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CONTROL DEVICE FOR VEHICLE

Abstract

A cockpit is capable of executing a light show by outputting music from a speaker and operating a movable component. In addition, the cockpit can detect an obstacle existing around the vehicle. When an obstacle is detected within the detection range corresponding to the movable range of the movable component, the cockpit causes music to be output from the speaker without operating the movable component when the light show is executed.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION
[0001] This application claims priority to Japanese Patent Application No. 2024-020177 filed on Feb. 14, 2024, incorporated herein by reference in its entirety.
BACKGROUND
1. Technical Field
[0002] The present disclosure relates to a control device for a vehicle.
2. Description of Related Art
[0003] A vehicle described in Japanese Unexamined Patent Application Publication No. 2023-150030 (JP 2023-150030 A) includes a back door supported pivotally to be openable or closable relative to the vehicle through rotation, a position specifying unit that specifies a position where an end portion of the back door is located farthest from the vehicle during rotation, and a notification unit that notifies the position specified by the position specifying unit. Accordingly, in the vehicle of JP 2023-150030 A, since the possibility of contact with an obstacle can be understood in advance before a user opens the back door, contact with the obstacle at the time of a back door opening operation can be avoided.
SUMMARY
[0004] Incidentally, within a control device of the vehicle, a light show function for a user or a viewer to enjoy may be included by controlling an operation of a component such as a door, in accordance with music flowing from a speaker. In such a case, since the user does not manually operate the component such as a door, it may be difficult to avoid contact with the obstacle at the time of the door opening operation, even if the location specified by the position specification unit is notified.
[0005] A control device for a vehicle that solves the problem is applied to a vehicle that includes a speaker and a movable component, in which the control device is able to execute: [0006] a specifying process that causes the movable component to operate along with outputting music from the speaker, and [0007] an obstacle detecting process that detects an obstacle present in a periphery of the vehicle, and [0008] when an obstacle is detected within a detection range corresponding to a movable range of the movable component in the obstacle detecting process, the specifying process causes music to be output from the speaker without operating the movable component.
[0009] According to the configuration, the movable component can be suppressed from contacting the obstacle when executing the specifying process.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0010] Features, advantages, and technical and industrial significance of exemplary embodiments of the disclosure will be described below with reference to the accompanying drawings, in which like signs denote like elements, and wherein:
[0011] FIG. **1** is a diagram schematically illustrating a configuration of a control device of a vehicle;
[0012] FIG. **2** is a diagram illustrating a detection range of an obstacle according to a movable range of each movable component;
[0013] FIG. **3** is a flow chart illustrating a write show execution-time operation stopping process according to a first embodiment; and
[0014] FIG. **4** is a flowchart illustrating a write show execution-time operation stop process according to a second embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

First Embodiment

Configuration of the Control Device

[0015] Hereinafter, a first embodiment of the present disclosure will be described with reference to FIG. **1** to FIG. **3**.

[0016] First, a configuration of a control device according to the present embodiment will be described with reference to FIG. **1**. As illustrated in FIG. **1**, the vehicles **100** are equipped with in-vehicle devices such as a driving assistance DC **200**, a cockpit DC **300**, and a body DC **400**. Note that "DC" is an abbreviation for Domain Controller. These in-vehicle devices are communicably connected to each other. The driving assistance DC **200**, the cockpit DC **300**, and the body DC **400** constitute the control device **500** of the vehicle.

[0017] The driving assistance DC **200** is an electronic control unit that provides a driving assistance function such as an automated braking device or a sudden start preventing device. A cockpit DC **300** is an electronic control unit that provides multimedia-related functions such as navigational and audio. The body DC **400** is an electronic control unit that controls various electrical components such as lights, doors, and mirrors.

Configuration of the Driving Assistance DC

[0018] The driving assistance DC **200** is electrically connected to the camera sensor device **10** and the sonar sensor device **20**.

[0019] As illustrated in FIG. **2**, the camera sensor device **10** includes cameras including a front camera **11**, a rear camera **12**, a left camera **13**, and a right camera **14**. In the following description, the front camera **11**, the rear camera **12**, the left camera **13**, and the right camera **14** may be collectively referred to as a "camera **15**".

