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Inventor(s)	LEE; Jun Min

VEHICLE AND METHOD OF CONTROLLING THE SAME

Abstract

A vehicle and a method of controlling the same are disclosed. The vehicle according to an aspect of the present disclosure includes a vehicle body; an environment sensor configured to generate environment detection information on an external environment; a support member coupled to the vehicle body and the environment sensor, respectively; and an actuator coupled to the vehicle body and one part of the support member, respectively, and configured to move the one part of the support member in a direction toward the vehicle body and a direction opposite to the vehicle body, wherein one side of the support member in a height direction is coupled to the actuator, and the other side of the support member in the height direction is rotatably coupled to the vehicle body, so that when the actuator is operated, the environment sensor rotates clockwise or counterclockwise about the other side of the support member.

Inventors:	**LEE; Jun Min (Incheon, KR)**
Applicant:	**HL KLEMOVE CORP.** (Incheon, KR)
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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2024-0023294, filed on Feb. 19, 2024, the disclosures of which is incorporated herein by reference in its entirety.

FIELD

[0002] The present disclosure relates to a vehicle and method of controlling the same, and more particularly, to a vehicle in which an area recognized by components for autonomous driving may be actively adjusted when the vehicle enters a slope road while driven, and a method of controlling the same.

BACKGROUND

[0003] Light Detection And Ranging (LIDAR) is a radar system that measures the distance to the outside using a laser pulse. The LIDAR device radiates laser light to the surrounding area and measures the time it takes for it to reflect outside and return to measure the distance to the outside and the shape of the measurement object.

[0004] Recently, the LIDAR device has be used in various technical fields such as mobile robots. In particular, the LIDAR device is actively applied to a vehicle for driver assistance and autonomous driving. The LIDAR device installed in the vehicle plays a very important role in recognizing objects present in the surrounding environment while the vehicle is driven.

[0005] The LIDAR device may recognize objects located at a predetermined field of view (FOV). In this case, the FOV of the LIDAR sensor is formed to have a fixed FOV in the height direction, that is, up and down directions or in the width direction, that is, left and right directions.

[0006] Meanwhile, when the LIDAR sensor is arbitrarily moved or rotated, the accuracy of the information collected may be deteriorated. Therefore, it is general that the LIDAR sensor is fixedly installed in a frame of the vehicle or the like.

[0007] Meanwhile, the road on which the vehicle is driven may be largely divided into a flat surface and a slope surface. When the vehicle is driven on the flat surface, the LIDAR device recognizes the object located within the predetermined FOA, and the vehicle's driving may be controlled according to the result. On the other hand, when the vehicle enters the slope surface, a situation may occur in which the LIDAR device may not accurately recognize the object.

[0008] Specifically, before the vehicle enters the slope surface, the LIDAR device may recognize that there is a slope surface on the front side. However, at the moment when the vehicle enters the slope surface and after the vehicle enters the slope surface, the FOA of the LIDAR device is fixed the same as when driven on the flat surface, so that some of the recognized objects may be missed. In this case, there is a concern that the accuracy and safety of the autonomous driving may be deteriorated.

[0009] Korean Patent Registration No. 10-2515614 discloses a system and method for adjusting the field of view of a sensor. More specifically, disclosed are a system and method for adjusting a field of view of a sensor by separately utilizing information related to an autonomous driving map for a moving route from a departure point to a destination point of a driving vehicle.

[0010] However, the system and method for adjusting the field of view of the sensor disclosed in the above prior document require additional information related to an autonomous driving map. Except for the case where the information is directly stored in the vehicle, when it is obtained by communication with the outside, there is a risk that immediate adjustment will not be possible depending on the communication status.

[0011] Korean Patent Registration No. 10-2343020 discloses a position signal correction device of an autonomous vehicle using road surface image information. More specifically, disclosed is a position signal correction device capable of correcting a GPS position signal of an autonomous vehicle by using image information of a road surface acquired during the driving.

[0012] However, the position signal correction device disclosed in the above prior document provides only a method for accurately determining the position of a driving vehicle. That is, the prior document does not provide a method for recognizing the entrance of the slope surface and adjusting the field of view (FOV) of the sensor. [0013] (Patent document 1) Korean Patent Registration No. 10-2515614 (2023 Mar. 24) [0014] (Patent document 2) Korean Patent Registration No. 10-2343020 (2021 Dec. 21)

SUMMARY

Technical Problem

[0015] The present disclosure is to solve the above problems, and an object of the present disclosure is to provide a vehicle for actively adjusting a field of view (FOV) of a component that detects information on an external environment according to a slope of a ground on which the vehicle is driven, and a method of controlling the same.

[0016] Another object of the present disclosure is to provide a vehicle for accurately detecting whether the vehicle enters a slope surface, and a method of controlling the same.

[0017] Still another object of the present disclosure is to provide a vehicle for accurately detecting information on an external environment in which the vehicle is driven, and a method of controlling the same.

[0018] Still another object of the present disclosure is to provide a vehicle for easily providing a component for detecting information on an external environment, and a method of controlling the same.

[0019] Still another object of the present disclosure is to provide a vehicle for achieving the above objects in a simplified structure, and a method of controlling the same.

[0020] The technical objects of the present disclosure are not limited to the above-mentioned technical objects, and other technical objects not mentioned may be clearly understood by those skilled in the art to which the present disclosure pertains from the following description.

Technical Solution

[0021] According to an aspect of the present disclosure, there is provided a vehicle, the vehicle including: a vehicle body; an environment sensor configured to generate environment detection information on an external environment; a support member coupled to the vehicle body and the environment sensor, respectively; and an actuator coupled to the vehicle body and one part of the support member, respectively, and configured to move the one part of the support member in a direction toward the vehicle body and a direction opposite to the vehicle body, wherein one side of the support member in a height direction is coupled to the actuator, and the other side of the support member in the height direction is rotatably coupled to the vehicle body, so that when the actuator is operated, the environment sensor rotates clockwise or counterclockwise about the other side of the support member.

[0022] In this case, a vehicle may be provided wherein the support member includes: a bracket member coupled to the environment sensor; a variable shaft coupled to one side of the bracket member in the height direction and the actuator, respectively; and a fixed shaft coupled to the other side of the bracket member in the height direction and the vehicle body, respectively.

[0023] In addition, a vehicle may be provided wherein the variable shaft and the fixed shaft are rotatably coupled to the bracket member, respectively, and the environment sensor is fixedly coupled to the bracket member to rotate clockwise or counterclockwise about a portion where the fixed shaft and the bracket member are coupled.

