

Assistance robot

Technical Field

[0001]

5 The present invention relates to an assistance robot.

Background Art

[0002]

Patent literature 1 discloses an assistance robot that appropriately moves a
10 holding member that holds a care receiver to assist the care receiver in a
standing operation and a sitting operation. With such an assistance robot, it is
desirable to appropriately position the holding member so as not to cause the
care receiver discomfort. The assistance robot of patent literature 1 is provided
with different movement paths that each correspond to the standing operation
15 and the sitting operation. Thus, by entering a standing operation or a sitting
operation as a requested operation, the assistance robot performs control of the
position of the holding member based on a movement path corresponding to
the requested operation.

20 Citation List

Patent Literature

[0003]

Patent literature 1: International publication WO2014/122752

25 Summary of Invention

Technical Problem

[0004]

However, with the assistance robot, depending on the current position of the holding member and how the body weight of the care receiver is positioned with respect to the holding member, there may be cases in which the movement path is not set appropriately for the required operation. Thus, an assistance
5 robot that moves a holding member on an appropriate movement path in accordance with the usage state is desired.

[0005]

The present invention takes account of such problems, and an object thereof is to provide an assistance robot that assists standing and sitting operations of a
10 care receiver by moving a holding member on a movement path in accordance with a usage state.

Solution to Problem

[0006]

15 The assistance robot of claim 1 is provided with: a base, a holding member configured to hold an upper body of a care receiver; a driving device configured to move the holding member in an up-down direction and a left-right direction of the base; and a control device configured to control operation of the driving device. The control device includes: a memory section configured to memorize a
20 standing path that is a movement path of the holding member corresponding to a standing operation of the care receiver, and a sitting path that is a movement path of the holding member corresponding to a sitting operation of the care receiver; a path setting section configured to, in a case in which the standing operation or the sitting operation has been entered as a requested
25 operation, select one of the standing path or the sitting path that corresponds to the requested operation, or one of the standing path or the sitting path that does not correspond to the requested operation, based on a usage state

including a current position of the holding member, and set the selected movement path as a reference path; and a driving control section configured to move the holding member based on the set reference path.

5 Advantageous Effects

[0007]

According to the configuration of the invention of claim 1, the reference path is switched based on the current state of the holding member. In other words, for the reference path of the requested operation, as well as a movement path
10 corresponding to the requested operation being set, a movement path that does not correspond to the requested operation may be set. Specifically, there are cases in which a holding member that moves based on the reference path is moved based on the sitting path instead of the standing path even though the standing operation was requested, and cases in which the holding member that
15 moves based on the reference path is moved based on the standing path instead of the sitting path even though the sitting operation was requested

[0008]

Thus, compared to a case in which the movement path is always selected according to the requested operation, the movement path can be set in
20 accordance with the current state of the holding member, that is, the usage state of the assistance robot. This allows a care receiver to be assisted in a standing operation or a sitting operation without any discomfort to the care receiver or an operator operating the assistance robot.

25 Brief Description of Drawings

[0009]

Fig. 1

Fig. 1 is a perspective view from the rear side of an assistance robot that is an embodiment of the present disclosure.

Fig. 2

Fig. 2 shows the configuration of the assistance robot and a care receiver in a sitting posture.

Fig. 3

Fig. 3 shows the configuration of the assistance robot and a care receiver in a standing posture.

Fig. 4

Fig. 4 is a block diagram showing a control device and controller of the assistance robot.

Fig. 5

Fig. 5 illustrates a movement path of the holding member and the angle of the holding member with respect to the position of the holding member.

Fig. 6

Fig. 6 is a flowchart illustrating reference path setting processing.

Fig. 7

Fig. 7 is a table showing reference path patterns set when the standing switch is pushed.

Fig. 8

Fig. 8 is a table showing reference path patterns set when the sitting switch is pushed.

Fig. 9

Fig. 9 illustrates a movement path of the holding member and the angle of the holding member with respect to the position of the holding member of an alternative embodiment.