[0020] The front camera **11** is attached to the center of the front end portion of the vehicle **100** so as to capture an image of a scene in front of the vehicle **100**. The rear camera **12** is attached to the center of the rear end portion of the vehicle **100** so as to capture an image of a landscape behind the vehicle **100**. The left camera **13** is attached to a left end portion of the vehicle **100** so as to capture an image of a landscape on the left side of the vehicle **100**. The right camera **14** is attached to the right end portion of the vehicle **100** so as to capture an image of the scenery on the right side of the vehicle **100**.

[0021] As illustrated in FIG. **1**, the camera sensor device **10** is electrically connected to a driving assistance DC **200**. The driving assistance DC **200** can acquire information about images of the surroundings of the vehicles **100** captured by the camera **15** via the camera sensor device **10**.

[0022] As shown in FIG. **2**, the sonar sensor device **20** includes a first clearance sonar **21** to a twelfth clearance sonar **32**. In the following description, the first clearance sonar **21** to the twelfth clearance sonar **32** are collectively referred to as "clearance sonar **33**". The clearance sonar **33** emits ultrasonic waves in a predetermined direction and receives the ultrasonic waves reflected by the object.

[0023] The first clearance sonar **21** is attached to the vehicle **100** so as to emit ultrasonic waves from the front left end portion to the front left of the vehicle **100**. The second clearance sonar **22** is attached to the vehicle **100** so as to emit ultrasonic waves forward from the left front end of the vehicle **100**. Similarly, the third clearance sonar **23** is attached to the vehicle **100** from the front right end portion to the front right of the vehicle **100**, and the fourth clearance sonar **24** is attached to the vehicle **100** from the front right end to the front right so as to emit ultrasonic waves, respectively. The fifth clearance sonar **25** is attached to the vehicle **100** so as to emit ultrasonic waves from the rear left end portion to the left rear side of the vehicle **100**, and the sixth clearance sonar **26** is attached to the vehicle **100** from the left rear end to the rear side thereof. The seventh clearance sonar **27** is attached to the vehicle **100** so as to emit ultrasonic waves from the right rear end portion of the vehicle **100** to the right rear, and the eighth clearance sonar **28** is attached to the vehicle **100** from the right rear end to the rear. The ninth clearance sonar **29** is attached to the

vehicle **100** to the left from the front left end of the vehicle **100**, and the tenth clearance sonar **30** is attached to the vehicle **100** to the left from the rear left end thereof so as to emit ultrasonic waves. The eleventh clearance sonar **31** is attached to the vehicle **100** from the front right end portion to the right side of the vehicle **100**, and the twelfth clearance sonar **32** is attached to the vehicle **100** from the rear right end portion to the right side so as to emit ultrasonic waves, respectively.

[0024] As shown in FIG. **1**, the sonar sensor device **20** is electrically connected to the driving assistance DC **200**. The sonar sensor device **20** transmits the ultrasonic waves emitted by the clearance sonar **33**, the ultrasonic waves received by the clearance sonar **33**, and the like to the driving assistance DC **200**. The driving assistance DC **200** can acquire information about an object existing around the vehicles **100** based on the information received from the sonar sensor device **20**.

Configuration of Cockpit DC

[0025] The cockpit DC **300** is electrically connected to the display **41**, the speaker **42**, and the operation unit **43** of the vehicle **100**.

[0026] The display **41** includes a display unit (not shown) capable of displaying various types of information. The display **41** displays various types of information on the display unit based on an instruction from the cockpit DC **300**.

[0027] The speaker **42** is configured to output sound. In the present specification, the term “sound” is intended to include any sound or music in addition to a single sound. The speaker **42** outputs a sound based on an instruction from the cockpit DC **300**.

[0028] The operation unit **43** is configured to be capable of various operations. The operation unit **43** may be a touch panel type operation unit integrated with the display **41** or an operation unit independent of the display **41**. The cockpit DC **300** is configured to be capable of inputting an operation signal indicating that the operation unit **43** is operated. The cockpit DC **300** can perform various types of control based on an operation signal inputted from the operation unit **43**.