[0024] In this case, a vehicle may be provided, including: a controller electrically connected to the environment sensor and the actuator, respectively, and configured to control the actuator using the generated environment detection information.

[0025] In addition, a vehicle may be provided, wherein the controller control the actuator to move the support member in a direction toward the vehicle body such that the environment sensor is tilted upward when the generated environment detection information means that a first slope surface is located on a front side.

[0026] In this case, a vehicle may be provided, including: an inclination sensor electrically connected to the controller and configured to generate inclination detection information on a slope of a surface on which the vehicle is located, wherein the controller controls the actuator to move the support member in a direction opposite to the vehicle body such that the environment sensor is tilted downward when the inclination detection information generated after entering the first slope surface is less than a predetermined first angle.

[0027] In addition, a vehicle may be provided, wherein the controller controls the actuator to move the support member in a direction opposite to the vehicle body such that the environment sensor is tilted downward when the generated environment detection information means that a second slope surface is located on a front side.

[0028] In this case, a vehicle may be provided, including: an inclination sensor electrically connected to the controller and configured to generate inclination detection information on a slope of a surface on which the vehicle is located, wherein the controller controls the actuator to move the support member in a direction toward the vehicle body such that the environment sensor is tilted upward when the inclination detection information generated after entering the second slope surface is less than a predetermined second angle.

[0029] In addition, a vehicle may be provided, including: an inclination sensor electrically connected to the controller and configured to generate inclination detection information on a slope of a surface on which the vehicle is located, wherein the controller calculates control information for controlling the actuator using only the environment detection information when the generated environment detection information means that a flat surface is located on a front side, and the generated inclination detection information means that a first slope surface or a second slope surface is located on the front side.

[0030] In this case, a vehicle may be provided, wherein the environment sensor includes one or more of a LIDAR sensor, a camera sensor, and a 4D imaging radar sensor.

[0031] In addition, according to an aspect of the present disclosure, there is provided a method of controlling a vehicle, the method including: (a) generating, by an environment sensor provided in a vehicle, environment detection information on an external environment; (b) controlling, by a controller, an actuator coupled with the environment sensor using the generated environment detection information; (c) generating, by an inclination sensor, inclination detection information on a slope on which the vehicle is disposed; and (d) controlling, by the controller, the actuator using the generated inclination detection information.

[0032] In this case, there is provided a method of controlling a vehicle, wherein the step (a) includes: (a**1**) generating, by the environment sensor, the environment detection information on a slope of a road located on a front side thereof; and (a**2**) transmitting, by the environment sensor, the generated environment detection information to the controller.

[0033] In addition, there is provided a method of controlling a vehicle, wherein the step (b) includes: (b**1**) controlling, by the controller, the actuator to maintain an angle of the environment sensor, when the generated environment detection information means that a road located on a front side is a flat surface; (b**2**) controlling, by the controller, the actuator to tilt the environment sensor upward, when the generated environment detection information means that a road located on a front side is a first slope surface; and (b**3**) controlling, by the controller, the actuator to tilt the environment sensor downward, when the generated environment detection information means that a road located on a front side is a second slope surface.

[0034] In this case, there is provided a method of controlling a vehicle, wherein the step (b) further includes before the steps (b**1**) to (b**3**): (b**0**) generating, by the inclination sensor, the inclination detection information on an angle at which the vehicle is disposed, and wherein the step (b**1**) includes: (b**11**) controlling, by the controller, the actuator to maintain the angle of the environment sensor regardless of the generated inclination detection information.

[0035] In addition, there is provided a method of controlling a vehicle, wherein the step (d) includes: (d**1**) controlling, by the controller, the actuator to tilt the environment sensor downward, when the inclination detection information generated while the environment sensor is tilted upward is less than a predetermined first angle; and (d**2**) controlling, by the controller, the actuator to tilt the environment sensor upward when the inclination detection information generated while the environment sensor is tilted downward is less than a predetermined second angle.

Advantageous Effects

[0036] According to the above configuration, the vehicle and method of controlling the same according to an embodiment of the present disclosure can actively adjust a field of view (FOV) of a component that detects information on an external environment according to a slope of a ground on which the vehicle is driven.

[0037] Additionally, according to the above configuration, the vehicle and method of controlling the same according to an embodiment of the present disclosure can accurately detect whether the vehicle enters a slope surface.

[0038] Additionally, according to the above configuration, the vehicle and method of controlling the same according to an embodiment of the present disclosure can accurately detect information on an external environment in which the vehicle is driven.

[0039] Additionally, according to the above configuration, the vehicle and method of controlling the same according to an embodiment of the present disclosure can easily provide a component for detecting information on an external environment.

[0040] Additionally, according to the above configuration, the vehicle and method of controlling the same according to an embodiment of the present disclosure can achieve the above objects in a simplified structure.

[0041] It should be understood that the effects of the present disclosure are not limited to the above effects, and include all effects that can be inferred from the detailed description of the present disclosure or the configuration of the invention described in the claims.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0042] FIG. **1** is a block diagram illustrating a connection relationship between components of a vehicle according to an embodiment of the present disclosure.

[0043] FIG. **2** is a conceptual diagram illustrating a state in which each component provided in the vehicle of FIG. **1** is adjusted to a first position.

[0044] FIG. **3** is a conceptual diagram illustrating a state in which each component provided in the vehicle of FIG. **1** is adjusted to a second position.

[0045] FIG. **4** is a conceptual diagram illustrating a state in which each component provided in the vehicle of FIG. **1** is adjusted to a third position.

[0046] FIGS. **5** to **7** are state diagrams illustrating a process of adjusting a position of each component when the vehicle of FIG. **1** is driven toward a first slope surface.

[0047] FIGS. **8** to **10** are state diagrams illustrating a process of adjusting a position of each component when the vehicle of FIG. **1** is driven toward a second slope surface.

[0048] FIG. **11** is a flowchart illustrating a flow of a method of controlling a vehicle according to an embodiment of the present disclosure.

[0049] FIG. **12** is a flowchart illustrating a detailed flow of step S**100** in the method of controlling the vehicle of FIG. **11**.

[0050] FIG. **13** is a flowchart illustrating a detailed flow of step S**200** in the method of controlling the vehicle of FIG. **11**.

[0051] FIG. **14** is a flowchart illustrating a detailed flow of step S**400** in the method of controlling the vehicle of FIG. **11**.

DETAILED DESCRIPTION

[0052] Hereinafter, embodiments of the present disclosure will be described in detail with reference to the accompanying drawings so that those skilled in the art can easily carry out the present disclosure. The present disclosure may be embodied in various different forms and is not limited to the embodiments described herein. In order to clearly describe the present disclosure, parts not related to the description are omitted in the drawings, and the same or similar components are denoted by the same reference numerals throughout the specification.