Description of Embodiments

[0010]

Embodiment

Configuration of assistance robot

- 5 Assistance robot 1 assists standing of care receiver M (shown in figs. 2 and 3) from a sitting posture to a standing posture and assists sitting from standing posture to a sitting posture. By supporting the upper body of care receiver M in a standing posture, assistance robot 1 can be maneuvered by only one caregiver such that care receiver M can be moved, for example, to a target location in a
10 care facility. Note that, a "standing posture" means a state in which at least the lower half of care receiver M is upright; it does not necessarily refer to a state in which the upper half of care receiver M is upright.

[0011]

- As shown in figs. 1 and 4, assistance robot 1 is provided with base 10,
15 supporting device 20, controller 50, and control device 60. In descriptions below, as shown in fig. 1, the front-rear, left-right, and up-down directions are as seen by care receiver M. Base 10 is configured to allow care receiver M to get on and to move in a front-rear direction and a left-right direction while care receiver M is on base 10. As shown in figs. 1 and 2, base 10 is provided with frame 11,
20 support column 12, footrest 13, fixed cover 14, and multiple wheels 15.

[0012]

- Frame 11 of base 10 is positioned slightly above floor surface 2 (floor or ground) and is substantially horizontal with respect to floor surface 2. Support column 12 is fixed to frame 11 and stands upright on an upper front surface of frame 11.
25 Support column 12 is arranged centrally in the left-right direction towards the front of frame 11. Note that, in the present embodiment, assistance robot 1 includes one support column 12, but two or more support columns 12 may be

provided.

[0013]

Footrest 13 is fixed to a rear upper surface of frame 11 for care receiver M to load their feet on. Contact marks 13a for the feet of care receiver M are provided on an upper surface of footrest 13. Contact marks 13a act as a foot positioning guide for care receiver M. As shown in fig. 1, fixed cover 14 is fixed to frame 11 or support column 12. Fixed cover 14 covers the range of a lower portion of raising and lowering main body 31 of raising and lowering section 30 in driving device 23, which is described later, and protects the inside of driving device 23. Multiple wheels 15 are provided on base 10 and support base 10 to be movable with respect to floor surface 2.

[0014]

Supporting device 20 is provided on base 10 and is configured to support care receiver M in a standing posture (refer to fig. 3). In the present embodiment, supporting device 20 includes holding member 21, lower limb contacting section 22, and driving device 23. Holding member 21 holds the upper body of care receiver M. In the present embodiment, holding member 21 is provided with torso receiving section 21a that contacts the torso of care receiver M and underarm receiving sections 21b that support the underarms of care receiver M. Note that, holding member 21 may be provided with only one of torso receiving section 21a and underarm receiving sections 21b.

[0015]

Torso receiving section 21a supports the torso of care receiver M from below. Torso receiving section 21a has a wide surface and is made of a cushion material. Torso receiving section 21a is formed to have an initial shape that matches that of a typical care receiver M, and is flexible to change shape to match the torso of each individual care receiver M. In the present embodiment,

torso receiving section 21a contacts care receiver M from the chest to the abdomen.

[0016]

Underarm receiving sections 21b are formed to have an arc shape and are
5 provided on the right and left sides of torso receiving section 21a such that the arc opening faces upward. Underarm receiving sections 21b support the underarms of care receiver M from below so as to support the upper body of care receiver M. Further, underarm receiving sections 21b regulate forward and rearward movement of care receiver M by sandwiching both underarm portions
10 of care receiver M from the front and rear. Accordingly, torso receiving section 21a and underarm receiving sections 21b regulate the shoulder position of care receiver M being held by holding member 21.