Configuration of the Body DC

[0029] The body DC **400** includes a light control unit **50**, a door control unit **60**, and a mirror control unit **70**.

[0030] As illustrated in FIG. **2**, the light control unit **50** is electrically connected to various lights including a left headlight **51**, a right headlight **52**, a left winker **53**, a right winker **54**, a left tail light **55**, and a right tail light **56** of the vehicle **100**. In the following description, various lights including the respective lights **51** to **56** are collectively referred to as “lights **57**”. The light **57** is configured to be blinkable. The light control unit **50** blinks the light **57** based on an instruction from the body DC **400**.

[0031] The left headlight **51** is attached to the left front end of the vehicle **100**. The right headlight **52** is attached to the right front end of the vehicle **100**. The left winker **53** is attached to a front left end portion of the vehicle **100**. The right winker **54** is attached to a rear left end portion of the vehicle **100**. The left tail light **55** is attached to the left rear end of the vehicle **100**. The right tail light **56** is attached to the right rear end of the vehicle **100**.

[0032] The door control unit **60** is electrically connected to various types of doors including the first door **61** to the fourth door **64** of the vehicle **100**. In the following description, various doors including the first door **61** to the fourth door **64** are collectively referred to as “doors **65**”. The door **65** is configured to be openable and closable by manual operation, and is configured to be openable and closable by control of the door control unit **60**. The door control unit **60** opens and closes the door **65** based on an instruction from the body DC **400**. The door **65** is an example of a movable component of the vehicle **100**.

[0033] The first door **61** is rotatably supported on the left front side of the vehicle **100** so as to be openable and closable with respect to the vehicle **100**. The second door **62** is pivotally supported on the right front side of the vehicle **100** so as to be openable and closable by rotation with respect to the vehicle **100**. The third door **63** is rotatably supported on the left rear side of the vehicle **100** so

as to be openable and closable with respect to the vehicle **100**. The fourth door **64** is pivotally supported on the right side rear side of the vehicle **100** so as to be openable and closable by rotation with respect to the vehicle **100**.

[0034] The mirror control unit **70** is electrically connected to the left side mirror **71** and the right side mirror **72** of the vehicle **100**. In the following description, the left side mirror **71** and the right side mirror **72** are collectively referred to as a "side mirror **73**". The side mirror **73** is configured to be rotatable under the control of the mirror control unit **70**. The mirror control unit **70** rotates the side mirror **73** based on an instruction from the body DC **400**. The side mirror **73** is an example of a movable component of the vehicle **100**.

[0035] The left side mirror **71** is pivotally supported on the left front side of the vehicle **100** so as to be rotatable relative to the first door **61**. The right side mirror **72** is pivotally supported on the right side front side of the vehicle **100** so as to be rotatable with respect to the second door **62**.

Processing when Running Light Show

[0036] The control device **500** can perform a light show execution process for causing the vehicle **100** to execute a light show. The light show is performed in such a manner that music is output from the speaker **42** in accordance with a predetermined program pattern and various electric components of the vehicle **100** operate.

[0037] The write show execution process can be executed triggered by an operation of the operation unit **43**. The cockpit DC **300** performs a write show execution process on the basis of an operation signal inputted from the operation unit **43**, and performs control so as to execute the write show. In the present embodiment, the write show execution process corresponds to a specifying process.

[0038] In the light show executing process, the cockpit DC **300** controls the speaker **42** so that a predetermined musical tone is outputted. Further, in the light show execution process, the cockpit DC **300** outputs, to the body DC **400**, information instructing the operation of various electrical components of the vehicle **100** at predetermined timings during the light show execution. The information instructing the operation of the various electrical components of the vehicle **100** is, for example, information instructing the blinking of the light **57**, information instructing the operation of the door **65**, information instructing the operation of the side mirror **73**, and the like. The body DC **400** operates various electrical components of the vehicles **100** based on data inputted from the cockpit DC **300**. That is, in the light show execution process, the control device **500** operates various movable components including the door **65** and the side mirror **73**, and controls blinking of the light **57** of the vehicle **100**. Further, the cockpit DC **300** controls the display **41** to execute an execution notification notifying that the light show is being executed as the light show starts.