[0053] The words and terms used in the specification and the claims are not to be construed as limited to ordinary or dictionary meanings, but should be construed as meanings and concepts corresponding to technical aspects of the present disclosure according to principles capable of defining terms and concepts by the inventor in order to describe the present disclosure in the best way.

[0054] Therefore, the embodiments described in the specification and the configurations illustrated in the drawings correspond to a preferred embodiment of the present disclosure and do not represent all the technical aspects of the present disclosure, and thus the corresponding configurations may have various equivalents and modifications to substitute them at the time of filing the present disclosure.

[0055] In the following description, some components may be omitted to clarify the features of the present disclosure.

[0056] The term “electrical connection” used in the following description means that one or more members are connected to each other to transmit a current or an electric signal. In an embodiment, the electrical connection may be formed in a wired form by a wire member or the like or in a wireless form such as Bluetooth, Wi-Fi, or RFID. In an embodiment, the electrical connection may include the meaning of “communication”.

[0057] The term “front side” used in the following description means the direction in which the vehicle **10** is driven, and the term “rear side” means the direction in which the vehicle **10** has already been driven. In addition, the term “upper side” means the direction away from a flat surface, and the term “lower side” means the direction toward the flat surface.

[0058] Referring to FIGS. **1** and **2**, each component of the vehicle **10** and a coupling relationship between them according to the embodiment of the present disclosure are illustrated as examples.

[0059] The vehicle **10** according to the embodiment of the present disclosure is provided with a component for generating environment detection information on an external environment. The environment detection information generated by the component may be transmitted to another component and used for autonomous driving of the vehicle **10**.

[0060] It is assumed that the vehicle **10** according to an embodiment of the present disclosure is a general vehicle provided for passenger use or cargo loading. However, the vehicle **10** according to an embodiment of the present disclosure may be equipped with any device capable of autonomously driving in response to an external environment such as an autonomous driving robot.

[0061] In the illustrated embodiment, the vehicle **10** includes a vehicle body **100**, an environment sensor **200**, an inclination sensor **300**, an actuator **400**, a support member **500**, and a controller **600**.

[0062] The vehicle body **100** constitutes the external shape of the vehicle **10**. The vehicle body **100** is a part where the vehicle **10** is exposed to the outside. The vehicle body **100** is made of a high-rigidity material and may protect passengers or cargo inside.

[0063] The vehicle body **100** may be equipped to be driven. To this end, the vehicle body **100** may include components such as wheels.

[0064] The vehicle body **100** is coupled with the environment sensor **200**. The environment sensor **200** generates environment detection information on the environment in the direction in which the vehicle body **100** is driving, that is, the front side. In an embodiment, the environment sensor **200** may be located outside the vehicle body **100**. In the above embodiment, the environment sensor **200** may be disposed on a loop or grill provided on the vehicle body **100**.

[0065] The vehicle body **100** is combined with the inclination sensor **300**. The inclination sensor **300** generates inclination detection information on the angle of the driving position of the vehicle body **100**.

[0066] The vehicle body **100** is combined with the actuator **400**. The vehicle body **100** may support the actuator **400**. Accordingly, when the actuator **400** is operated, the support member **500** coupled thereto may be moved.

[0067] The vehicle body **100** is combined with the support member **500**. At this time, some components of the support member **500** may be coupled to the vehicle body **100** through the actuator **400**. In addition, the other components of the support member **500** may be directly coupled to and supported by the vehicle body **100**.

[0068] As will be described later, some of the above components of support member **500** may be moved by actuator **400**. Additionally, the other components of the support member **500** may be maintained at a fixedly coupled state to the vehicle body **100**. Accordingly, the field of view (FOV) of the environment sensor **200** may be adjusted, which will be described in detail later.

[0069] A controller **600** may be coupled to the vehicle body **100**. The vehicle body **100** may accommodate or support the controller **600**. Various electrical components provided in the vehicle body **100** may be electrically connected to the controller **600** and controlled by the controller **600**.

[0070] The environment sensor **200** generates environment detection information on the direction in which the vehicle **10** will be driven, that is, the environment on the front side. The environment detection information generated by the environment sensor **200** may be transmitted to the controller **600** and used as a basis for controlling the driving of the vehicle **10**.

[0071] The environment sensor **200** may be formed to have a predetermined field of view (FOV). The FOV may be formed to have a predetermined size along the height direction of the vehicle **10**, that is, the up and down directions, or the width direction of the vehicle **10**, that is, the left and right directions. In the following description, the FOV of the environment sensor **200** is described based on the FOV of the height direction.

[0072] The size of the FOV of the environment sensor **200** may be a fixed value. In other words, the environment sensor **200** may generate environment detection information on the detecting area (A) as much as the FOV of a predetermined size.

[0073] Therefore, while the vehicle **10** is driving on a flat surface (F), the environment sensor **200** may accurately generate environment detection information on the external environment of the vehicle **10**. On the other hand, at the moment when the vehicle **10** enters the slope surfaces (S**1**, and S**2**), some of the spaces on the front side of the vehicle **10** are excluded from the detecting area (A), so that the accuracy of environment detection information for the external environment is reduced.

[0074] Accordingly, the vehicle **10** according to an embodiment of the present disclosure is configured to adjust the angle itself at which the environment sensor **200** is coupled to the vehicle body **100**. At this time, the angle formed between the environment sensor **200** and the vehicle body **100** may be adjusted again after entering the slope surfaces (S**1**, and S**2**). Accordingly, no matter whether the vehicle **10** drives on a flat surface (F) or a slope surfaces (S**1**, and S**2**), environment detection information on the external environment can be accurately generated.

[0075] The environment sensor **200** may be provided in any form capable of generating environment detection information on the external environment of the vehicle **10**. In one embodiment, the environment sensor **200** may be equipped with a LIDAR sensor, a camera sensor, a 4D imaging radar sensor, etc.

[0076] The environment sensor **200** may be supported by being coupled to the vehicle body **100**. As described above, the environment sensor **200** may be exposed to the outside of the vehicle body **100**.