[0017]

Lower limb contacting section 22 contacts a front portion (shin or knee) of the
15 lower limbs of care receiver M in a sitting posture, thereby helping to decide the position and posture of the lower body of care receiver M in a sitting posture. In particular, the positions of the legs are decided to a certain extent. Lower limb contacting section 22 is fixed to support column 12 of base 10. Lower limb contacting section 22 is provided with two support members 22a and lower
20 limb contacting main body 22b.

[0018]

Support members 22a are L-shaped. One end of the L shape of support member 22a is fixed to support column 12, and the other end of the L shape of support member 22a is positioned to the rear of support column 12. Lower limb
25 contacting main body 22b is fixed to the other end of support member 22a and is positioned to the rear of raising and lowering cover 33 and below oscillation support section 32. Lower limb contacting main body 22b is a portion for

contacting the front of the lower limbs of care receiver M, has a wide surface, and is formed of a cushion material.

[0019]

Driving device 23 supports holding member 21 to be movable with respect to
5 the up-down direction and the front-rear direction of base 10, and moves
holding member 21 along multiple different movement paths. In the present
embodiment, driving device 23 includes raising and lowering section 30 and
oscillating section 40. Raising and lowering section 30 moves in the up-down
direction with respect to base 10. Raising and lowering section 30 is provided
10 with raising and lowering main body 31, oscillation support section 32, and
raising and lowering cover 33.

[0020]

As shown in fig. 2, raising and lowering main body 31 is formed elongated in
the up-down direction. Raising and lowering main body 31 is provided on a rear
15 surface of support column 12 to be movable linearly in the up-down direction.
Raising and lowering main body 31 is guided by a guide (not shown) on the rear
surface of support column 12, and is driven by a linear motion device (not
shown). Raising and lowering main body 31 is enclosed by fixed cover 14.
Oscillation support section 32 is provided on an upper end side of raising and
20 lowering main body 31 and includes oscillating shaft center 32a that is parallel
to the left-right direction.

[0021]

As shown in fig. 1, raising and lowering cover 33 is fixed to raising and lowering
section 30 and encloses raising and lowering main body 31 and oscillation
25 support section 32. Further, raising and lowering cover 33 encloses support
column 12 and fixed cover 14. Note that, in the present embodiment, assistance
robot 1 includes one raising and lowering section 30 with respect to one

support column 12. However, in a case where two or more support columns 12 are provided, a quantity of raising and lowering sections 30 may be provided corresponding to the quantity of support columns 12.

[0022]

- 5 Oscillating section 40 moves holding member 21 with respect to raising and lowering section 30 in the front-rear direction of base 10, and rotates holding member 21 around an axis parallel to the left-right direction of base 10. Oscillating section 40 is provided with oscillation main body 41, arm 42, and grip 43. Oscillation main body 41 is removably attached to torso receiving
10 section 21a of holding member 21.

[0023]

- Arm 40 is provided to rotate around oscillating shaft center 32a of oscillation support section 32 of raising and lowering section 30. Arm 42 is rotated by an arm driving device (not shown). When assistance robot 1 performs standing
15 assistance, arm 42 pivots forwards from a state extending to the rear. On the other hand, when assistance robot 1 is performing sitting assistance, arm 42 pivots rearwards to a state extending to the rear.

[0024]

- Grip 43 is U-shaped as seen from the front-rear direction, and both ends of the
20 U shape of grip 43 are fixed to oscillation main body 41. The center section of grip 43 is positioned to the front of torso receiving section 21a and oscillation main body 41 and is gripped by care receiver M who is being held by holding member 21. Also, grip 43 is used when a caregiver is pulling assistance robot 1 and so on.

- 25 [0025]

According to the above configuration, oscillating section 40 rotates holding member 21 attached to oscillation main body 41 on the front end of arm 42

around an axis (oscillating shaft center 32a) parallel to the left-right direction of base 10. Oscillating section 40, by rotating holding member 21, oscillates holding member 21 to be at an angle regulated with respect to the position of holding member 21 in the front-rear direction.