[0039] After that, the cockpit DC **300** terminates the write show by terminating the write show executing process in response to the completion of the predetermined program pattern. At this time, the cockpit DC **300** controls the speaker **42** to stop outputting a predetermined musical tone. The cockpit DC **300** also controls the display **41** to terminate the running notification.

Processing of Stopping the Operation of Movable Components when Executing a Light Show

[0040] When executing the light show, the control device **500** performs a light show execution operation stop process for stopping the operation of the movable components included in the various electrical components of the vehicle **100**. The write show execution-time operation stop process is executed over a period during which the write show is being executed.

[0041] As illustrated in FIG. **3**, in the write show execution-time operation stopping process, the control device **500** checks whether there is an obstacle within the detection range corresponding to the movable components (S**1**). The process of S**1** in the write show execution-time operation stopping process corresponds to an obstacle detecting process of detecting an obstacle existing around the vehicles **100**. Specifically, the driving assistance DC **200** outputs, to the cockpit DC **300**, information on images of the surroundings of the vehicles **100** captured by the camera **15** acquired via the camera sensor device **10**. Further, the driving assistance DC **200** outputs, to the

cockpit DC **300**, information related to an object existing around the vehicles **100** acquired based on the information received from the sonar sensor device **20**. Then, the cockpit DC **300** detects obstacles around the vehicles **100** based on the information inputted from the driving assistance DC **200** to determine whether there is an obstacle within the detection range corresponding to the respective movable components.

[0042] As illustrated in FIG. **2**, the cockpit DC **300** individually determines whether there is an obstacle within a predetermined detection range for each movable component. For example, the cockpit DC **300** determines whether there is an obstacle within the detection range A**1** corresponding to the first door **61**. Similarly, the cockpit DC **300** individually determines whether there is an obstacle within the detection ranges of the detection range A**2** corresponding to the second door **62**, the detection range A**3** corresponding to the third door **63**, and the detection range A**4** corresponding to the fourth door **64**. The respective detection ranges A**1** to A**4** are set in accordance with the movable ranges of the respective doors **61** to **64**. More specifically, the detection range A**1** is set to include the entire movable range of the first door **61**. Similarly, the detection range A**2** is set to include the entire movable range of the second door **62**, the detection range A**3** is set to include the entire movable range of the third door **63**, and the detection range A**4** is set to include the entire movable range of the fourth door **64**.

[0043] The cockpit DC **300** individually determines whether there is an obstacle within the detection ranges of the detection range B**1** corresponding to the left side mirror **71** and the detection range B**2** corresponding to the right side mirror **72**. The respective detection ranges B**1**, B**2** are set in accordance with the movable ranges of the respective side mirrors **71** and **72**. More specifically, the detection range B**1** is set to include the entire movable range of the left side mirror **71**. In particular, since the left side mirror **71** is rotatable with respect to the first door **61**, the detection range B**1** is configured to include the entire largest movable range of the left side mirror **71** considering the movable range of the first door **61**. Similarly, the detection range B**2** is set to include the entire movable range of the right side mirror **72**. In particular, since the right side mirror **72** is rotatable with respect to the second door **62**, the detection range B**2** is configured to include the entire largest movable range of the right side mirror **72** considering the movable range of the second door **62**.

[0044] Next, as shown in FIG. **3**, the cockpit DC **300** cancels the stopping of the operation instruction for the movable component that has determined that there is no obstacle within the corresponding detection range (S**2**). In other words, when determining that there is no obstacle within the detection range corresponding to the predetermined movable component, the cockpit DC **300** is capable of outputting, to the body DC **400**, the information instructing the operation of the movable component determined to be free of obstacles in the light show execution process.