[0077] The environment sensor **200** is coupled with the actuator **400**. Specifically, the environment sensor **200** is movably coupled to the actuator **400** by the support member **500**. The relative angle between the environment sensor **200** and the vehicle body **100** may be adjusted by moving the actuator **400** and the support member **500** coupled thereto.
[0078] The environment sensor **200** is electrically connected to the controller **600**. The environment detection information generated by the environment sensor **200** may be transmitted to the controller **600** and utilized to control each component of the vehicle **10**, especially the actuator **400**.
[0079] The inclination sensor **300** generates inclination detection information on the slope of the surface on which the vehicle **10** is driven. The inclination detection information generated by the inclination sensor **300** may be transmitted to the controller **600** and utilized as a basis for controlling the driving of the vehicle **10**. In addition, the inclination detection information generated by the inclination sensor **300** may be utilized to control each component of the vehicle **10**, particularly the actuator **400**.
[0080] The inclination sensor **300** may be provided in any form capable of generating inclination detection information on the slope of the surface on which the vehicle **10** is located. In one embodiment, the inclination sensor **300** may be equipped with an Inertial Measurement Unit (IMU) sensor or a gyro sensor, etc.
[0081] The inclination sensor **300** is electrically connected to the controller **600**. The inclination detection information generated by the inclination sensor **300** may be transmitted to the controller **600** and utilized to control each component of the vehicle **10**, especially the actuator **400**.
[0082] The actuator **400** is coupled to the vehicle body **100** and the support member **500**. The actuator **400** moves the support member **500** and the environment sensor **200** coupled thereto relative to the vehicle body **100**. Accordingly, the angle of the environment sensor **200** may be adjusted and the position of the detecting area (A) may also be changed.
[0083] The actuator **400** is coupled to the vehicle body **100**. One side of the actuator **400**, in the illustrated embodiment, the rear side may be fixedly coupled to the vehicle body **100**. Accordingly, it will be understood that when the actuator **400** is operated, only the support member **500** and the environment sensor **200** coupled thereto are moved.
[0084] In this case, the height at which the actuator **400** is coupled with the vehicle body **100** may be determined corresponding to the height of the variable shaft **520**. In the illustrated embodiment, the actuator **400** is coupled to the upper side of the vehicle body **100**.
[0085] The actuator **400** is coupled to the support member **500**. The other side of the actuator **400**, in the illustrated embodiment, the front side, may be coupled to the support member **500**. The actuator **400** may move the support member **500** in any direction. In one embodiment, the actuator **400** may move the support member **500** in the front and rear directions.
[0086] At this time, the support member **500** includes a pair of shafts **520** and **530** that are spaced apart in the height direction of the vehicle **10**, that is, in the up and down directions. The actuator **400** is coupled to a variable shaft **520** located on one side in the height direction, in the illustrated embodiment, on the upper side. When the actuator **400** is operated, only the variable shaft **520** may be moved while the length of the other shaft **530**, that is, the fixed shaft **530**, is maintained.
[0087] The actuator **400** is electrically connected to the controller **600**. The actuator **400** may be controlled corresponding to control information calculated by the controller **600**.
[0088] The actuator **400** is controlled by the controller **600** and may be provided in any form capable of moving the support member **500** and the environment sensor **200** coupled thereto. In one embodiment, the actuator **400** may be provided in the form of a motor or hydraulic cylinder.
[0089] The support member **500** movably supports the environment sensor **200**. The support member **500** is coupled with the actuator **400** and may move together with the environment sensor **200** according to the operation of the actuator **400**.
[0090] The support member **500** is coupled to the vehicle body **100**. Specifically, one side of the

support member **500**, in the illustrated embodiment, a portion of the rear side, is coupled to the vehicle body **100**. The portion of the support member **500** may be fixedly coupled to the vehicle body **100**.

[0091] The support member **500** is coupled to the actuator **400**. Specifically, the one side of the support member, that is, the other portion of the rear side, **500** may be coupled to the actuator **400** and moved in the front and rear directions by the actuator **400**.

[0092] That is, the support member **500** may be moved by the actuator **400** in the front and rear directions at an angle with respect to the vertical direction.

[0093] The support member **500** is coupled with the environment sensor **200**. Specifically, the other side of the support member **500**, in the illustrated embodiment, the front side, is coupled with the environment sensor **200**. The support member **500** may be moved along with the environment sensor **200**.

[0094] The support member **500** may be provided separately and combined with other components of the vehicle **10**. Therefore, the vehicle **10** according to the embodiment of the present disclosure may be configured not only by itself but also by additionally providing the support member **500**.

[0095] In the illustrated embodiment, the support member **500** includes a bracket member **510**, a variable shaft **520**, and a fixed shaft **530**.

[0096] The bracket member **510** is a portion where the support member **500** is coupled to the environment sensor **200**. The bracket member **510** is located on the other side, that is, front side and to be coupled to the environment sensor **200** and support it. The bracket member **510** may be moved along with the environment sensor **200**.

[0097] One portion of the bracket member **510** on the one side, that is, the rear upper side, is coupled to the variable shaft **520**. The bracket member **510** may be moved by the variable shaft **520**. That is, when the actuator **400** is operated and the variable shaft **520** is moved in the front and rear directions, the bracket member **510** may be moved together in the front and rear directions by the variable shaft **520**.

[0098] At this time, the bracket member **510** may be rotatably coupled to the variable shaft **520**. Accordingly, the bracket member **510** may be moved in the front-back direction and rotated at the same time. Accordingly, the environment sensor **200** coupled to the bracket member **510** may also be rotated.

[0099] The other portion of the bracket member **510** on the one side, that is, the rear lower side, is coupled to the fixing shaft **530**. The bracket member **510** may be supported by the fixed shaft **530**. Among the portions of the bracket member **510**, the portion coupled to the fixed shaft **530** is not moved in the front and rear directions.

[0100] In this case, the bracket member **510** may be rotatably coupled to the fixed shaft **530**. Therefore, even if the upper side of the bracket member **510** is moved in the front and rear directions by the variable shaft **520**, the lower side of the bracket member **510** may be rotated in a state where its position in the front and rear directions is fixed by the fixed shaft **530**.

[0101] The bracket member **510** supports the environment sensor **200** and may be of any shape that may be rotatably coupled to the variable shaft **520** and the fixed shaft **530**, respectively. In the illustrated embodiment, the bracket member **510** has a three-dimensional shape with a thickness in the front and back directions and a height in the up and down directions.

[0102] The variable shaft **520** is a portion where the support member **500** is coupled to the actuator **400**. The variable shaft **520** extends between actuator **400** and bracket member **510**. In the illustrated embodiment, the variable shaft **520** extends in the front and rear directions. One side of the variable shaft **520** in the extension direction, in the illustrated embodiment, the rear side is coupled to the actuator **400**. The other side of the variable shaft **520** in the extension direction, in the illustrated embodiment, the front side is coupled to the rear upper side of the bracket member **510**.

