

VEHICLE POSITIONING SYSTEM AND METHOD, AND VEHICLE CONTROL METHOD AND APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based on and claims priority to Chinese Patent Application No. 201910816312.2, filed August 30, 2019, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure relates to the technical field of computer, and in particular to a system and method for vehicle positioning, and a method and device for vehicle control.

BACKGROUND

[0003] Research results for a vehicle model may be used in many fields, such as automatic driving and vehicle control. However, a runway for the vehicle model is usually an entity runway, and a path of the runway is usually fixed, such runway has a high economic cost and requires some time to be built.

SUMMARY

[0004] The present disclosure provides a system and method for vehicle positioning, and a method and device for vehicle control.

[0005] Embodiments of the disclosure provide a system for vehicle positioning, the

system includes a virtual runway display device, an image acquisition device, and a processor. The virtual runway display device is configured to display a virtual runway. The image acquisition device is located above the virtual runway and is configured to acquire a target image in a process of a target vehicle traveling on the virtual runway. The processor is connected to or disposed in the image acquisition device, and the processor is configured to: determine first position information of the target vehicle in the virtual runway according to the target image, and transmit the first position information to the target vehicle to enable the target vehicle to travel on the virtual runway according to the first position information.

[0006] According to the system for vehicle positioning in the embodiments of the disclosure, the virtual runway can be displayed by the virtual runway display device, and a plurality of runways can be designed for the target vehicle. Therefore, the cost of the runway can be reduced, the time for building the runway is not required and the flexibility of the runway path can be improved. The processor may determine the first position information of the target vehicle according to the target image of the target vehicle traveling on the virtual runway, so that the target vehicle can determine the position of the target vehicle in the runway in real time, and can further travel on the virtual runway accurately. Therefore, the target vehicle itself does not need to record and adapt to the virtual runway, which can simplify the calculation of the target vehicle during traveling.

[0007] In a possible implementation, the processor may be further configured to: acquire second position information of an obstacle according to the target image; and transmit the second position information to the target vehicle to enable the target vehicle to travel on the virtual runway according to the first position information and the second position information. In this way, the target vehicle can have a capability of avoiding obstacles, thereby improving the performance of the target vehicle.

[0008] In a possible implementation, the virtual runway display device may include a projection device, and the projection device is configured to project a pattern of the

virtual runway.

[0009] In a possible implementation, the projection device may include a projector and a projection plane, and the projector is configured to project the pattern of the virtual runway onto the projection plane.

[0010] In a possible implementation, the virtual runway display device may include an augmented reality device, and the augmented reality device is configured to display the virtual runway in an augmented reality interface.

[0011] In a possible implementation, the virtual runway display device may be further configured to determine a size of the virtual runway according to a size of the target vehicle. The size of the target vehicle includes a width of the target vehicle, and the size of the virtual runway includes a runway width.

[0012] In a possible implementation, the virtual runway display device may be configured to acquire a field image used for displaying a field of the virtual runway; acquire field information according to the field image, herein the field information comprises a size of the field; and determine a size of the virtual runway and a pattern of the virtual runway according to the field information and a size of the target vehicle.

[0013] In a possible implementation, the processor may be further configured to: acquire field information and a size of the target vehicle; determine a size of the virtual runway and a pattern of the virtual runway according to the field information and the size of the target vehicle; and transmit the size of the virtual runway and the pattern of the virtual runway to the virtual runway display device. In this way, the size of the virtual runway can be adapted to the size of the target vehicle. If the target vehicle is replaced, the size of the virtual runway can be easily adjusted without buying or building a new runway again. Therefore, the cost can be saved and the convenience for the use of the virtual runway can be improved.

[0014] In a possible implementation, the processor may be further configured to:

generate a vehicle control instruction at least according to the first position information; and transmit the vehicle control instruction to the target vehicle to enable the target vehicle to travel on the virtual runway according to the vehicle control instruction.

[0015] In a possible implementation, the operation of determining the first position information of the target vehicle in the virtual runway according to the target image may include the following actions. An offset of the target vehicle in the virtual runway with respect to a lane center line is determined according to the target image; and the first position information is generated according to the offset.

[0016] In a possible implementation, the operation of determining the first position information of the target vehicle in the virtual runway according to the target image may include the following actions. An image of a preset range in a traveling direction of the target vehicle is determined according to the target image; and the first position information is generated according to the image of the preset range.

[0017] In a possible implementation, the system may further include a target vehicle, the target vehicle is configured to travel on the virtual runway at least according to the first position information.

[0018] In a possible implementation, the first position information may include an offset of the target vehicle in the virtual runway with respect to a lane center line, or an image of a preset range in a traveling direction of the target vehicle.

[0019] In a possible implementation, the target vehicle may be configured to determine a traveling path for the target vehicle according to the offset or determine the traveling path for the target vehicle according to the image of the preset range in the traveling direction of the target vehicle.

[0020] Embodiments of the disclosure provide a method for vehicle control. The method includes the following operations. First position information for a target vehicle sent by a system for vehicle positioning is received. A traveling path for the target

vehicle in a virtual runway is determined according to the first position information. The target vehicle is controlled to travel according to the traveling path.

[0021] In a possible implementation, the operation of determining the traveling path for the target vehicle in the virtual runway according to the first position information may include the following actions. An offset of the target vehicle in the virtual runway with respect to a lane center line is determined according to the first position information. The traveling path for the target vehicle is determined according to the offset.

[0022] In a possible implementation, the operation of determining the traveling path for the target vehicle in the virtual runway according to the first position information may include the following actions. An image of a preset range in a traveling direction of the target vehicle is determined according to the first position information. The traveling path for the target vehicle is determined according to the image of the preset range.

[0023] In a possible implementation, the method may further includes the following operations. A vehicle control instruction sent by the system for vehicle positioning is received. The target vehicle is controlled to travel according to the vehicle control instruction.

[0024] In a possible implementation, the method may further include the following operations. Second position information of an obstacle sent by the system for vehicle positioning is received. The traveling path for the target vehicle in the virtual runway is determined according to the first position information and the second position information. The target vehicle is controlled to travel according to the traveling path.

[0025] Embodiments of the disclosure provide a method for vehicle positioning. The method includes the following operations. First position information of a target vehicle in a virtual runway is determined according to a target image, the virtual runway is a runway displayed by a virtual runway display device, and the target image is an image of the target vehicle traveling on the virtual runway acquired by an image acquisition device. The first position information is transmitted to the target vehicle to enable the

target vehicle to travel on the virtual runway according to the first position information.

[0026] In a possible implementation, the method may further include the following operations. Second position information of an obstacle is acquired according to the target image. The second position information is transmitted to the target vehicle to enable the target vehicle to travel on a runway pattern according to the first position information and the second position information.

[0027] In a possible implementation, the method may further include the following operations. The virtual runway display device acquires a field image used for displaying a field of the virtual runway. Field information is acquired according to the field image, the field information includes a size of the field. A size of the virtual runway and a pattern of the virtual runway are determined according to the field information and a size of the target vehicle.

[0028] In a possible implementation, the method may further include the following operations. The field information and the size of the target vehicle are acquired. The size of the virtual runway and the pattern of the virtual runway are determined according to the field information and the size of the target vehicle. The size of the virtual runway and the pattern of the virtual runway are transmitted to the virtual runway display device.

[0029] In a possible implementation, the method may further include the following operations. A vehicle control instruction is generated at least according to the first position information. The vehicle control instruction is transmitted to the target vehicle to enable the target vehicle to travel on the runway pattern according to the vehicle control instruction.

[0030] In a possible implementation, the operation of determining the first position information of the target vehicle in the virtual runway according to the target image may include the following actions. An offset of the target vehicle in the virtual runway with respect to a lane center line is determined according to the target image. The first position information is generated according to the offset.

[0031] In a possible implementation, the operation of determining the first position information of the target vehicle in the virtual runway according to the target image may include the following actions. An image of a preset range in a traveling direction of the target vehicle is determined according to the target image. The first position information is generated according to the image of the preset range.

[0032] Embodiments of the disclosure provide a device for vehicle control. The device includes a first receiving module, a first determination module and a first traveling module. The first receiving module is configured to receive first position information of a target vehicle sent by a system for vehicle positioning. The first determination module is configured to determine a traveling path for the target vehicle in a virtual runway according to the first position information. The first traveling module is configured to control the target vehicle to travel according to the traveling path.

[0033] Embodiments of the disclosure provide a device for vehicle positioning. The device includes a third determination module and a transmission module. The third determination module is configured to determine first position information of a target vehicle in a virtual runway according to a target image, the virtual runway is a runway displayed by a virtual runway display device, and the target image is an image of the target vehicle traveling on the virtual runway acquired by an image acquisition device. The transmission module is configured to transmit the first position information to the target vehicle to enable the target vehicle travel on the virtual runway according to the first position information.