[0045] Subsequently, the cockpit DC **300** performs S**3** so as to stop the operation instruction for the movable component that has determined that there is an obstacle within the corresponding detection range. That is, when the cockpit DC **300** determines that there is an obstacle within the detection range corresponding to the predetermined movable component, it does not cause the body DC **400** to output information instructing the operation of the movable component determined to have an obstacle in the light show execution process.

[0046] Then, the cockpit DC **300** causes the display **41** to execute an operation stop notification, which is a notification regarding the movable component for which the operation instruction is stopped (S**4**). Specifically, the cockpit DC **300** causes the display **41** to indicate that the movement of the movable component is stopped due to the presence of an obstacle within the detection range corresponding to the predetermined movable component. At this time, when there is no movable component that has stopped the operation instruction, the operation stop notification is not executed.

[0047] Thereafter, the cockpit DC **300** determines whether or not the light show has ended (S**5**). If the light show has not ended (S**5**: NO), the cockpit DC **300** waits for a certain period of time (S**6**),

and then repeats the processes after S**1**. On the other hand, when the write show is ended (S**5**: YES), the cockpit DC **300** ends the write show execution-time operation stopping process. Incidentally, the cockpit DC **300** releases the stop of the operation instruction to the movable component that is stopping the operation instruction in accordance with the end of the operation stop process at the time of executing the write show, and controls so as to terminate the operation stop notification.

Operation of the First Embodiment

[0048] In the above-described light show execution processing, in addition to being able to output music from the speaker **42** and operate various movable components of the vehicle **100**, the light **57** of the vehicle **100** can be made to blink.

[0049] In the light show execution operation stop process, when an obstacle is detected within a detection range corresponding to each movable component, an operation instruction for the movable component in which the obstacle is detected is stopped. At this time, in the light show execution process, music is output from the speaker **42** without operating the movable component in which the obstacle is detected.

[0050] In particular, it is assumed that an obstacle is detected within a detection range corresponding to a part of the movable components among the movable components in the light show execution operation stop process, and an obstacle is not detected within a detection range corresponding to another movable component different from the part of the movable components. In this case, in the light show execution operation stop process, the operation instruction for a part of the movable components in which the obstacle is detected is stopped, while the operation instruction for another movable component in which the obstacle is not detected is not stopped. At this time, in the light show execution process, music is output from the speaker **42** without operating a part of the movable components in which the obstacle is detected, and another movable component in which the obstacle is not detected is operated. In this example, a part of the movable components in which the obstacle is detected corresponds to the first movable component, and another movable component in which the obstacle is not detected corresponds to the second movable component.

Effect of the First Embodiment

[0051] The effects of the present embodiment will be described.

[0052] (1-1) When an obstacle is detected within a detection range corresponding to a predetermined movable component when a light show is executed, an operation instruction to the movable component is stopped, so that it is possible to prevent the movable component from coming into contact with the obstacle.

[0053] (1-2) In the light show execution operation stop process, even when an obstacle is detected within a detection range corresponding to a part of the movable components among the movable components, an operation instruction to the movable components in which the obstacle is not detected within the corresponding detection range is not stopped. According to this configuration, even when an obstacle is detected within a detection range corresponding to a part of the movable components among the movable components, the user or the viewer can be enjoyed by a combination of an operation of another movable component different from the part of the movable components and an output of music.

[0054] (1-3) In the light show, in addition to the output of music and the operation of movable components, the flickering of the light can be combined to enjoy the user and the viewer.

[0055] (1-4) In the display **41**, since the operation stop notification regarding the movable component that has stopped the operation instruction is executed, it is possible to suppress the user or the viewer from feeling uncomfortable because the movable component does not operate in the light show.

[0056] (1-5) In the write show execution operation stop process, it is repeatedly determined whether or not there is an obstacle within a detection range corresponding to each movable

component at regular time intervals during a period in which the write show is being executed. Then, the operation instruction is stopped for the movable component determined to have an obstacle within the corresponding detection range, and the stop of the operation instruction is released for the movable component determined to have no obstacle within the corresponding detection range. Therefore, even when an obstacle is newly detected within the detection range of the movable component during the execution of the light show, it is possible to prevent the movable component from coming into contact with the obstacle. In addition, when an obstacle within the detection range of the movable component is removed during the execution of the light show, the user and the viewer can be enjoyed by combining the operations of the movable component thereafter.

