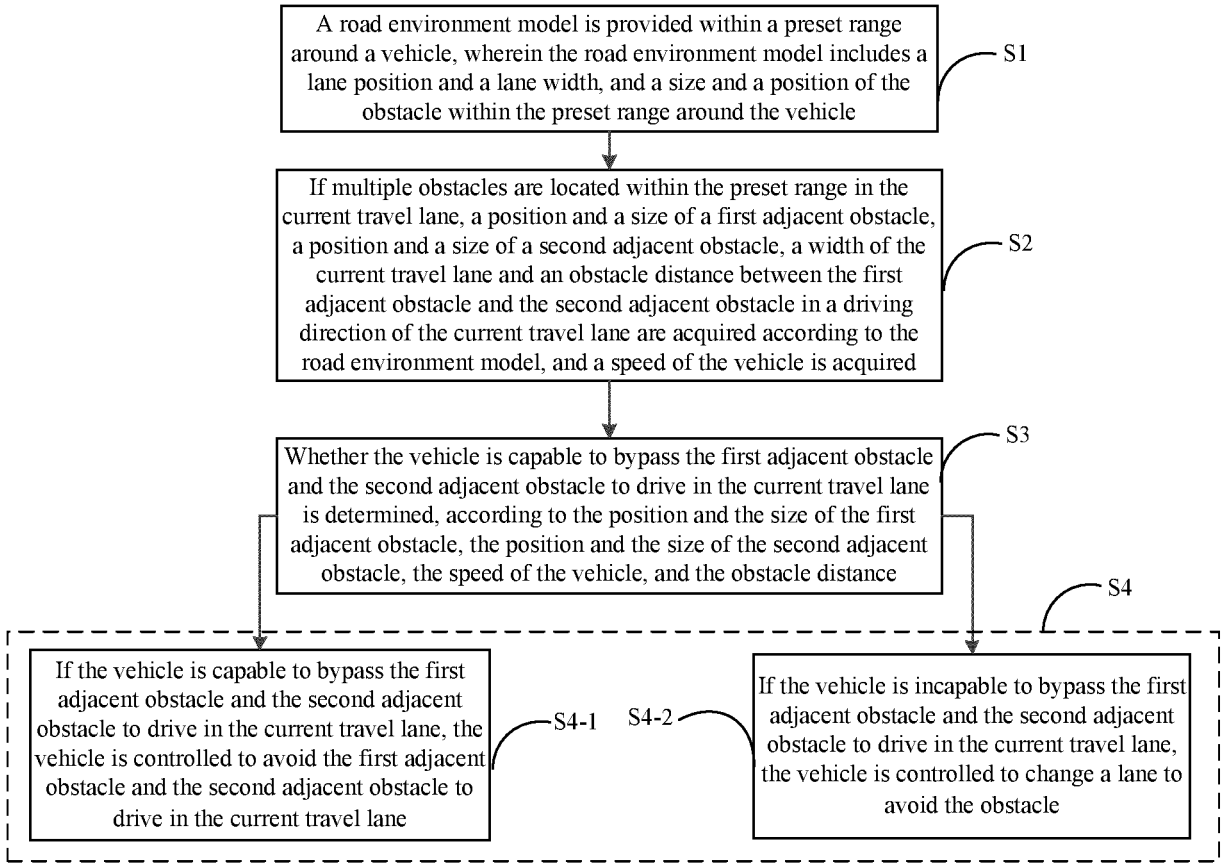
A road environment model is provided within a preset range around a vehicle, wherein the road environment model includes a lane position and a lane width, and a size and a position of the obstacle within the preset range around the vehicle
S1
If multiple obstacles are located within the preset range in the current travel lane, a position and a size of a first adjacent obstacle, a position and a size of a second adjacent obstacle, a width of the current travel lane and an obstacle distance between the first adjacent obstacle and the second adjacent obstacle in a driving direction of the current travel lane are acquired according to the road environment model, and a speed of the vehicle is acquired
S2
Whether the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane is determined, according to the position and the size of the first adjacent obstacle, the position and the size of the second adjacent obstacle, the speed of the vehicle, and the obstacle distance
S3
S4
If the vehicle is capable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, the vehicle is controlled to avoid the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane
S4-1
S4-2
If the vehicle is incapable to bypass the first adjacent obstacle and the second adjacent obstacle to drive in the current travel lane, the vehicle is controlled to change a lane to avoid the obstacle