[0034] Embodiments of the disclosure provide an electronic device, the electronic device includes a processor and a memory configured to store processor-executable instructions. The processor is configured to perform the abovementioned method.

[0035] Embodiments of the disclosure provide a computer-readable storage medium, which has computer program instructions stored thereon. The computer program instructions are executed by the processor to perform the abovementioned method.

[0036] Embodiments of the disclosure provide a computer program product. The computer program product includes a computer readable code. When run in an electronic device, the computer readable code causes a processor of the electronic device to perform the abovementioned method performed by the processor in the abovementioned one or more embodiments.

[0037] According to the system for vehicle positioning according to the embodiments of the disclosure, the virtual runway can be displayed by the virtual runway display device, and a plurality of runways can be designed for the target vehicle. Therefore, the cost of the runway can be reduced, a time for building the runway is not required and the flexibility of the runway path can be improved. The processor may determine the first position information of the target vehicle according to the target image of the target vehicle traveling on the virtual runway, so that the target vehicle can determine the position of the target vehicle in the runway in real time, and can further travel on the virtual runway accurately. Therefore, the target vehicle itself does not need to record and adapt to the virtual runway, which can simplify the calculation of the target vehicle during traveling.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] FIG. 1 illustrates a block diagram of a system for vehicle positioning according to embodiments of the disclosure;

[0039] FIG. 2 illustrates a schematic diagram of a virtual runway according to embodiments of the disclosure;

[0040] FIG. 3 illustrates a flowchart of a method for vehicle control according to embodiments of the disclosure;

[0041] FIG. 4 illustrates an application diagram of a system for vehicle positioning according to embodiments of the disclosure;

[0042] FIG. 5 illustrates a flowchart of a method for vehicle positioning according to embodiments of the disclosure;

[0043] FIG. 6A illustrates a block diagram of a device for vehicle control according to embodiments of the disclosure;

[0044] FIG. 6B illustrates a block diagram of a device for vehicle positioning according to embodiments of the disclosure;

[0045] FIG. 7 illustrates a block diagram of an electronic device according to embodiments of the disclosure;

[0046] FIG. 8 illustrates a block diagram of an electronic device according to embodiments of the disclosure.

DETAILED DESCRIPTION

[0047] Various exemplary embodiments, features, and aspects of the disclosure will be described in detail below with reference to the accompanying drawings. The same reference numerals in the figures identify the same or similar elements. Although various aspects of the embodiments are shown in the drawings, the drawings are not necessarily drawn to scale unless otherwise specified.

[0048] The word “exemplary” used herein means “serving as an example, an embodiment, or an illustration”. Any embodiments described herein as “exemplary” would not be understood as superior or better to other embodiments. The term “and/or” as used herein is merely an association that describes associated objects. The term means that there may be three relationships. For example, a1 and/or b1 may represent three cases, namely a1 alone, both a1 and b1, and b1 alone. In addition, the term “at least one” used herein represents any one of a plurality and any combination of at least two of the plurality. For example, inclusion of at least one of a1, b1, and c1 may represents

inclusion of one or more elements selected from the set consisting of a1, b1, and c1.

[0049] In addition, for better description of the embodiments of the disclosure, many certain details are set forth in the following detailed description. It is understood by those skilled in the art that the embodiments of the disclosure can be implemented without the certain details. In some embodiments, methods, means, elements, and circuits that are well known to those skilled in the art are not described in detail in order to highlight the spirit of the embodiments of the disclosure.

[0050] In the related art, a runway for a vehicle model is a physical runway. The vehicle model determines position of itself in the physical runway and a position of an obstacle in real time based on a sensor or a computer vision method, such that the position of the vehicle model is adjusted according to the position of the obstacle. However, the physical runway has the following disadvantages: 1) the economic cost of replacing the physical runway is high; 2) the time cost of building the physical runway is high; 3) the size of the physical runway depends on the size of the vehicle model. When replacing the vehicle model, the size of the physical runway cannot be adjusted according to the size of the vehicle model. Therefore, in the related art, the flexibility of the size of the physical runway is low, which limits the spread of the vehicle model race to some extent. For example, in an education project, it is required for one vehicle model to be matched with a plurality of runways, the economic burden of the education project is therefore increased.

[0051] FIG. 1 illustrates a block diagram of a system for vehicle positioning according to embodiments of the disclosure. As illustrated in FIG.1, the system includes a virtual runway display device 11, an image acquisition device 12 and a processor 13. The virtual runway display device 11 is configured to display a virtual runway. The image acquisition device 12 is located above the virtual runway and is configured to acquire a target image in a process of a target vehicle traveling on the virtual runway. The processor 13 is connected to or disposed inside the image acquisition device, and the processor is configured to: determine first position information of the target vehicle in

the virtual runway according to the target image, and transmit the first position information to the target vehicle to enable the target vehicle to travel on the virtual runway according to the first position information.

[0052] According to the system for vehicle positioning in the embodiment of the disclosure, the virtual runway can be displayed by the virtual runway display device, and a plurality of runways can be designed for the target vehicle. Therefore, the cost of the runway can be reduced, a time for building the runway is not required and the flexibility of the runway path can be improved. The processor may determine the first position information of the target vehicle according to the target image of the target vehicle traveling on the virtual runway, in such way, the target vehicle can determine the position of the target vehicle in the runway in real time, and can further accurately travel on the virtual runway. Therefore, the target vehicle itself does not need to record and adapt to the virtual runway, which can simplify the calculation of the target vehicle during traveling.

[0053] In a possible implementation, the processor 13 may be an operation device such as a single chip microcomputer, a digital signal processor (DSP), a field-programmable gate array (FPGA), a central processing unit (CPU), or a graphics processing unit (GPU). The type of the vehicle controller is not limited in the embodiments of the disclosure.

[0054] In a possible implementation, the virtual runway display device 11 may display a pattern of the virtual runway. For example, the virtual runway display device 11 may be a display device that can display the pattern of the virtual runway. For example, the virtual runway display device 11 includes an augmented reality (AR) device which is configured to display the virtual runway in an augmented reality (AR) interface. As another example, the virtual runway display device 11 includes a projection device which is configured to project the pattern of the virtual runway. The projection device may include a projector, or a projector and a projection plane, the projector is configured to project the pattern of the virtual runway onto the projection plane. For

example, the pattern of the virtual runway may be stored in the projector, and the projection plane may be a projection curtain or an actual field which can be used for displaying the pattern (i.e., the pattern of the virtual runway) projected by the projector.

[0055] FIG. 2 illustrates a schematic diagram of a virtual runway according to an embodiment of the disclosure. As illustrated in FIG. 2, the virtual runway display device 11 may display the virtual runway on a display plane, such as the runway 20 in FIG. 2, the runway may be the pattern of the virtual runway projected by the projector onto the projection plane, and the target vehicle may travel on the virtual runway.

[0056] In a possible implementation, the virtual runway display device 11 is further configured to determine a size of the virtual runway according to a size of the target vehicle. The size of the target vehicle includes a width of the target vehicle, and the size of the virtual runway includes a runway width. In an example, the target vehicle is a vehicle model having a width of 20 cm, and the virtual runway display device 11 may adaptively determine the runway width according to the width of the target vehicle. For example, the virtual runway may be a two-lane runway, and the width of each lane may be greater than the width of the target vehicle. For example, the width of each lane is 30 cm, and the width of the virtual runway is 60 cm. The width of the target vehicle and the width of the virtual runway are not limited in the embodiments of the disclosure.

[0057] In a possible implementation, the size of the target vehicle may also include a length of the target vehicle, and the size of the virtual runway may also include a curve radius of a curve in the virtual runway. For example, when the length of the target vehicle is long and the curve radius of the curve in the virtual runway is small, the target vehicle may not pass through the curve. Therefore, the virtual runway display device 11 may set the curve radius of the curve according to the length of the target vehicle, such that the target vehicle can pass through the curve. The size of the target vehicle may also include a height of the target vehicle, and the size of the virtual runway may also include a total length of the virtual runway. The size of the target vehicle and the size of the virtual runway are not limited in the embodiments of the disclosure.

[0058] In a possible implementation, the virtual runway display device 11 is configured to: acquire a field image used for displaying a field of the virtual runway; acquire field information according to the field image, herein the field information comprises a size of the field; and determine a size of the virtual runway and a pattern of the virtual runway according to the field information and a size of the target vehicle.

[0059] In a possible implementation, the image acquisition device 12 may capture the field image and transmit the field image to the virtual runway display device 11. Alternatively, the user may input the field image or the field information into the virtual runway display device 11. After obtaining the field image or the field information, the virtual runway display device 11 may acquire the field information. For example, the virtual runway display device may take the size of the field as a basis for the scale of the virtual runway. If the field size is large, a large scale virtual runway may be used, for example, the virtual runway with a complex runway path and/or a long total path length. Otherwise, a small scale virtual runway may be used.