[0103] The one side of the variable shaft **520** in the extension direction may be fixedly coupled to the actuator **400** and move together. The other side of the variable shaft **520** in the extension direction may be rotatably coupled to the rear upper side of the bracket member **510**. The variable shaft **520** may rotate relative to the bracket member **510** and may be moved in the front and rear directions with the bracket member **510**.

[0104] The fixing shaft **530** is a portion where the support member **500** is coupled to the vehicle body **100**. The fixing shaft **530** extends between the vehicle body **100** and the bracket member **510**. In the illustrated embodiment, the fixing shaft **530** extends in the front and rear directions. One side of the fixing shaft **530** in the extending direction, in the illustrated embodiment, the rear side are coupled to the front lower side of the vehicle body **100**. The other side of the fixing shaft **530** in the extending direction, in the illustrated embodiment, the front side are coupled to the rear lower side of the bracket member **510**.

[0105] The one side of the fixing shaft **530** in the extending direction may be fixedly coupled to the vehicle body **100**. The other side of the fixing shaft **530** in the extending direction may be rotatably coupled to the rear lower side of the bracket member **510**. The fixing shaft **530** may rotatably support the bracket member **510**.

[0106] The controller **600** receives environment detection information generated by the environment sensor **200** and inclination detection information generated by the inclination sensor **300**. The controller **600** may calculate control information for controlling the actuator **400** using the received environment detection information and inclination detection information. The controller **600** may control the actuator **400** corresponding to the calculated control information. The controller **600** is electrically connected to the environment sensor **200**, the inclination sensor **300**, and the actuator **400**, respectively.

[0107] Additionally, the controller **600** may be electrically connected to other components provided in the vehicle **10**, that is, any components provided for driving. The controller **600** may use environment detection information and inclination detection information to calculate control information for controlling the other components.

[0108] The controller **600** may be provided in any form capable of inputting, calculating, and outputting information. In one embodiment, the controller **600** may be provided in the form of any electronic device including a CPU or microprocessor.

[0109] The controller **600** may calculate control information for adjusting the direction in which the detecting area (A) faces using the received environment detection information and inclination detection information.

[0110] That is, as shown in FIGS. **2** to **4**, the controller **600** may operate the actuator **400** corresponding to the calculated control information. Accordingly, the angle of the environment sensor **200** and the detecting area (A) detected by the environment sensor **200** may be adjusted to any one of the first position (P**1**), the second position (P**2**), and the third position (P**3**).

[0111] In the following description, it is assumed that the flat surface (F) refers to a surface that is flat enough not to affect the driving angle of the vehicle **10**, the first slope surface (S**1**) refers to an uphill surface, and the second slope surface (S**2**) refers to a downhill surface.

[0112] First, as shown in FIG. **2**, the controller **600** may control the actuator **400** to move and maintain the environment sensor **200** to the first position (P**1**). In this state, the bracket member **510** and the environment sensor **200** coupled thereto may be moved and maintained at a predetermined angle with respect to the ground. In one embodiment, the predetermined angle may be 0°.

[0113] The first position (P**1**) may be formed when the vehicle **10** driving on one of the flat surface (F), the first slope surface (S**1**) and the second slope surface (S**2**) enters the same surface (F, S**1**, and S**2**). That is, the first position (P**1**) is formed when the vehicle **10** is driving on a continuous flat surface (F), a continuous first slope surface (S**1**), and a continuous second slope surface (S**2**).

[0114] In other words, when the vehicle **10** continues to drive on the flat surface (F), sufficiently accurate environment detection information may be generated even if the detection area (A) that may be detected by the environment sensor **200** does not move.

[0115] In addition, when the vehicle **10** enters the first slope surface (S**1**) or the second slope surface (S**2**), the vehicle **10** is driving in a state in which it is inclined corresponding to the first slope surface (S**1**) or the second slope surface (S**2**), so a movement of the detecting area (A) is not required.

[0116] Accordingly, when the environment detection information generated by the environment sensor **200** means that the same surfaces (F, S**1**, and S**2**) are located on the front side, the controller **600** calculates the control information so that the environment sensor **200** is moved and maintained at the first position (P**1**), and controls the actuator **400** accordingly.

[0117] Referring to FIG. **3**, the controller **600** may control the actuator **400** to move and maintain the environment sensor **200** to the second position (P**2**). In this state, the bracket member **510** and the environment sensor **200** coupled thereto may be moved and maintained at different angles opposite to the ground.

[0118] The second position (P**2**) may be formed when the vehicle **10** being driven on the flat surface (F) enters the first slope surface (S**1**) or when the vehicle **10** being driven on the second slope surface (S**2**) enters the flat surface (F) or the first slope surface (S**1**). That is, the second position (P**2**) is formed when the angle formed by the surface on which the vehicle **10** will be driven later increases in the upward direction compared to the surface on which the vehicle **10** is currently driven.

[0119] That is, when the vehicle **10** being driven on the flat surface (F) enters the first slope surface (S**1**), an area (specifically, an upper area) that is partially excluded from the detecting area (A) among the front areas of the vehicle **10** may be generated as the angle of the vehicle **10** is changed.

[0120] Likewise, when the vehicle **10** being driven on the second slope surface (S**2**) enters the flat surface (F) or the first slope surface (S**1**), an area (specifically, an upper area) that is partially excluded from the detecting area (A) among the front areas of the vehicle **10** may be generated as the angle of the vehicle **10** is changed.

[0121] Accordingly, the environment detection information generated by the environment sensor **200** means that the surface located on the front side is inclined upward compared to the surface currently being driven, the controller **600** calculates control information so that the environment sensor **200** is tilted upward and is moved and maintained at the second position (P**2**), and controls the actuator **400** accordingly.

[0122] Referring to FIG. **4**, the controller **600** may control the actuator **400** to move and maintain the environment sensor **200** to the third position (P**3**). In this state, the bracket member **510** and the environment sensor **200** coupled thereto may be moved and maintained at another angle toward the ground.

[0123] The third position (P**3**) may be formed when the vehicle **10** being driven on the flat surface (F) enters the second slope surface (S**2**) or when the vehicle **10** being driven on the first slope surface (S**1**) enters the flat surface (F) or the second slope surface (S**2**). That is, the third position (P**3**) is formed when the angle formed by the surface on which the vehicle **10** will be driven later increases in the downward direction compared to the surface on which the vehicle **10** is currently driven.

[0124] That is, when the vehicle **10** being driven on the flat surface (F) enters the second slope surface (S**2**), an area (specifically, a lower area) that is partially excluded from the detecting area (A) among the front areas of the vehicle **10** may be generated as the angle of the vehicle **10** is changed.