FIG. 3

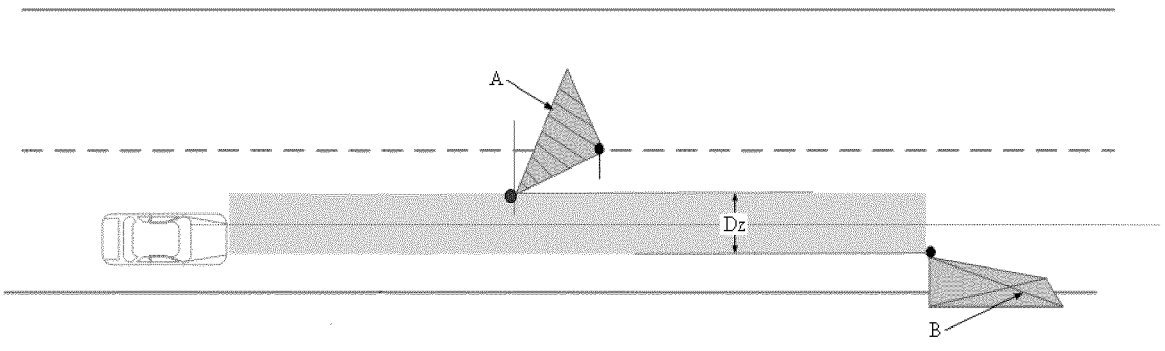
A
Dz
B

FIG. 4

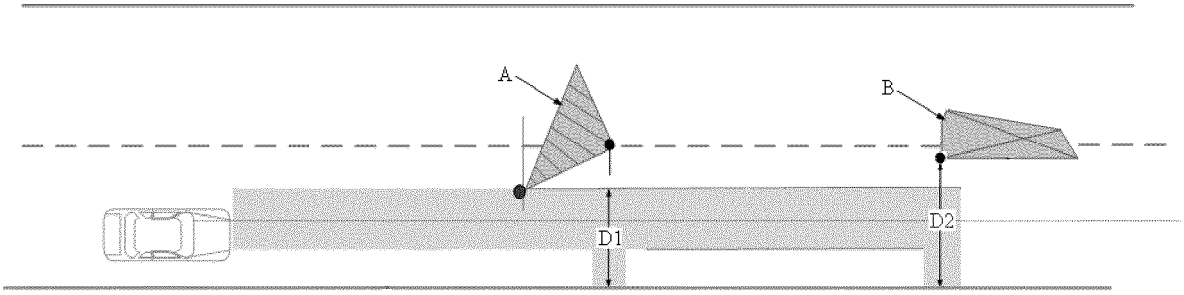

FIG. 5

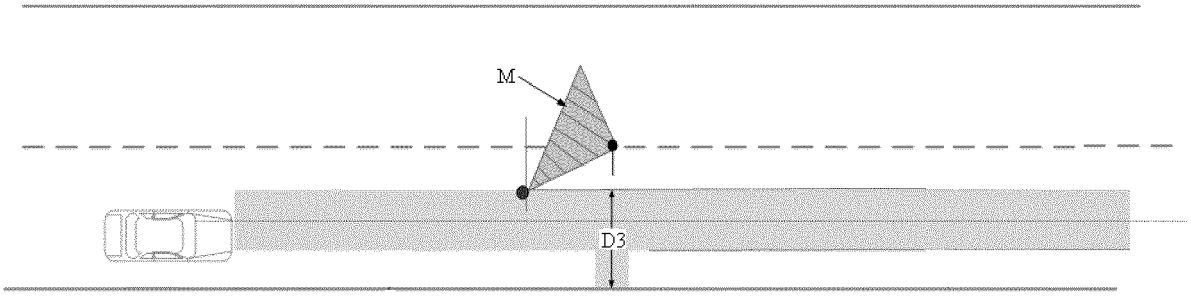

FIG. 6

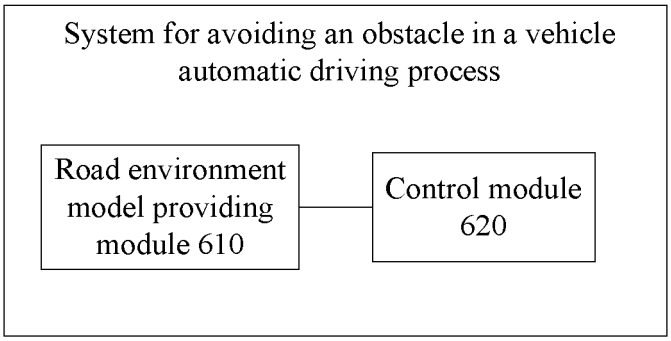

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2019/129278

A. CLASSIFICATION OF SUBJECT MATTER

G05D 1/02(2020.01)i; B60W 30/08(2012.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G05D; B60W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC, CNPAT, CNKI: 车, 车辆, 车距, 间距, 间隔, 第二, 临近, 障碍, 避障, 安全, 自动驾驶, 周围, 周边, 环境, 宽度, 尺寸; vehicle, distance, Second, near, obstacle, security, auto, around, size, width

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 107097790 A (ROBERT BOSCH GMBH) 29 August 2017 (2017-08-29) description, paragraphs [0040]-[0052], [0077], [0078], and [0100], and figures 1 and 4	1-16
A	CN 108256233 A (CHINA FIRST AUTOMOBILE WORKS GROUP CO., LTD.) 06 July 2018 (2018-07-06) entire document	1-16
A	CN 106199642 A (SHANGHAI HAIJI INFORMATION TECHNOLOGY CO., LTD.) 07 December 2016 (2016-12-07) entire document	1-16
A	CN 105046960 A (PAN, Jin et al.) 11 November 2015 (2015-11-11) entire document	1-16
A	CN 106228816 A (HENAN UNIVERSITY OF URBAN CONSTRUCTION) 14 December 2016 (2016-12-14) entire document	1-16
A	US 5555312 A (FUJITSU LIMITED) 10 September 1996 (1996-09-10) entire document	1-16

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 February 2020	**27 March 2020**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088** **China**	Authorized officer
Facsimile No. **(86-10)62019451**	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2019/129278

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 107097790 A	29 August 2017	DE 102016202594 A1	24 August 2017
		US 10311309 B2	04 June 2019
		US 2017243070 A1	24 August 2017
CN 108256233 A	06 July 2018	None	
CN 106199642 A	07 December 2016	CN 106199642 B	28 August 2018
CN 105046960 A	11 November 2015	CN 105046960 B	02 March 2018
CN 106228816 A	14 December 2016	CN 106228816 B	09 November 2018
US 5555312 A	10 September 1996	JP 3169483 B2	28 May 2001
		JP H0728975 A	31 January 1995

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 201811637024 **[0001]**
- CN 201811637022 **[0001]**