[0060] In a possible implementation, the virtual runway display device 11 may determine the size and pattern of the virtual runway according to the field information and the size of the target vehicle. For example, the width of the target vehicle may be taken as a basis for the runway width. After the runway width is determined, the pattern of the virtual runway may be selected according to the size of the field. For example, if the width of the runway is large and the size of the field is small, only the virtual runway with a simple pattern and a small size may be used. The pattern of the virtual runway may be automatically generated by the virtual runway display device 11 or the processor 13 according to the field information; or the pattern of the virtual runway may be a template pattern pre-stored in the virtual runway display device 11; or the pattern of the virtual runway may be automatically generated by the virtual runway display device 11 or the processor 13 according to the user-defined information (for example, n curves, k obstacles) input by the user.

[0061] In a possible implementation, the operation of determining the size and pattern

of the virtual runway may be performed by the processor 13. The processor 13 is further configured to: acquire the field information and the size of the target vehicle; determine the size of the virtual runway and the pattern of the virtual runway according to the field information and the size of the target vehicle; and transmit the size of the virtual runway and the pattern of the virtual runway to the virtual runway display device. The way that the processor 13 determines the size and pattern of the virtual runway may be the same as the way of the virtual runway display device 11 determining the size and pattern of the virtual runway described above, and will not be elaborated again.

[0062] In this way, the size of the virtual runway can be adapted to the size of the target vehicle. When the target vehicle is replaced, the size of the virtual runway can be easily adjusted without buying or building a new runway again. Therefore, the cost may be saved and the convenience for the use of the virtual runway can be improved.

[0063] In a possible implementation, the image acquisition device 12 may include a camera, the camera may be located above the virtual runway to capture the virtual runway, and the camera may take the target image of the target vehicle traveling on the virtual runway while the target vehicle is traveling on the virtual runway. The image acquisition device 12 and the virtual runway display device 11 may not shade each other. For example, the display plane of the virtual runway display device 11 may be a plane in a horizontal direction, and the camera located above the display plane may capture a complete virtual runway. As another example, the virtual runway display device 11 may include a projector and a projection plane, and the camera may be disposed near the projector to capture a complete virtual runway which is projected by the projector onto the projection plane. The position of the image acquisition device 12 is not limited in the embodiments of the disclosure.

[0064] In a possible implementation, the processor 13 may be configured to connect to the camera 12, or the processor 13 may be disposed inside the camera 12. When the camera 12 captures the target image, the processor 13 may acquire and process the target image. For example, the processor 13 may detect the target vehicle in the target image

through a detection method such as neural network detection, and determine the first position information of the target vehicle in the virtual runway. In an example, the first position information may be a relative position of the target vehicle in the path of the virtual runway. For example, the target vehicle is at the starting point of the virtual runway, the target vehicle is at the first curve of the virtual runway, the target vehicle is at the second intersection of the virtual runway, and the target vehicle is at the ending point of the virtual runway. The first position information is not limited in the embodiments of the disclosure. In another example, the first position information may be relative position information such as an offset of the target vehicle with respect to a lane center line, or may be image information, such as an image (which may include the target vehicle), of a preset range (for example, within 2 meters) in a traveling direction of the target vehicle.

[0065] In a possible implementation, the processor 13 may determine the first position information of the target vehicle in the virtual runway according to the target image, and the operation may include the following actions. An offset of the target vehicle in the virtual runway with respect to a lane center line is determined according to the target image; and the first position information is generated according to the offset.

[0066] In a possible implementation, the processor 13 may use the first position information to enable the target vehicle to travel on the lane of the virtual runway. For example, the target vehicle may travel forward, and when there is a curve appears in the virtual runway, the target vehicle may shift with respect to the lane of the virtual runway. In other words, the target vehicle may not be held in the lane when the target vehicle travels forward along a straight line. The processor 13 may calculate the first position information, i.e., the offset of the center of the target vehicle with respect to the lane center line, according to the position relationship between the target vehicle and the lane center line in the target image, and transmit the first position information to the target vehicle, so that the target vehicle can calculate a traveling direction, a traveling speed, a traveling path and the like according to the offset, and control the target vehicle to travel in the lane.

[0067] In a possible implementation, the processor 13 may determine the first position information of the target vehicle in the virtual runway according to the target image. The operation may include the following actions. An image of a preset range in a traveling direction of the target vehicle is determined according to the target image. The first position information is generated according to the image of the preset range.

[0068] In a possible implementation, the processor 13 may use the first position information to enable the target vehicle to travel along the lane of the virtual runway. The first position information may represent an image of the position of the target vehicle in the virtual runway. For example, the processor 13 takes the image (for example, at least part of the image including the target vehicle) of a preset range (for example, within 3 meters) in a traveling direction of the target vehicle as the first position information and transmits the first position information to the target vehicle. After receiving the image of the preset range, the target vehicle may perform path planning according to the image and control the target vehicle to travel along the planned path, i.e., travel along the lane of the virtual runway.

[0069] In a possible implementation, the first position information may directly include a vehicle control instruction, such as a vehicle control instruction including information of a next position of the vehicle. For example, the processor 13 may: position the target vehicle according to the target image acquired in real time; then calculate the relative position offset of the target vehicle in the virtual runway according to the pattern of the virtual runway, and directly generate the vehicle control instruction; and transmit the instruction to the target vehicle, to enable the target vehicle to travel on the virtual runway according to the instruction. The vehicle control instruction may be an instruction including at least one of the following information: a direction, a speed, a route, and information of the next position of vehicle traveling.

[0070] In another implementation, the information transmitted by the processor 13 back to the target vehicle may be freely combined according to the condition of the target vehicle and actual requirements. In a possible implementation, the system further

includes a target vehicle. The target vehicle is configured to travel on the virtual runway at least according to the first position information. For example, the first position information includes the offset of the target vehicle with respect to a lane center line, or the image of the preset range in the traveling direction of the target vehicle. The target vehicle may generate a control instruction according to the first position information, to control the target vehicle to travel in the lane of the virtual runway.

[0071] In a possible implementation, the target vehicle is configured to determine a traveling path for the target vehicle according to the offset or determine the traveling path for the target vehicle according to the image of the preset range in the traveling direction of the target vehicle.

[0072] In a possible implementation, the target vehicle may determine the traveling path for the target vehicle according to the offset of the target vehicle with respect to the lane center line. For example, the target vehicle calculates the traveling direction, the traveling speed, or the traveling path according to the offset, that is, the target vehicle may reduce the offset by turning or the like, so that the body of the target vehicle can be held in the lane.

[0073] In a possible implementation, the target vehicle may determine the traveling path according to the image of the preset range in the traveling direction of the target vehicle. For example, the target vehicle may perform the path planning according to the pattern of the virtual runway in the image, to enable the path for the target vehicle to adapt to the pattern of the virtual runway, namely, to enable the target vehicle to travel on the virtual runway.

[0074] In a possible implementation, at least one obstacle may also be provided in the virtual runway. For example, the at least one obstacle may be placed on the display plane, or a pattern of the at least one obstacle may be provided in the pattern of the virtual runway. The processor 13 may also detect the position of the at least one obstacle and transmit the position to the target vehicle, to enable the target vehicle to avoid the at least

one obstacle.

[0075] In a possible implementation, the processor 13 is further configured to: acquire second position information of the obstacle according to the target image; and transmit the second position information to the target vehicle 21, to enable the target vehicle 21 to travel on the virtual runway according to the first position information and the second position information.

[0076] In a possible implementation, the second position information may be position coordinates of the obstacle in the virtual runway, and the first position information may be position coordinates of the target vehicle in the virtual runway. After receiving the first position information and the second position information, the target vehicle may determine a relative position relationship between the target vehicle and the obstacle according to the first position information and the second position information, so that a control instruction may be generated. For example, an avoidance path may be generated and the target vehicle is controlled to travel along the avoidance path, such that the target vehicle can avoid the obstacle and travel in the lane of the virtual runway. In this way, the target vehicle can acquire the positions of the target image and the at least one detectable obstacle in real time, and therefore have the capability of avoiding the obstacle, such that the performance of the target vehicle can be improved.

[0077] In a possible implementation, the second position information of the obstacle may be a relative position of the obstacle in the path of the virtual runway. For example, the obstacle is at the first bend of the virtual runway, the obstacle is at the second intersection of the virtual runway. In addition, the second position information of the obstacle may further include information of the lane where the obstacle is located and information of size of the obstacle. Optionally, the second position information of the obstacle may also be the relative position between the target vehicle and the obstacle. The target vehicle may position the obstacle by using the second position information, thereby controlling the target vehicle to avoid the obstacle.