[0125] Likewise, when the vehicle **10** being driven on the first slope surface (S**1**) enters the flat surface (F) or the second slope surface (S**2**), an area (specifically, a lower area) that is partially excluded from the detecting area (A) among the front areas of the vehicle **10** may be generated as the angle of the vehicle **10** is changed.

[0126] Accordingly, the environment detection information generated by the environment sensor

200 means that the surface located on the front side is inclined downward compared to the surface currently being driven, the controller **600** calculates control information so that the environment sensor **200** is tilted upward and is moved and maintained at the third position (P**3**), and controls the actuator **400** accordingly.
[0127] In addition, as described above, the controller **600** may calculate control information for controlling the actuator **400** by further utilizing inclination detection information on the slope generated by the inclination sensor **300**.
[0128] That is, the controller **600** may calculate whether the vehicle **10** enters the surface located in the front side using the inclination detection information generated by the inclination sensor **300**. When the vehicle **10** completely enters the surface, the controller **600** calculates control information so that the environment sensor **200** is moved and maintained again in the first position (P**1**), and controls the actuator **400** accordingly.
[0129] Specifically, when it is calculated that the vehicle **10** has entered the flat surface (F) or the first slope surface (S**1**) after the environment sensor **200** is moved and maintained at the second position (P**2**), the controller **600** calculates control information so that the environment sensor **200** is tilted downward and returns to the first position (P**1**), and controls the actuator **400** accordingly.
[0130] In addition, when it is calculated that the vehicle **10** has entered the flat surface (F) or the second slope surface (S**2**) after the environment sensor **200** is moved and maintained at the third position (P**3**), the controller **600** calculates control information so that the environment sensor **200** is tilted upward and returns to the first position (P**1**), and controls the actuator **400** accordingly.
[0131] On the other hand, when the environment detection information generated by the environment sensor **200** and the inclination detection information generated by the inclination sensor **300** conflict, the controller **600** may calculate control information by prioritizing the environment detection information generated by the environment sensor **200**.
[0132] For example, if an unevenness or speed bump, etc. is formed on the road surface on which the vehicle **10** is driven, despite the vehicle **10** being scheduled to continue being driven on the same surface (F, S**2**, and S**2**), the inclination detection information generated by the inclination sensor **300** may mean that the vehicle **10** is scheduled to be driven on a different surface from the currently traveling surface.
[0133] In this case, since the position of the environment sensor **200** does not need to be changed, the controller **600** may calculate control information by prioritizing the environment detection information generated by the environment sensor **200**, that is, the environment detection information on the surfaces (F, S**1**, and S**2**) located in the front side.
[0134] Referring to FIGS. **5** to **10**, a process of changing the position of the environment sensor **200** and the detecting area (A) through the above-described process is illustrated as an example.
[0135] In the embodiment shown in FIGS. **5** to **7**, the vehicle **10** is driven on the flat surface (F), and then enters the first slope surface (S**1**). It will be understood that the above embodiment may be equally applied to the case where the vehicle **10** is driven on the second slope surface (S**2**) and then enters the flat surface (F) or the first slope surface (S**1**).
[0136] Referring to FIG. **5**, the vehicle **10** is driven on the flat surface (F). At this time, the environment sensor **200** detects that the first slope surface (S**1**) that extends inclined upwardly by a first angle (a**1**) exists in the front side of the vehicle **10**. The environment detection information generated by the environment sensor **200** is transmitted to the controller **600**.
[0137] Referring to FIG. **6**, the vehicle **10** is driven to a position adjacent to the boundary between the flat surface (F) and the first slope surface (S**1**). The controller **600** uses the environment detection information generated by the environment sensor **200** to calculate control information for controlling the actuator **400**. The controller **600** controls the actuator **400** according to the calculated control information.
[0138] The actuator **400** is operated to move the variable shaft **520** and the bracket member **510** coupled thereto to the rear side. Accordingly, the environment sensor **200** is tilted upward and

adjusted to the second position (P**2**).

[0139] Referring to FIG. **7**, the vehicle **10** completely enters the first slope surface (S**1**). The controller **600** calculates control information for controlling the actuator **400** by further using the inclination detection information generated by the inclination sensor **300**. The controller **600** controls the actuator **400** according to the calculated control information.

[0140] Accordingly, the actuator **400** is operated to move the variable shaft **520** and the bracket member **510** coupled thereto to the front side. Accordingly, the environment sensor **200** is tilted downward and adjusted to the first position (P**1**).

[0141] In the embodiment shown in FIGS. **8** to **10**, the vehicle **10** is driven on the flat surface (F), and then enters the second slope surface (S**2**). It will be understood that the above embodiment may be equally applied to the case where the vehicle **10** is driven on the first slope surface (S**1**) and then enters the flat surface (F) or the second slope surface (S**2**).

[0142] Referring to FIG. **8**, the vehicle **10** is driven on the flat surface (F). At this time, the environment sensor **200** detects that the second slope surface (S**2**) that extends inclined downward by a second angle (a**2**) exists in the front side of the vehicle **10**. The environment detection information generated by the environment sensor **200** is transmitted to the controller **600**.

[0143] Referring to FIG. **9**, the vehicle **10** is driven to a position adjacent to the boundary between the flat surface (F) and the second slope surface (S**2**). The controller **600** uses the environment detection information generated by the environment sensor **200** to calculate control information for controlling the actuator **400**. The controller **600** controls the actuator **400** according to the calculated control information.

[0144] The actuator **400** is operated to move the variable shaft **520** and the bracket member **510** coupled thereto to the front side. Accordingly, the environment sensor **200** is tilted downward and adjusted to the third position (P**3**).

[0145] Referring to FIG. **10**, the vehicle **10** completely enters the second slope surface (S**2**). The controller **600** calculates control information for controlling the actuator **400** by further using the inclination detection information generated by the inclination sensor **300**. The controller **600** controls the actuator **400** according to the calculated control information.

[0146] The actuator **400** is operated to move the variable shaft **520** and the bracket member **510** coupled thereto to the rear side. Accordingly, the environment sensor **200** is tilted upward and adjusted to the first position (P**1**).

[0147] Accordingly, in the vehicle **10** according to an embodiment of the present disclosure, the environment sensor **200** may be adjusted to any one of the second and third positions (P**2**, and P**3**) immediately before entering the driving surface (F, S**1**, and S**2**). Additionally, after the vehicle **10** enters the driving surface (F, S**1**, and S**2**), the environment sensor **200** may be adjusted to the first position (P**1**) again in accordance with the inclination detection information generated by the inclination sensor **300**.

[0148] Referring to FIGS. **11** to **14**, a flow of a method of controlling a vehicle **10** according to an embodiment of the present disclosure is illustrated as an example. The method of controlling the vehicle **10** according to the illustrated embodiment may be performed by each component of the vehicle **10**.