Second Embodiment

Operation Stop Processing at the Time of Executing the Write Show in the Second Embodiment

[0057] Next, a second embodiment of the present disclosure will be described with reference to FIG. **4**. The control device **500** performs an operation stop process at the time of executing the write show at the time of starting the write show.

[0058] As illustrated in FIG. **4**, in the write show execution-time operation stopping process, the control device **500** confirms whether there is an obstacle within the detection range corresponding to the movable components as in the first embodiment (S**11**). Next, the cockpit DC **300** performs S**12** so as to stop the operation instruction for the movable component that has determined that there is an obstacle within the corresponding detection range. Subsequently, the cockpit DC **300** controls S**13** display **41** to execute the operation stop notification.

[0059] Then, the cockpit DC **300** waits until the light show ends (S**14**). Thereafter, the cockpit DC **300** ends the write show execution-time operation stopping process. Incidentally, the cockpit DC **300** releases the stop of the operation instruction to the movable component that is stopping the operation instruction in accordance with the end of the operation stop process at the time of executing the write show, and controls so as to terminate the operation stop notification.

Operation and Effect of the Second Embodiment

[0060] (2-1) In the write show execution operation stop process of the second embodiment, it is determined whether or not there is an obstacle within the detection range corresponding to each movable component at the start of the light show, and then the process waits until the light show ends. According to this configuration, it is possible to easily perform processing for stopping an operation instruction to each movable component as compared with a case where the determination of whether or not there is an obstacle within the detection range corresponding to each movable component is repeated every predetermined time or every time each movable component is operated.

Modifications

[0061] The present embodiment can be realized with the following modifications. The present embodiment and the following modifications can be combined with each other within a technically consistent range to be realized.

[0062] When the operation stop notification is executed on the display **41**, the execution stop notification may be interrupted or terminated. When the operation stop notification is executed on the display **41**, the operation stop notification and the execution notification may be executed in parallel.

[0063] The in-execution notification and the operation stop notification may be executed on different displays. The display **41** for executing the operation stop notification is not limited to the one provided in the vehicle **100**, and may be, for example, a display of a mobile terminal held by a user. In this case, the cockpit DC **300** may be configured to provide the display of the mobile terminal of the user with information about the movable component whose operation instruction is stopped via the radio network.

[0064] The operation stop notification and the execution notification are not limited to those

displayed on the display **41**, and may be executed by, for example, audio output by the speaker **42** or blinking of the light **57**. The operation unit **43** is not limited to the one provided in the vehicle **100**, and may be, for example, an operation unit of a portable terminal held by a user. In this case, the cockpit DC **300** may be configured to execute the light show in response to the acquisition of the information indicating that the operation unit of the mobile terminal of the user is operated via the radio network.

[0065] The number and position of the camera **15** and the clearance sonar **33** may be changed as appropriate. The camera sensor device **10** and the sonar sensor device **20** are not limited to being connected to the driving assistance DC **200**, and may be connected to a cockpit DC **300** or a body DC **400**, or may be combined with them. In this case, the cockpit DC **300** may detect an obstacle around the vehicle **100** based on information inputted from the camera sensor device and the sonar sensor device connected to the cockpit DC **300** or the body DC **400**.

[0066] The cockpit DC **300** may detect an obstacle around the vehicle **100** based on one of information about images around the vehicle **100** and information about an object existing around the vehicle **100**.

[0067] A method of detecting an obstacle around the vehicle **100** may be changed as appropriate. For example, instead of the cockpit DC **300**, the driving assistance DC **200** or the body DC **400** may detect an obstacle around the vehicles **100**. The driving assistance DC **200** and the body DC **400** output the detected obstacle to the cockpit DC **300**. The cockpit DC **300** may be configured to stop and release the operation instruction to the movable components based on the driving assistance DC **200** or the detection result inputted from the body DC **400**.