[0078] In a possible implementation, the processor 13 may detect the obstacle in the target image by using a detection method such as neural network detection, and determine the second position information of the obstacle. In some embodiments of the disclosure, the second position information may be transmitted to the target vehicle. The vehicle controller of the target vehicle may receive the second position information, and determine the traveling path according to the first position information and the second position information, to enable the target vehicle to travel according to the traveling path. In an example, the vehicle controller may determine the traveling path according to the first position information when the target vehicle is far from the obstacle. For example, the vehicle controller may determine the traveling path of the target vehicle in the virtual runway according to the path of the virtual runway. Moreover, the vehicle controller may determine the traveling path according to the second position information when the target vehicle is near the obstacle. For example, the virtual runway has two lanes, and the obstacle is located on one of the lanes. The vehicle controller may determine to control the target vehicle to travel on the other lane, in order to avoid the obstacle. After avoiding the obstacle, the target vehicle may travel back to the original lane. Traveling according to such path enables the target vehicle to avoid the obstacle in the other lane.

[0079] In another example, the vehicle controller may determine the traveling path according to both the first position information and the second position information. For example, the virtual runway may have branch roads, the branch roads may include two or more roads, and the obstacle may be provided in one of these roads. The vehicle controller may: determine a road on which the obstacle is located according to the second position information, determine a traveling path that can avoid the road, and determine a traveling path for traveling on another road according to the first position information. In such way, when the target vehicle travels according to the path, the target vehicle may avoid the obstacle by traveling on the road without an obstacle and select the road without an obstacle to travel on. The way of determination of the traveling path is not limited in the embodiments of the disclosure.

[0080] In a possible implementation, the operation of controlling the target vehicle

may be performed by the processor 13. Specifically, the processor 13 may remotely control the target vehicle according to the first position information, the first position information and the second position information, or the like. The processor 13 is further configured to: generate a vehicle control instruction at least according to the first position information; transmit the vehicle control instruction to the target vehicle to enable the target vehicle to travel on the virtual runway according to the vehicle control instruction. In an example, the processor 13 may: calculate the offset of the target vehicle in the virtual runway with respect to the lane center line; determine the traveling direction of the target vehicle according to the offset; and generate the vehicle control instruction according to the traveling direction to control the target vehicle to travel in the lane. In an example, the processor 13 may: plan a path within a preset distance in the traveling direction of the target vehicle according to the image of a preset range in the traveling direction of the target vehicle; and generate the vehicle control instruction to control the target vehicle to travel along the path, such that the target vehicle is controlled to travel in the lane along the path. In an example, the processor 13 may also determine the second position information of the obstacle and generate the vehicle control instruction according to the first position information and the second position information, to control the target vehicle to avoid the obstacle and to travel in the lane without the obstacle. The way of the processor 13 controlling the target vehicle is not limited in the embodiments of the disclosure.

[0081] Embodiments of the disclosure also provide a method for vehicle control method, an execution subject of the method may be a device for vehicle control, such as a terminal, a remote control device, a server, an intelligent vehicle. The method may also be executed by a processor running a computer-executable code.

[0082] FIG. 3 illustrates a flowchart of a method for vehicle control according to embodiments of the disclosure. As illustrated in FIG. 3, the method is applied to a vehicle controller. The vehicle controller may be provided in the target vehicle or may be remotely connected to the target vehicle (e.g., connected by a wired or wireless manner). The method includes the following operations.

[0083] At operation S11, first position information sent by a system for vehicle positioning is received.

[0084] At operation S12, a traveling path for a target vehicle in a virtual runway is determined according to the first position information.

[0085] At operation S13, the target vehicle is controlled to travel according to the traveling path.

[0086] The system for vehicle positioning may refer to the system for vehicle positioning described in the embodiments of the disclosure, and will not be elaborated herein again.

[0087] In a possible implementation, the vehicle controller may be an operation device such as a single chip microcomputer, a DSP, an FPGA, a CPU. The type of the vehicle controller is not limited in the embodiments of the disclosure.

[0088] In a possible implementation, at operation S11, the target vehicle may receive the first position information sent by the system for vehicle positioning.

[0089] In a possible implementation, at operation S12, the target vehicle may determine the traveling path according to the first position information.

[0090] In an example, the first position information includes an offset of the target vehicle with respect to a lane center line, and the operation S12 may include the following actions. The offset of the target vehicle in the virtual runway with respect to the lane center line is determined according to the first position information. The traveling path for the target vehicle is determined according to the offset. For example, the vehicle controller may: acquire the offset according to the first position information, determine a magnitude of a left turning or a right turning of the target vehicle according to the lane offset, and perform a corresponding control. For example, the target vehicle may be controlled to travel toward a direction for offset decrease by steering, which allows the target vehicle be held in the lane, or, the traveling path for the target vehicle

may be directly determined according to the offset.

[0091] In an example, the first position information includes an image of a preset range in a traveling direction of the target vehicle, and the operation S12 may include the following actions. The image of the preset range in the traveling direction of the target vehicle is determined according to the first position information, for example, the image of the preset range in the traveling direction of the target vehicle may be a path in the virtual runway within a preset distance in the traveling direction of the target vehicle. The traveling path for the target vehicle is determined according to the image of the preset range. For example, the target vehicle may perform path planning according to a pattern of the virtual runway in the image, to enable the path for the target vehicle to adapt to the pattern of the virtual runway, i.e., to enable the target vehicle to travel on the virtual runway.

[0092] In a possible implementation, at operation S13, the target vehicle may travel according to the traveling path. For example, the vehicle controller may control a power system and a steering system of the target vehicle, to enable the target vehicle to travel according to the traveling path. For example, when the target vehicle travels according to a traveling path of left turning, the target vehicle may pass through the above-mentioned curve of left curve.

[0093] In a possible implementation, the method further includes the following operations. Second position information of an obstacle, sent by the system for vehicle positioning, is received. The traveling path for the target vehicle in the virtual runway is determined according to the first position information and the second position information. The target vehicle is controlled to travel according to the traveling path.

[0094] In an example, the vehicle controller may: determine the traveling path for the target vehicle according to the first position information and the second position information of the obstacle; determine a traveling path for the target vehicle to avoid the obstacle and travel in the lane without the obstacle; and control the power system and the

steering system of the target vehicle, to enable the target vehicle to travel according to the traveling path.

[0095] In a possible implementation, the method further includes the following operations. A vehicle control instruction sent by the system for vehicle positioning is received. The target vehicle is controlled to travel according to the vehicle control instruction. For example, the target vehicle may only need to receive the remote control from the processor 13 of the system for vehicle positioning, to travel according to the traveling path.

[0096] According to the system for vehicle positioning in the embodiments of the disclosure, the virtual runway can be displayed by the virtual runway display device, and a plurality of runways can be designed for the target vehicle. The sizes of the virtual runways are adapted to the size of the target vehicle. When the target vehicle is replaced, the sizes of the virtual runways can be easily adjusted without buying or building new runways again, such that the cost of the runways can be reduced, and the flexibility of the runway path can be improved. The processor may determine the first position information of the target vehicle according to the target image of the target vehicle traveling on the virtual runway, so that the target vehicle can determine the position of the target vehicle in the runway in real time, and can further accurately travel on the virtual runway. Further, the target vehicle can have a capability of avoiding obstacles by using the second position information, such that the performance of the target vehicle can be improved. In addition, the target vehicle itself does not need to record and adapt to the virtual runway, which can simplify the calculation of the target vehicle during traveling.

[0097] FIG. 4 illustrates an application diagram of a system for vehicle positioning according to embodiments of the disclosure. As illustrated in FIG. 4, the system for vehicle positioning may include a virtual runway display device, an image acquisition device and a processor. The virtual runway display device includes a projector. The pattern of the virtual runway may be stored in the projector. The projection plane may be

a projection curtain or an actual field, which can be used for displaying the pattern projected by the projector. In some embodiments of the disclosure, the size of the virtual runway may be adjusted by adjusting a distance between the projector and the projection plane, to adapt the width of the virtual runway to the width of the target vehicle. For example, the width of the target vehicle is 20 cm, the virtual runway may be a two-lane runway, and the width of each lane may be greater than the width of the target vehicle, for example, the width of each lane is 30 cm, and the width of the virtual runway is 60 cm.

[0098] In a possible implementation, the image acquisition device may include a camera. The camera may be disposed in a position where the image of a complete virtual runway can be captured and the camera and the projector would not block each other, for example, the camera may be disposed below or adjacent to the projector. The camera may take the target image of the target vehicle traveling on the virtual runway in real time while the target vehicle is traveling on the virtual runway, and may send the target image to the processor. The processor may determine the first position information of the target vehicle in the virtual runway in real time according to the target image. For example, the first information may be the offset of the target vehicle in the virtual runway with respect to a lane center line or the image of a preset range in the traveling direction of the target vehicle. The first information may be transmitted to the target vehicle in real time, to enable the target vehicle to determine the traveling path in real time by using the first position information.