[0149] In an embodiment illustrated in FIG. **11**, the method for controlling the vehicle **10** includes generating, by an environment sensor **200** provided in the vehicle **10**, environment detection information on an external environment (step S**100**), controlling, by a controller, an actuator **400** coupled with the environment sensor **200** using the generated environment detection information **600** (step S**200**), generating, by an inclination sensor **300**, inclination detection information on an angle on which the vehicle **10** is disposed (step S**300**), and controlling, by the controller **600**, the actuator **400** using the generated inclination detection information (step S**400**).

[0150] Referring to FIG. **12**, a detailed flow of the step S**100** of generating, by an environment sensor **200** provided in the vehicle **10**, environment detection information on an external environment is shown as an example. The present step S**100** is a step in which the environment sensor **200** generates environment detection information on a surface which the vehicle **10** will enter.

[0151] First, the environment sensor **200** generates environment detection information on a slope of the road located on front side of the vehicle **10** (step S**110**). The environment detection information generated by the environment sensor **200** may be one of a flat surface (F), a first slope surface (S**1**), and a second slope surface (S**2**). The environment sensor **200** transmits the generated inclination detection information to the controller **600** (step S**120**).

[0152] Referring to FIG. **13**, a detailed flow of the step S**200** of controlling, by a controller, an actuator **400** coupled with the environment sensor **200** using the generated environment detection information **600** is shown as an example. The present step S**200** is a step in which the controller **600** controls the actuator **400** so that the position of the detecting area (A) formed by the environment sensor **200** is adjusted.

[0153] At this time, a step S**201** in which the inclination sensor **300** generates inclination detection information on an angle at which the vehicle **10** is disposed may be preceded.

[0154] When the environment detection information generated by the environment sensor **200** means that a road located on the front side is the flat surface (F), the controller **600** controls the actuator **400** to maintain the angle of the environment sensor **200** (step S**210**). Accordingly, the environment sensor **200** may be maintained at the first position (P**1**). In other words, The present step S**210** may be performed when the height of the environment sensor **200** and the detecting area (A) formed thereby does not need to be changed.

[0155] In the illustrated embodiment, it is assumed that the surface on which the vehicle **10** is currently driven is the flat surface (F). Although not shown, the present step S**210** may be performed even when the surface on which the vehicle **10** is currently driven is the first slope surface (S**1**) and the generated environment detection information means the first slope surface (S**1**). Furthermore, it will be understood that the present step S**210** may be performed in the same manner even when the surface on which the vehicle **10** is currently driven is the second slope surface (S**2**) and the generated environment detection information means the second slope surface (S**2**).

[0156] On the other hand, when an unevenness or the like exists on the ground on which the vehicle **10** is driven, the inclination detection information generated by the inclination sensor **300** and the environment detection information generated by the environment sensor **200** may be different.

[0157] In this case, the controller **600** may control the actuator **400** to maintain the angle of the environment sensor **200** regardless of the generated inclination detection information (step S**211**). That is, when the generated environment detection information and the generated inclination detection information conflict, the controller **600** may calculate control information by prioritizing the environment detection information.

[0158] In addition, when the environment detection information generated by the environment sensor **200** means that a road located on the front side is the first slope surface (S**1**), the controller **600** controls the actuator **400** to tilt the environment sensor **200** upward (step S**220**). Accordingly, the environment sensor **200** may be moved and maintained at the second position (P**2**). In other words, The present step S**220** may be performed when the environment sensor **200** and the detecting area (A) formed thereby need to be moved upward.

[0159] In the illustrated embodiment, it is assumed that the surface on which the vehicle **10** is currently driven is the flat surface (F). Although not shown, it will be understood that the present step S**220** may be performed even when the vehicle **10** is currently driven the second slope surface (S**2**), and the generated environment detection information means the flat surface (F) or the first slope surface (S**1**).

[0160] Furthermore, when the environment detection information generated by the environment sensor **200** means that a road located on the front side is the second slope surface (S**2**), the controller **600** controls the actuator **400** to tilt the environment sensor **200** downward (step S**230**). Accordingly, the environment sensor **200** may be moved and maintained at the third position (P**3**). In other words, The present step S**230** may be performed when the environment sensor **200** and the detecting area (A) formed thereby need to be moved downward.

[0161] In the illustrated embodiment, it is assumed that the surface on which the vehicle **10** is currently driven is the flat surface (F). Although not shown, it will be understood that the present step S**230** may be performed even when the vehicle **10** is currently driven the first slope surface (S**1**) and the generated environment detection information means the flat surface (F) or a second slope surface (S**2**).

[0162] Referring to FIG. **14**, a detailed flow of the step S**400** of controlling, by the controller **600**, the actuator **400** using the generated inclination detection information is shown as an example. The present step S**400** is a step in which the actuator **400** is controlled so that the environment sensor **200** is returned to the first position (p**1**) again after the vehicle **10** enters a surface located on the front side.

[0163] When the inclination detection information generated while the environment sensor **200** is tilted upward is less than the predetermined first angle (a**1**), the controller **600** controls the actuator **400** to tilt the environment sensor **200** downward (step S**410**). Accordingly, the environment sensor **200**, which has been moved and maintained at the second position (P**2**), may be moved and maintained at the first position (P**1**).

[0164] That is, the present step S**410** may be performed when the vehicle **10** driven on the flat surface (F) completely enters the first slope surface (S**1**), or when the vehicle **10** driven on the second slope surface (S**2**) completely enters the flat surface (F) or the first slope surface (S**1**).

[0165] Meanwhile, the predetermined first angle (a**1**) may be defined as an angle of a minimum size in which it may be determined that the surface into which the vehicle **10** is completely entered extends inclined upward compared to the surface on which the vehicle **10** is previously driven. In other words, the first angle (a**1**) may be defined as an angle of a maximum size at which the vehicle **10** may be determined to be driven on a surface having the same slope.

[0166] Therefore, when the inclination detection information generated by the inclination sensor **300** is less than the first angle (a**1**), the vehicle **10** may be considered to have completely entered the uphill surface. Accordingly, the controller **600** controls the actuator **400** so that the environment sensor **200** adjusted to the second position (P**2**) is adjusted to the first position (P**1**) again.

[0167] When the inclination detection information generated while the environment sensor **200** is tilted downward is less than the predetermined second angle (a**2**), the controller **600** controls the actuator **400** to tilt the environment sensor **200** upward (step S**420**). Accordingly, the environment sensor **200**, which has been moved and maintained at the third position (P**3**), may be moved and maintained at the first position (P**1**).