5 [0026]

Controller 50 is an input device for receiving inputs by an operator (caregiver or care receiver M). In the present embodiment, as shown in fig. 4, controller 50 includes standing switch 51, sitting switch 52, raising switch 53, and lowering switch 54. Standing switch 51 receives an instruction for an operation request of
10 a standing operation for assisting care receiver M to a standing posture from the current state including the current position and current angle of holding member 21. Sitting switch 52 receives an instruction for an operation request of a sitting operation for assisting care receiver M to a sitting posture from the current state of holding member 21.

15 [0027]

Raising switch 53 receives an instruction for an operation request for a raising operation for raising holding member 21 from the current position. Lowering switch 54 receives an instruction for an operation request for a lowering operation for lowering holding member 21 from the current position. Controller
20 50 is connected to control device 60 such that communication is possible, and in a case in which only one of the switches is pushed, sends the operation corresponding to the pushed switch as an operation request to control device 60.

[0028]

25 Control device 60 controls operation of driving device 23 such that holding member 21 is lowered and raised and oscillated in accordance with the operation request sent from controller 50. Control device 60 is fixed to frame 11

of base 10 to the side of support column 12. Control device 60 includes memory section 61, path setting section 62, and driving control section 63. Memory section 61 memorizes standing operation data 71 and sitting operation data 72.
[0029]

5 Standing operation data 71 is two-dimensional coordinate data representing standing path 81 (refer to fig. 5) that is a movement path of holding member 21 corresponding to standing operation of a care receiver M. Sitting operation data 72 is two-dimensional coordinate data representing sitting path 82 (refer to fig. 5) that is a movement path of holding member 21 corresponding to sitting
10 operation of a care receiver M. The origin point of the two-dimensional coordinate data may be a given reference point in the moving range of holding member 21, or the position of the center of gravity of assistance robot 1.
[0030]

Here, standing path 81 and sitting path 82 of holding member 21, for example,
15 are paths along which a reference point of holding member 21 is moved by operation of driving device 23. Specifically, as shown in fig. 5, standing path 81 is a curved path from first position P1 to second position P2. Also, sitting path 82 is a path configured from a curved path from second position P2 to third position P3 and a straight path from third position P3 to first position P1.
20 [0031]

Path setting section 62, in a case in which a standing operation or a sitting operation is input as an operation request, sets either of standing path 81 or sitting path 82 as a reference path based on the current state including the current position of holding member 21. Driving control section 63 moves
25 holding member 21 based on the set reference path. Specifically, driving control section 63 synchronizes operation of raising and lowering section 30 and oscillating section 40 and controls operation of driving device 23 such that

holding member 21 is moved along the reference path.

[0032]

According to such a configuration, control device 60, for example, in a case in which sitting switch 52 of controller 50 is pushed, controls movement of holding member 21 along standing path 81 in addition to controlling movement of holding member 21 along sitting path 82. Similarly, this applies when standing switch 51 of controller 50 is pushed. In this manner, the purpose of executing operation processing of holding member 21 based a movement path not corresponding to the requested operation is so that holding member 21 is moved along a movement path corresponding to the usage state of assistance robot 1.

[0033]

In detail, path setting section 62, in a case in which standing switch 51 or sitting switch 52 is pushed so as to input a requested operation, sets the reference path of the requested operation based on at least one of the current position and the current angle of holding member 21 that are included in the current state of holding member 21. In the present embodiment, path setting section 62 sets the reference path of the requested operation based on the current position of holding member 21 and area information 73 memorized in memory section 61.

[0034]

The above area information 73 represents multiple areas demarcated by a specified position of holding member 21 in at least one of the up-down direction and the front-rear direction with respect to base 10. In the present embodiment, as shown in fig. 5, specified position Pr is a position of holding member 21 in the front-rear direction with respect to base 10 and is set based on the angle of holding member 21.