[0099] In a possible implementation, the processor may: detect the target vehicle in the target image by using a detection method such as neural network detection, and determine the first position information of the target vehicle in the virtual runway. For example, the first information may be a relative position of the target vehicle in the path of the virtual runway. The vehicle controller of the target vehicle may determine the path of the virtual runway according to the relative position, and further determine the traveling path for the target vehicle. For example, the target vehicle is at a curve of the virtual runway, namely, the path of the virtual runway is a curved path and then the

traveling path for the vehicle is determined as a path for turning. In some embodiments of the disclosure, the vehicle controller may control the power system, the steering system, and the like, of the target vehicle, to enable the target vehicle to travel according to the traveling path, for example, the target vehicle may travel through a curve according to the traveling path.

[00100] In a possible implementation, at least one obstacle may also be provided in the virtual runway. For example, the at least one obstacle may be placed on the display plane, or a pattern of the at least one obstacle may be provided in the pattern of the virtual runway. The processor may: detect the first position information of the target vehicle and the second position information of the at least one obstacle in the target image, and transmit the first position information and the second position information to the vehicle controller of the target vehicle. The vehicle controller may determine a traveling path that can avoid the at least one obstacle according to the first position information and the second position information.

[00101] In an example, the virtual runway may have two lanes, and the obstacle may be provided in one lane of the virtual runway. The vehicle controller may determine a lane to be traveled along according to the first position information when the vehicle controller determines that target vehicle is far from the obstacle according to the second position information. When the vehicle controller determines that target vehicle is near the obstacle according to the second position information, the target vehicle may travel on another lane to avoid the obstacle, and after avoiding the obstacle, the target vehicle may travel back to the original lane. In another example, the virtual runway may have branch roads, the branch roads may include two or more roads, and the obstacle may be located on one of these roads. The vehicle controller may: determine a road on which the obstacle is located according to the second position information, and determine to travel on another road according to the first position information, to avoid the obstacle.

[00102] In a possible implementation, the abovementioned vehicle positioning system may be used in a field of vehicle model competition or education and so on, and the time

and cost of building the runway can be saved. In addition, the target vehicle itself may not need to record and adapt to the virtual runway, which can simplify the calculation of the target vehicle during traveling. The application field of the system for vehicle positioning is not limited in the embodiments of the disclosure.

[00103] FIG. 5 illustrates a flowchart of a method for vehicle positioning according to embodiments of the disclosure. An execution subject of the method for system positioning may be a device for vehicle positioning, such as the system for vehicle positioning in the embodiments of the disclosure, or a processor in the system for vehicle positioning, or a terminal, a remote control device, a server. In addition, the method may also be executed by a processor running a computer-executable code.

[00104] As illustrated in FIG. 5, the method includes the following operations.

[00105] At operation S21, first position information of a target vehicle in a virtual runway is determined according to a target image. The virtual runway is a runway displayed by a virtual runway display device, and the target image is an image of the target vehicle traveling on the virtual runway acquired by an image acquisition device.

[00106] At operation S22, the first position information is transmitted to the target vehicle to enable the target vehicle to travel on the virtual runway according to the first position information.

[00107] In a possible implementation, the method may further include the following operations. Second position information of an obstacle is acquired according to the target image. The second position information is transmitted to the target vehicle to enable the target vehicle to travel on a runway pattern according to the first position information and the second position information.

[00108] In a possible implementation, the method may further include the following operations. The virtual runway display device acquires a field image used for displaying a field of the virtual runway. Field information is acquired according to the field image.

The field information includes a size of the field. A size of the virtual runway and a pattern of the virtual runway are determined according to the field information and a size of the target vehicle.

[00109] In a possible implementation, the method may further include the following operations. Field information and a size of the target vehicle are acquired. A size of the virtual runway and a pattern of the virtual runway are determined according to the field information and the size of the target vehicle. The size of the virtual runway and the pattern of the virtual runway are transmitted to the virtual runway display device.

[00110] In a possible implementation, the method may further include the following operations. A vehicle control instruction is generated at least according to the first position information. The vehicle control instruction is transmitted to the target vehicle to enable the target vehicle to travel on the runway pattern according to the vehicle control instruction.

[00111] In a possible implementation, the operation of determining the first position information of the target vehicle in the virtual runway according to the target image may include the following actions. An offset of the target vehicle in the virtual runway with respect to a lane center line is determined according to the target image. The first position information is generated according to the offset.

[00112] In a possible implementation, the operation of determining the first position information of the target vehicle in the virtual runway according to the target image may include the following actions. An image of a preset range in a traveling direction of the target vehicle is determined according to the target image. The first position information is generated according to the image of the preset range.

[00113] An embodiment of the disclosure provides a method for vehicle positioning. The method is applied to a system for vehicle positioning. The system includes a projector, a camera, and a processor. Taking a car as a target vehicle for illustration, the method includes the following operations. At operation S31, a pattern of the virtual

runway is projected onto a projection plane. Here, it is necessary for the projector to cooperate with the projection plane to project the pattern of the virtual runway. FIG. 2 illustrates a projected virtual runway pattern.

[00114] At operation S41, the camera captures the pattern of the virtual runway and the car on the virtual runway.

[00115] Here, after the camera captures the pattern of the virtual runway and the car on the virtual runway, the processor may position the global position of the car and the position of the obstacle according to the pattern of the virtual runway and the car captured by the camera. The processor may calculate the relative position offset of the car in the virtual runway according to the pattern of the virtual runway, and directly generate a control instruction for the car.

[00116] At operation S51, the car performs a feedback adjustment according to the received position information. In embodiments of the disclosure, the global position of the car and the position of the obstacle are positioned according to the pattern of the virtual runway and the car on the virtual runway, an accurate detection of the obstacle and an estimation of the relative position of the car in the virtual runway are therefore realized. In addition, detection information and estimation information are transmitted to the car in real time, such that the car can adjust the traveling path in real time according to the detection information and the estimation information.

[00117] A usage scenario of embodiments of the disclosure may include one of the following scenarios: 1) an introduction of the research of cars; 2) funds for purchasing an entity platform is not enough; and 3) it is required to develop cars of different sizes at the same time, and runways that match cars of different sizes are required.

[00118] In the embodiments of the disclosure, the position estimation is performed by using a detection algorithm of computer vision. A running platform based on global positioning and real-time information can reduce time and economic cost for building the runway, and the flexibility and the convenience of replacement of the runway can be

enhanced. The cooperation of the projector and the projection plane ensures that the projector can be automatically adjusted according to the size of the projection plane and the size of the car, such that a reasonable runway pattern can be projected. In addition, the camera can acquire the global position of the car and information of the obstacle, and the camera and the car can communicate with each other in real time. Further, the computer vision algorithm can realize accurate detection of the obstacle and estimation of the relative position of the car in the virtual runway.

[00119] In this way, the economic and time cost of the runway can be reduced and the flexibility is strong, which may facilitate the generalization of cars. Moreover, the position estimation can be better performed by using a computer vision algorithm, such that the car can adjust the traveling path in real time according to the detection information and the estimation information. In addition, the diversity of the runway is enriched, and the development of the car can be further improved.

[00120] FIG. 6A illustrates a block diagram of a device 100 for vehicle control according to embodiments of the disclosure. As illustrated in FIG. 6A, the device 100 includes a first receiving module 11, a first determination module 12 and a first traveling module 13. The first receiving module 11 is configured to receive first position information of a target vehicle sent by a system for vehicle positioning. The first determination module 12 is configured to determine a traveling path for the target vehicle in a virtual runway according to the first position information. The first traveling module 13 is configured to control the target vehicle to travel according to the traveling path.

[00121] In a possible implementation, the first determination module may be further configured to determine an offset of the target vehicle in the virtual runway with respect to a lane center line according to the first position information; and determine the traveling path for the target vehicle according to the offset.

[00122] In a possible implementation, the first determination module may be further

configured to: determine an image of a preset range in a traveling direction of the target vehicle according to the first position information; and determine the traveling path for the target vehicle according to the image of the preset range.

[00123] In a possible implementation, the device may further include a second receiving module and a control module. The second receiving module is configured to receive a vehicle control instruction sent by the system for vehicle positioning. And the control module is configured to control the target vehicle to travel according to the vehicle control instruction.

[00124] In a possible implementation, the device may further include a third receiving module, a second determination module and a second traveling module. The third receiving module is configured to receive second position information of an obstacle sent by the system for vehicle positioning. The second determination module is configured to determine the traveling path for the target vehicle in the virtual runway according to the first position information and the second position information. The second traveling module is configured to control the target vehicle to travel according to the traveling path.