[0168] That is, the present step S**420** may be performed when the vehicle **10** driven on the flat surface (F) completely enters the second slope surface (S**2**), or when the vehicle **10** driven on the first slope surface (S**1**) completely enters the flat surface (F) or the second slope surface (S**2**).

[0169] Meanwhile, the predetermined second angle (a**2**) may be defined as an angle of a minimum size in which it may be determined that the surface into which the vehicle **10** is completely entered extends inclined downward compared to the surface on which the vehicle **10** is previously driven. In other words, the second angle (a**2**) may be defined as an angle of a maximum size at which the vehicle **10** may be determined to be driven on a surface having the same slope.

[0170] Therefore, when the inclination detection information generated by the inclination sensor **300** is less than the second angle (a**2**), the vehicle **10** may be considered to have completely entered the downhill surface. Accordingly, the controller **600** controls the actuator **400** so that the environment sensor **200** adjusted to the third position (P**3**) is adjusted to the first position (P**1**) again.

[0171] Although the embodiments of the present disclosure are described, the spirit of the present disclosure is not limited by the embodiments presented in the specification, and those skilled in the art who understand the spirit of the present disclosure can easily propose other embodiments by adding, changing, deleting, and adding components within the same spirit, but this is also within the spirit of the present disclosure.

LIST OF REFERENCE SIGNS

[0172] **10**: vehicle [0173] **100**: vehicle body [0174] **200**: environment sensor [0175] **300**: inclination sensor [0176] **400**: actuator [0177] **500**: support member [0178] **510**: bracket member [0179] **520**: variable shaft [0180] **530**: fixed shaft [0181] **600**: controller [0182] A: detecting area [0183] F: flat surface [0184] P**1**: first position [0185] P**2**: second position [0186] P**3**: third position [0187] S**1**: first slope [0188] S**2**: second slope [0189] a**1**: first angle [0190] a**2**: second angle

Claims

1. A vehicle, comprising: a vehicle body; an environment sensor configured to generate environment detection information on an external environment; a support member coupled to the vehicle body and the environment sensor, respectively; and an actuator coupled to the vehicle body and one part of the support member, respectively, and configured to move the one part of the support member in a direction toward the vehicle body and a direction opposite to the vehicle body, wherein one side of the support member in a height direction is coupled to the actuator, and the other side of the support member in the height direction is rotatably coupled to the vehicle body, so that when the actuator is operated, the environment sensor rotates clockwise or counterclockwise about the other side of the support member.

2. The vehicle of claim 1, wherein the support member includes: a bracket member coupled to the environment sensor; a variable shaft coupled to one side of the bracket member in the height direction and the actuator, respectively; and a fixed shaft coupled to the other side of the bracket member in the height direction and the vehicle body, respectively.

3. The vehicle of claim 2, wherein the variable shaft and the fixed shaft are rotatably coupled to the bracket member, respectively, and the environment sensor is fixedly coupled to the bracket member to rotate clockwise or counterclockwise about a portion where the fixed shaft and the bracket member are coupled.

4. The vehicle of claim 1, comprising: a controller electrically connected to the environment sensor and the actuator, respectively, and configured to control the actuator using the generated environment detection information.

5. The vehicle of claim 4, wherein the controller control the actuator to move the support member in a direction toward the vehicle body such that the environment sensor is tilted upward when the generated environment detection information means that a first slope surface is located on a front side.

6. The vehicle of claim 5, comprising: an inclination sensor electrically connected to the controller and configured to generate inclination detection information on a slope of a surface on which the vehicle is located, wherein the controller controls the actuator to move the support member in a direction opposite to the vehicle body such that the environment sensor is tilted downward when the inclination detection information generated after entering the first slope surface is less than a predetermined first angle.

7. The vehicle of claim 4, wherein the controller controls the actuator to move the support member in a direction opposite to the vehicle body such that the environment sensor is tilted downward when the generated environment detection information means that a second slope surface is located on a front side.

8. The vehicle of claim 7, comprising: an inclination sensor electrically connected to the controller and configured to generate inclination detection information on a slope of a surface on which the vehicle is located, wherein the controller controls the actuator to move the support member in a direction toward the vehicle body such that the environment sensor is tilted upward when the inclination detection information generated after entering the second slope surface is less than a predetermined second angle.

9. The vehicle of claim 4, comprising: an inclination sensor electrically connected to the controller and configured to generate inclination detection information on a slope of a surface on which the vehicle is located, wherein the controller calculates control information for controlling the actuator using only the environment detection information when the generated environment detection information means that a flat surface is located on a front side, and the generated inclination detection information means that a first slope surface or a second slope surface is located on the front side.

10. The vehicle of claim 1, wherein the environment sensor includes one or more of a LIDAR sensor, a camera sensor, and a 4D imaging radar sensor.

11. A method of controlling a vehicle, comprising: (a) generating, by an environment sensor provided in a vehicle, environment detection information on an external environment; (b) controlling, by a controller, an actuator coupled with the environment sensor using the generated environment detection information; (c) generating, by an inclination sensor, inclination detection information on a slope on which the vehicle is disposed; and (d) controlling, by the controller, the actuator using the generated inclination detection information.

12. The method of claim 11, wherein the step (a) includes: (a**1**) generating, by the environment sensor, the environment detection information on a slope of a road located on a front side thereof; and (a**2**) transmitting, by the environment sensor, the generated environment detection information to the controller.

13. The method of claim 11, wherein the step (b) includes: (b**1**) controlling, by the controller, the actuator to maintain an angle of the environment sensor, when the generated environment detection information means that a road located on a front side is a flat surface; (b**2**) controlling, by the controller, the actuator to tilt the environment sensor upward, when the generated environment detection information means that a road located on a front side is a first slope surface; and (b**3**) controlling, by the controller, the actuator to tilt the environment sensor downward, when the generated environment detection information means that a road located on a front side is a second slope surface.

14. The method of claim 13, wherein the step (b) further includes before the steps (b**1**) to (b**3**): (b**0**) generating, by the inclination sensor, the inclination detection information on an angle at which the vehicle is disposed, and wherein the step (b**1**) includes: (b**11**) controlling, by the controller, the actuator to maintain the angle of the environment sensor regardless of the generated inclination detection information.

15. The method of claim 11, wherein the step (d) includes: (d**1**) controlling, by the controller, the actuator to tilt the environment sensor downward, when the inclination detection information generated while the environment sensor is tilted upward is less than a predetermined first angle; and (d**2**) controlling, by the controller, the actuator to tilt the environment sensor upward when the inclination detection information generated while the environment sensor is tilted downward is less than a predetermined second angle.