[0068] When the cockpit DC **300** determines that there is an obstacle within the detection range corresponding to the predetermined movable component, it may be configured to output, to the body DC **400**, ignore instruction information instructing to ignore the operation instruction to the predetermined movable component. In this case, the body DC **400** may stop the operation of the predetermined movable component by ignoring the operation instruction information when the operation instruction information for instructing the operation of the predetermined movable component is input after the input of the ignoring instruction information for the predetermined movable component.

[0069] When the cockpit DC **300** determines that there is an obstacle within the detection range corresponding to the predetermined movable component, the cockpit may stop the operation instruction to both the predetermined movable component and the other movable component. For example, when the cockpit DC **300** determines that there is an obstacle within the detection range corresponding to at least a part of the movable components that can operate in the light show, the cockpit DC **300** may suspend the operation instruction to all the movable components. In addition, when the cockpit DC **300** determines that there is an obstacle within a detection range corresponding to a specific movable component among the movable components that can operate in the light show, the cockpit DC **300** may suspend an operation instruction to both the specific movable component and another movable component corresponding to the specific movable component. At this time, the cockpit DC **300** may not stop an operation instruction to another movable component that does not correspond to a particular movable component.

[0070] The detection range corresponding to each movable component may be changed as appropriate. For example, the detection range corresponding to each movable component may be the same as the movable range of each movable component.

[0071] The same detection range may be set for a plurality of movable components. In this case, the detection range may be set to include all of the movable ranges of the plurality of movable components. In addition, the cockpit DC **300** may stop the operation instruction for all of the plurality of movable components when it is determined that there is an obstacle within the detection range.

[0072] The frequency of determining whether or not there is an obstacle in the write show

execution operation stop process may be changed as appropriate. For example, the cockpit DC **300** may determine whether or not there is an obstacle in the detection range corresponding to the movable component prior to the operation of the movable component every time the movable component is operated in the light show.
[0073] There may be a plurality of types of music output from the speaker **42** in the light show. In this case, the music output by the operation of the operation unit **43** may be selected. There may be a plurality of types of program patterns for the light show. The program pattern of the light show may be configured to be settable by the user.
[0074] The timing at which the light show ends may be changed as appropriate. For example, the cockpit DC **300** may terminate the light show when a predetermined period of time has elapsed since the light show started. The cockpit DC **300** may terminate the light show based on an instruction from the operation unit **43**.
[0075] Various electrical components operated in the light show may be changed as appropriate. For example, a back door, a power window, a bonnet, a sunroof, an oil supply port, a charging port, and the like of the vehicle **100** may be operated. In addition, any or all of the door, the mirror, and the light may not be operated. That is, in the light show, at least one movable component may operate in accordance with the output of music from the speaker **42**.

Claims

1. A control device applied to a vehicle that includes a speaker and a movable component, wherein: the control device is able to execute a specifying process that causes the movable component to operate along with outputting music from the speaker, and an obstacle detecting process that detects an obstacle present in a periphery of the vehicle; and when an obstacle is detected within a detection range corresponding to a movable range of the movable component in the obstacle detecting process, the specifying process causes music to be output from the speaker without operating the movable component.
2. The control device according to claim 1, wherein: the vehicle includes a first movable component and a second movable component as the movable component; and when an obstacle is detected within a detection range corresponding to a movable range of the first movable component and an obstacle is not detected within a detection range corresponding to a movable range of the second movable component in the obstacle detecting process, the specifying process causes music to be output from the speaker and the second movable component to be operated without operating the first movable component.
3. The control device according to claim 1, wherein the specifying process further controls blinking of a light of the vehicle.
4. The control device according to claim 1, wherein: the obstacle detecting process is executed when the specifying process starts; the obstacle detecting process determines whether or not the obstacle is present within a detection range corresponding to a movable range of the movable component for each of the movable components operated in the specifying process; and the specifying process causes the movable component for which determination is made that an obstacle is present within the detection range to not operate when the specifying process starts and the specifying process causes the movable component for which determination is made that an obstacle is not present within the detection range to operate when the specifying process starts.
5. The control device according to claim 1, wherein an operation of the movable component stopping due to an obstacle being present within the detection range is displayed on a display.