[00125] FIG. 6B illustrates a block diagram of a device 200 for vehicle positioning according to embodiments of the disclosure. As illustrated in FIG. 6B, the device 200 includes a third determination module 21 and a first transmission module 22. The third determination module is configured to determine first position information of a target vehicle in a virtual runway according to a target image. The virtual runway is a runway displayed by a virtual runway display device, and the target image is an image of the target vehicle traveling on the virtual runway acquired by an image acquisition device. The first transmission module is configured to transmit the first position information to the target vehicle to enable the target vehicle travel on the virtual runway according to the first position information.

[00126] In a possible implementation, the device may further include a first acquisition

module and a second transmission module. The first acquisition module is configured to acquire second position information of an obstacle according to the target image. The second transmission module is configured to transmit the second position information to the target vehicle to enable the target vehicle to travel on a runway pattern according to the first position information and the second position information.

[00127] In a possible implementation, the device may further include a second acquisition module, a third acquisition module and a fourth determination module. The second acquisition module is configured to acquire a field image used for displaying a field of the virtual runway by the virtual runway display device. The third acquisition module is configured to acquire field information according to the field image. The field information comprises a size of the field. The fourth determination module is configured to determine a size of the virtual runway and a pattern of the virtual runway according to the field information and a size of a target vehicle.

[00128] In a possible implementation, the device may further include a fourth acquisition module and a fifth determination module. The fourth acquisition module is configured to acquire the field information and the size of the target vehicle. The fifth determination module is configured to: determine the size of the virtual runway and the pattern of the virtual runway according to the field information and the size of the target vehicle; and transmit the size of the virtual runway and the pattern of the virtual runway to the virtual runway display device.

[00129] In a possible implementation, the device may further include a generation module and a third transmission module. The generation module is configured to generate a vehicle control instruction at least according to the first position information. The third transmission module is configured to transmit the vehicle control instruction to the target vehicle to enable the target vehicle to travel on the runway pattern according to the vehicle control instruction.

[00130] In a possible implementation, the third determination module may be further

configured to: determine an offset of the target vehicle in the virtual runway with respect to a lane center line according to the target image; and generate the first position information according to the offset.

[00131] In a possible implementation, the third determination module may be further configured to: determine an image of a preset range in a traveling direction of the target vehicle according to the target image; and generate the first position information according to the image of the preset range.

[00132] It would be understood that each of the abovementioned methods in the embodiments of the disclosure may be combined with each other to form a combined embodiment without departing from the principle logic. Due to the limit of space, details are not described herein for brevity.

[00133] It should be understood by those skilled in the art that in the abovementioned methods of the specific embodiments, the order in which the operations are described does not imply a strict order of execution that constitutes any limitation on the implementation process, and that the order in which the operations are executed should be determined in terms of their function and possible intrinsic logic. In some embodiments, the devices provided by the embodiments of the disclosure may have functions or include modules that may be configured to perform the methods described in the above method embodiments, the implementation of which may be understood with reference to the above method embodiments, and details are not described herein for brevity.

[00134] Embodiments of the disclosure provide a computer readable storage medium having stored thereon computer program instructions that, when executed by a processor, the method as described above is implemented. The computer-readable storage medium may be a non-volatile computer-readable storage medium.

[00135] Embodiments of the disclosure also provide a computer program product comprising computer readable codes. When computer readable codes are run on a device,

a processor in the electronic device executes instructions configured to implement the method provided in any of the above embodiments.

[00136] Embodiments of the disclosure also provide another computer program product, which is configured to store computer readable instructions. When the instructions are executed, the computer performs operations of the method provided in any of the above embodiments.

[00137] The computer program product may be implemented in hardware, software, or a combination thereof. In an optional embodiment, the computer program product is reflected as a computer storage medium. In another embodiment, the computer program product is reflected as a software product, such as a software development kit (SDK).

[00138] Embodiments of the disclosure further provide an electronic device including a processor and a memory configured to store processor-executable instructions. The processor is configured to perform the above method. The electronic device may be provided as a terminal, a server, or another form of device. FIG. 7 illustrates a block diagram of an electronic device 800 according to an embodiment of the disclosure. For example, the electronic device 800 may be a mobile phone, a computer, a digital broadcast terminal, a messaging device, a game console, a tablet device, a medical device, an exercise device, a personal digital assistant, or the like. Referring to FIG. 7, the electronic device 800 may include one or more of the following components: a processing component 802, a memory 804, a power component 806, a multimedia component 808, an audio component 810, an input/output (I/O) interface 812, a sensor component 814, and a communication component 816. The processing component 802 generally controls the overall operation of the electronic device 800, such as operations associated with displays, telephone calls, data communications, camera operations, and recording operations. The processing component 802 may include one or more processors 820 configured to execute instructions to perform all or partial of the operations of the methods described above. In addition, the processing component 802 may include one or more modules to facilitate interaction between the processing

component 802 and other components. For example, the processing component 802 may include a multimedia module to facilitate interaction between the multimedia component 808 and the processing component 802. The memory 804 is configured to store various types of data to support operations at the electronic device 800. Examples of such data include: instructions of any application or method configured to operate on electronic device 800, contact data, phone book data, messages, pictures, video, and the like. The memory 804 may be implemented by any type of volatile or non-volatile storage device or a combination thereof, such as static random-access memory (SRAM), electrically erasable programmable read only memory (EEPROM), erasable programmable read-only memory (EPROM), programmable read-only memory (PROM), read-only memory (ROM), magnetic memory, flash memory, magnetic disk, or optical disk. The power component 806 provides power to various components of the electronic device 800. The power component 806 may include a power management system, one or more power supplies, and other components associated with generating, managing, and distributing power for the electronic device 800. The multimedia component 808 includes a screen providing an output interface between the electronic device 800 and a user. In some embodiments, the screen may include a Liquid Crystal Display (LCD) and a Touch panel (TP). In a case where the screen includes a touch panel, the screen may be implemented as a touch screen to receive input signals from a user. The touch panel includes one or more touch sensors to sense touch and slide, and gestures on the touch panel. The touch sensor may not only sense the boundary of a touch or sliding action, but also detect the duration and pressure associated with the touch or sliding operation. In some embodiments, the multimedia component 808 includes a front-facing camera and/or a rear-facing camera. In the case where the electronic device 800 is in an operation mode, such as a shooting mode or a video mode, the front-facing camera and/or the rear-facing camera may receive external multimedia data. Each of the front-facing camera and rear-facing camera may be a fixed optical lens system or have a focal length and optical zoom capability. The audio component 810 is configured to output and/or input audio signals. For example, the audio component 810 includes a microphone (MIC). In a case where the electronic device 800 is in an operating mode,

such as a call mode, a recording mode, and a speech recognition mode, the microphone is configured to receive an external audio signal. The received audio signal may be stored in memory 804 or transmitted via communication component 816. In some embodiments, audio component 810 further includes a speaker configured to output an audio signal. The I/O interface 812 provides an interface between the processing component 802 and a peripheral interface module. The above peripheral interface module may be a keyboard, a click wheel, a button, or the like. These buttons may include, but are not limited to, a home page button, a volume button, an activation button, and a lock button. The sensor component 814 includes one or more sensors configured to provide various aspects of the state assessment for the electronic device 800. For example, the sensor component 814 may detect an on/off state of the electronic device 800, a relative positioning of the components, for example, the components are a display and keypad of the electronic device 800. The sensor component 814 may also detect: a position change of the electronic device 800 or one of the components of the electronic device 800, whether there is contact between user and the electronic device 800, an orientation or acceleration/deceleration of the electronic device 800, and a temperature change in the electronic device 800. The sensor component 814 may include a proximity sensor configured to detect the presence of a nearby object without any physical contact. The sensor component 814 may also include a photo sensor, such as a complementary metal oxide semiconductor (CMOS) or charge-coupled device (CCD) image sensor, configured for use in imaging applications. In some embodiments, the sensor component 814 may also include an acceleration sensor, a gyroscope sensor, a magnetic sensor, a pressure sensor, or a temperature sensor. The communication component 816 is configured to facilitate wired or wireless communication between electronic device 800 and other devices. The electronic device 800 may access a wireless network based on a communication standard, such as WiFi, 2-Generation wireless telephone technology (2G) or 3-Generation wireless telephone technology (3G), or a combination thereof. In one exemplary embodiment, the communication component 816 receives broadcast signals or broadcast-related information from an external broadcast management system via a broadcast channel. In one exemplary embodiment, the communication component 816

further includes a near field communication (NFC) module to facilitate short-range communication. For example, the NFC module may be implemented based on radio frequency identification (RFID) technology, infrared data association (IrDA) technology, ultra wide band (UWB) technology, bluetooth (BT) technology, and other technologies.

[00139] In an exemplary embodiment, the electronic device 800 may be implemented by one or more application specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), controllers, microcontrollers, microprocessors, or other electronic components, to perform the above-described methods.

[00140] In an exemplary embodiment, a non-volatile computer-readable storage medium is also provided. For example, the above non-volatile computer-readable storage medium includes a memory 804 including computer program instructions. The above computer program instructions can be executable by the processor 820 of the electronic device 800 to implement the methods described above.

[00141] FIG. 8 illustrates a block diagram of an electronic device 1900 according to embodiments of the present disclosure. For example, the electronic device 1900 may be provided as a server. Referring to FIG. 8, the electronic device 1900 includes: a processing component 1922 that includes one or more processors; and memory resources represented by a memory 1932, configured to store instructions executed by the processing component 1922, such as application. The application stored in memory 1932 may include one or more modules each corresponding to a set of instructions. In addition, processing component 1922 is configured to execute instructions to perform the methods described above. The electronic device 1900 may also include: a power component 1926 configured to perform power management of the electronic device 1900; a wired or wireless network interface 1950 configured to connect the electronic device 1900 to a network; and an input/output (I/O) interface 1958. The electronic device 1900 may operate an operating system stored in the memory 1932, such as Windows Server™, Mac OS X™, Unix™, Linux™, FreeBSD™, or the like. In an exemplary

embodiment, a non-volatile computer-readable storage medium is also provided. For example, the non-volatile computer-readable storage medium is a memory 1932 including computer program instruction. The computer program instructions can be executable by the processing component 1922 of the electronic device 1900 to perform the methods described above.

[00142] The embodiments of the disclosure may be systems, methods, and/or computer program products. The computer program product may include a computer readable storage medium containing computer readable program instructions thereon, which are configured to cause a processor to implement various aspects of embodiments of the disclosure.

[00143] The computer-readable storage medium may be a tangible device that may hold and store instructions for use by an instruction execution device. The computer-readable storage medium may be, for example, but not limited to, an electrical storage device, a magnetic storage device, an optical storage device, an electromagnetic storage device, a semiconductor storage device, or any suitable combination of the above. Examples (non-exhaustive list) of the computer-readable storage medium include a portable computer disk, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or flash memory), a static random access memory (SRAM), a compact disc read-only memory (CD-ROM), a digital video disc (DVD), a memory stick, a floppy disk, a mechanical encoding device, such as a punch slot or in-recess bump structure on which instructions are stored, and any suitable combination of the above. As used herein, a computer-readable storage medium is not to be explained as an instantaneous signal itself, such as a radio wave or other freely propagating electromagnetic wave, an electromagnetic wave propagating through a waveguide or other transmission medium (e.g., an optical pulse through a fiber optic cable), or an electrical signal transmitted through a wire. The computer readable program instructions described herein may be downloaded from a computer readable storage medium to various computing/processing devices, or to an external computer or external storage device via a network, such as the

Internet, a local area network, a wide area network, and/or a wireless network. The network may include copper transmission cables, fiber optic transmission, wireless transmission, routers, firewalls, switches, gateway computers, and/or edge servers. A network adapter card or network interface in each computing/processing device receives computer readable program instructions from the network and forwards the computer readable program instructions for storing in a computer readable storage medium in the respective computing/processing device.

[00144] The computer program instructions for performing the operations of the embodiments of the disclosure may be assembly instructions, industry standard architecture (ISA) instructions, machine instructions, machine-related instructions, microcode, firmware instructions, state setting data, or source code or object code written in any combination of one or more programming languages, including object-oriented programming languages such as Smalltalk, C++, and conventional procedural programming languages such as “C” language or similar programming languages. The computer readable program instructions may be executed: entirely on the user computer, partly on the user computer, as a separate software package, partly on the user computer and partly on the remote computer, or entirely on the remote computer or server. In the case involving a remote computer, the remote computer may be connected to the user computer through any kind of network including a local area network (LAN) or a wide area network (WAN), or may be connected to an external computer (e.g., connection via the Internet through an Internet service provider). In some embodiments, various aspects of embodiments of the disclosure are implemented by personalizing an electronic circuit, such as a programmable logic circuit, a field programmable gate array (FPGA), or a programmable logic array (PLA), with the status information of the computer-readable program instructions.

[00145] Aspects of embodiments of the disclosure are described herein with reference to flowcharts and/or block diagrams of methods, apparatus (systems), and computer program products in accordance with embodiments of the disclosure. It should be understood that each block of the flowcharts and/or block diagrams, and combinations of

blocks in the flowcharts and/or block diagrams, can be implemented by computer readable program instructions.

[00146] The computer readable program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus, to produce a machine such that the instructions, when executed by the processor of the computer or other programmable data processing apparatus, produce apparatus for implementing the functions/acts specified in one or more blocks of the flowcharts and/or block diagrams. The computer-readable program instructions may also be stored in a computer-readable storage medium. The instructions cause computers, programmable data processing apparatus, and/or other devices to operate in a particular manner. Therefore, the computer-readable medium having stored thereon the instructions includes a manufacture that includes instructions that implement various aspects of the functions/acts specified in the one or more blocks of the flowchart and/or block diagrams.

[00147] The computer readable program instructions may also be loaded onto computers, other programmable data processing apparatus, or other devices, such that a series of operational steps are performed on the computers, other programmable data processing apparatus, or other devices to produce a computer-implemented process. Therefore, the functions/actions specified in one or more blocks of the flowcharts and/or block diagrams can be implemented by the instructions that executed on the computers, other programmable data processing apparatus, or other devices.

[00148] The flowcharts and block diagrams in the drawings illustrate architectures, functions, and operations of possible implementations of multiple systems, methods, and computer program products in various embodiments of the disclosure. In this regard, each block in a flowchart or block diagram may represent a module, program segment, or part of an instruction. The module, program segment, or part of the instruction includes one or more executable instructions for implementing a specified logical function. In some alternative implementations, the functions noted in the blocks may

also occur in an order different from that noted in the drawings. For example, two successive blocks may actually be executed substantially in parallel, and may sometimes be executed in a reverse order, which depends on the functionality involved. It is also noted that each block of the block diagrams and/or flowcharts and combinations of blocks in the block diagrams and/or flowcharts, may be implemented by a dedicated hardware-based system that performs specified functions or actions, or may be implemented by a combination of the dedicated hardware and computer instructions.

[00149] The various embodiments of the disclosure have been described above. The above description is illustrative, not exhaustive, and is not limited to the various embodiments disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the illustrated embodiments. The choice of terms used herein is intended to best explain the principles and practical applications the various embodiments, or technical improvements to the technology in the marketplace, or to enable others of ordinary skill in the art to understand the various embodiments disclosed herein.

INDUSTRIAL APPLICABILITY

[00150] The disclosure relates to a system and a method for vehicle positioning, and a method and a device for vehicle control. The system includes a virtual runway display device, an image acquisition device, and a processor. The virtual runway display device is configured to display a virtual runway. The image acquisition device is configured to acquire a target image in a process of a target vehicle traveling on the virtual runway. The processor is configured to: determine first position information of the target vehicle in the virtual runway according to the target image, and transmit the first position information to the target vehicle. According to the vehicle positioning system in the embodiments of the disclosure, the virtual runway can be displayed by the virtual runway display device, and a plurality of runways can be designed for the target vehicle.

Therefore, the cost of the runway can be reduced, a time for building the runway is not required and the flexibility of the runway path is improved. In addition, the target vehicle can determine the position of the target vehicle in the runway in real time, and further accurately travel on the virtual runway. Therefore, the target vehicle itself does not need to record and adapt to the virtual runway, which can simplify the calculation of the target vehicle during traveling.

CLAIMS

1. A system for vehicle positioning, comprising a virtual runway display device, an image acquisition device and a processor; wherein

the virtual runway display device is configured to display a virtual runway;

the image acquisition device is located above the virtual runway and is configured to acquire a target image in a process of a target vehicle traveling on the virtual runway; and

the processor is connected to or disposed inside the image acquisition device, and the processor is configured to:

determine first position information of the target vehicle in the virtual runway according to the target image; and

transmit the first position information to the target vehicle to enable the target vehicle to travel on the virtual runway according to the first position information.

2. The system of claim 1, wherein the processor is further configured to:

acquire second position information of an obstacle according to the target image; and

transmit the second position information to the target vehicle to enable the target vehicle to travel on the virtual runway according to the first position information and the second position information.

3. The system of claim 1 or 2, wherein the virtual runway display device comprises a projection device, and the projection device is configured to project a pattern of the virtual runway.

4. The system of claim 3, wherein the projection device comprises a projector and a projection plane, and the projector is configured to project the pattern of the virtual runway onto the projection plane.

5. The system of any one of claims 1 to 4, wherein the virtual runway display device comprises an augmented reality device, and the augmented reality device is configured to display the virtual runway in an augmented reality interface.

6. The system of any one of claims 1 to 5, wherein the virtual runway display device is further configured to determine a size of the virtual runway according to a size of the target vehicle; and

wherein the size of the target vehicle comprises a width of the target vehicle, and the size of the virtual runway comprises a runway width.

7. The system of any one of claims 1 to 5, wherein the virtual runway display device is configured to:

acquire a field image used for displaying a field of the virtual runway;

acquire field information according to the field image, wherein the field information comprises a size of the field; and

determine a size of the virtual runway and a pattern of the virtual runway according to the field information and a size of the target vehicle.

8. The system of claim 1, wherein the processor is further configured to:

acquire field information and a size of the target vehicle;

determine a size of the virtual runway and a pattern of the virtual runway according to the field information and the size of the target vehicle, and

transmit the size of the virtual runway and the pattern of the virtual runway to the virtual runway display device.

9. The system of any one of claims 1 to 8, wherein the processor is further configured to:

generate a vehicle control instruction at least according to the first position information; and

transmit the vehicle control instruction to the target vehicle to enable the target vehicle to travel on the virtual runway according to the vehicle control instruction.

10. The system of any one of claims 1 to 9, wherein the processor is further configured to:

determine an offset of the target vehicle in the virtual runway with respect to a lane center line according to the target image; and

generate the first position information according to the offset.

11. The system of any one of claims 1 to 9, wherein the processor is further configured to:

determine an image of a preset range in a traveling direction of the target vehicle according to the target image; and

generate the first position information according to the image of the preset range.

12. The system of any one of claims 1 to 11, wherein the system further comprises:

a target vehicle, configured to travel on the virtual runway at least according to the first position information.

13. The system of claim 12, wherein the first position information comprises: an offset of the target vehicle in the virtual runway with respect to a lane center line, or an image of a preset range in a traveling direction of the target vehicle; and the target vehicle is further configured to:

determine a traveling path for the target vehicle according to the offset or determine the traveling path for the target vehicle according to the image of the preset range in the traveling direction of the target vehicle.

14. A method for vehicle control, comprising:

receiving first position information of a target vehicle sent by a system for vehicle positioning;

determining a traveling path for the target vehicle in a virtual runway according to the first position information; and

controlling the target vehicle to travel according to the traveling path.

15. The method of claim 14, wherein determining the traveling path for the target vehicle in the virtual runway according to the first position information comprises:

determining an offset of the target vehicle in the virtual runway with respect to a lane

center line according to the first position information; and

determining the traveling path for the target vehicle according to the offset.

16. The method of claim 14, wherein determining the traveling path for the target vehicle in the virtual runway according to the first position information comprises:

determining an image of a preset range in a traveling direction of the target vehicle according to the first position information; and

determining the traveling path for the target vehicle according to the image of the preset range.

17. The method of any one of claims 14 to 16, further comprising:

receiving a vehicle control instruction sent by the system for vehicle positioning; and

controlling the target vehicle to travel according to the vehicle control instruction.

18. The method of any one of claims 14 to 16, wherein further comprising:

receiving second position information of an obstacle sent by the system for vehicle positioning; and

determining the traveling path for the target vehicle in the virtual runway according to the first position information and the second position information; and

controlling the target vehicle to travel according to the traveling path.

19. A method for vehicle positioning, including:

determining first position information of a target vehicle in a virtual runway according to a target image, wherein the virtual runway is a runway displayed by a virtual runway display device, and the target image is an image of the target vehicle traveling on the virtual runway acquired by an image acquisition device; and

transmitting the first position information to the target vehicle to enable the target vehicle to travel on the virtual runway according to the first position information.

20. The method of claim 19, further comprising:

acquiring second position information of an obstacle according to the target image;
and

transmitting the second position information to the target vehicle to enable the target vehicle to travel on the runway pattern according to the first position information and the second position information.

21. The method of claim 19, further comprising:

acquiring, by the virtual runway display device, a field image used for displaying a field of the virtual runway;

acquiring field information according to the field image, wherein the field information comprises a size of the field; and

determining a size of the virtual runway and a pattern of the virtual runway according to the field information and a size of the target vehicle.

22. The method of claim 19, further comprising:

acquiring the field information and the size of the target vehicle;

determining the size of the virtual runway and the pattern of the virtual runway according to the field information and the size of the target vehicle, and

transmitting the size of the virtual runway and the pattern of the virtual runway to the virtual runway display device.

23. The method of any one of claims 19 to 22, further comprising:

generating a vehicle control instruction at least according to the first position information; and

transmitting the vehicle control instruction to the target vehicle to enable the target vehicle to travel on the runway pattern according to the vehicle control instruction.

24. The method of any one of claims 19 to 23, wherein determining the first position information of the target vehicle in the virtual runway according to the target image comprises:

determining an offset of the target vehicle in the virtual runway with respect to a lane center line according to the target image; and

generating the first position information according to the offset.

25. The method of any one of claims 19 to 23, wherein determining the first position information of the target vehicle in the virtual runway according to the target image comprises:

determining an image of a preset range in a traveling direction of the target vehicle according to the target image; and

generating the first position information according to the image of the preset range.

26. A device for vehicle control, including:

a first receiving module, configured to receive first position information of a target vehicle sent by a system for vehicle positioning;

a first determination module, configured to determine a traveling path for the target vehicle in a virtual runway according to the first position information; and

a first traveling module, configured to control the target vehicle to travel according to the traveling path.

27. The device of claim 26, wherein the first determination module is further configured to:

determine an offset of the target vehicle in the virtual runway with respect to a lane center line according to the first position information; and

determine the traveling path for the target vehicle according to the offset.

28. The device of claim 26, wherein the first determination module is further configured to:

determine an image of a preset range in a traveling direction of the target vehicle according to the first position information; and

determine the traveling path for the target vehicle according to the image of the preset range.

29. The device of claim 26, further comprising:

a second receiving module, configured to receive a vehicle control instruction sent by the system for vehicle positioning; and

a control module, configured to control the target vehicle to travel according to the vehicle control instruction.

30. The device of claim 26, further comprising:

a third receiving module, configured to receive second position information of an obstacle sent by the system for vehicle positioning;

a second determination module, configured to determine the traveling path for the target vehicle in the virtual runway according to the first position information and the second position information; and

a second traveling module, configured to control the target vehicle to travel according to the traveling path.

31. A device for vehicle positioning, including:

a third determination module, configured to determine first position information of a target vehicle in a virtual runway according to a target image, wherein the virtual runway is a runway displayed by a virtual runway display device, and the target image is an image of the target vehicle traveling on the virtual runway acquired by an image acquisition device; and

a first transmission module, configured to transmit the first position information to the target vehicle to enable the target vehicle travel on the virtual runway according to the first

position information.

32. The device of claim 31, further comprising:

a first acquisition module, configured to acquire second position information of an obstacle according to the target image; and

a second transmission module, configured to transmit the second position information to the target vehicle to enable the target vehicle to travel on a runway pattern according to the first position information and the second position information.

33. The device of claim 31, further comprising:

a second acquisition module, configured to acquire a field image used for displaying a field of the virtual runway by the virtual runway display device;

a third acquisition module, configured to acquire field information according to the field image, wherein the field information comprises a size of the field; and

a fourth determination module, configured to determine a size of the virtual runway and a pattern of the virtual runway according to the field information and a size of a target vehicle.

34. The device of claim 33, further comprising:

a fourth acquisition module, configured to acquire the field information and the size of the target vehicle;

a fifth determination module, configured to determine the size of the virtual runway and the pattern of the virtual runway according to the field information and the size of the

target vehicle, and transmit the size of the virtual runway and the pattern of the virtual runway to the virtual runway display device.

35. The device of claim 31, further comprising:

a generation module, configured to generate a vehicle control instruction at least according to the first position information; and

a third transmission module, configured to transmit the vehicle control instruction to the target vehicle to enable the target vehicle to travel on the runway pattern according to the vehicle control instruction.

36. The device of claim 31, wherein the third determination module is further configured to:

determine an offset of the target vehicle in the virtual runway with respect to a lane center line according to the target image; and

generate the first position information according to the offset.

37. The device of claim 31, wherein the third determination module is further configured to:

determine an image of a preset range in a traveling direction of the target vehicle according to the target image; and

generate the first position information according to the image of the preset range.

38. An electronic device, comprising:

a processor; and

a memory configured to store processor-executable instructions;

wherein the processor is configured to perform the method for vehicle control of any one of claims 14 to 18, or perform the method for vehicle positioning of any one of claims 19 to 25.

39. A computer-readable storage medium, having computer program instructions stored thereon, the computer program instructions being executed by the processor to perform the method for vehicle control of any one of claims 14 to 18, or perform the method for vehicle positioning of any one of claims 19 to 25.

40. A computer program product, comprising computer readable codes, when run in an electronic device, the computer readable codes cause a processor of the electronic device to perform the method for vehicle control of any one of claims 14 to 18, or perform the method for vehicle positioning of any one of claims 19 to 25.