[0035]

Here, driving device 23 of the embodiment is configured to move holding member 21 in the front-rear direction and to rotate holding member 21 around oscillation shaft center 32a by rotating arm 42 of oscillating section 40. That is, as shown in the lower section of fig. 5, oscillating section 40 oscillates holding member 21 to be at an angle θ regulated with respect to the position of holding member 21 in the front-rear direction. As shown in figs. 2 and 3, angle θ of holding member 21 is an angle with respect to a vertical axis, and increases as holding member 21 moves forward.

[0036]

Also, for care receiver M being held by holding member 21, when holding member 21 has been rotated by a certain amount, the buttock portion Mb of the care receiver M is raised from the seat of chair and their body weight is leaning towards supporting device 20. In the embodiment, the position of holding member 21 in the front-rear direction corresponding to specified angle θ_t of holding member 21 in the above state is set as the above specified position Pr. Included in the multiple areas represented by area information 73 are standing priority area Ar and sitting priority area As generated by demarcating the moving region Rn of holding member 21 in the front-rear direction via specified position Pr.

[0037]

Standing priority area Ar is an area for which path setting section 62 gives priority to setting standing path 81 as the reference path in a case in which holding member 21 is positioned in that area. Standing priority area As is an area for which path setting section 62 gives priority to setting sitting path 82 as the reference path in a case in which holding member 21 is positioned in that area. As shown in fig. 5, standing priority area Ar is positioned to the rear of

sitting priority area As.

[0038]

Reference path setting processing

Reference path setting processing by path setting section 62 of control device

5 60 is described below with reference to figs. 5 to 8. Reference path setting processing is executed when, for example, standing switch 51 or sitting switch 52 of controller 60 is pushed so as to input a standing operation or a sitting operation as a requested operation. Note that, when raising switch 53 or lowering switch 54 of controller 50 are pushed, because operation of raising and
10 lowering section 30 is controlled without using the reference path, reference path setting processing is not executed.

[0039]

As shown in fig. 6, path setting section 62 of control device 60, first, determines whether the requested operation and the previous operation that moved

15 holding member 21 to the current position are the same (step 11 [hereinafter, "step" is abbreviated to "S"]). For this, path setting section 62 acquires information representing the previous operation that is temporarily memorized in memory section 61. This information includes, as the previous operation, a standing operation, a sitting operation, a raising operation, and a lowering
20 operation. Also, in a case in which information representing the previous operation is not memorized, path setting section 62 determines that the power switch (not shown) has just been turned on, and that the previous operation was turning on the power.

[0040]

25 Path setting section 62, when determining that the previous operation and the requested operation are the same (S11: yes), sets the movement path of holding member 21 corresponding to the requested operation as the reference path

regardless of the current state of holding member 21 (S15). Then, the same operation as the previous operation is restarted by controlling driving control section 63. This operation assumes a case in which, for example, an operator released standing switch 51 during standing operation, and then pushed
5 standing switch 51 again (patterns N11 and N12 in fig. 7).

[0041]

Or, similarly, this assumes a case in which an operator released sitting switch 52 during sitting operation, and then pushed sitting switch 52 again (patterns N23 and N24 in fig. 8). Note that, in the furthest right column of figs. 7 and 8, the
10 movement path of the previous operation that moved holding member 21 to the current position Pc is shown by a thick dashed arrow, whereas the movement path of the requested operation from current position Pc based on the reference path is shown by a thick solid arrow.

[0042]

15 On the other hand, if the previous operation and the requested are different (S11: no), path setting section 62, based on the information representing the previous operation, determines whether the previous operation was any of the raising operation, the lowering operation, or turning on the power (S12). If the previous action is determined to be one of the raising operation, the lowering
20 operation, or turning on the power (S12: yes), path setting section 62 sets the movement path of holding member 21 corresponding to the requested operation as the reference path regardless of the current state of holding member 21. Then, holding member 21 is moved from the current position and the current angle along the reference path corresponding to the requested
25 operation by control of driving control section 63 (patterns N15 and N16 in fig. 7 and patterns N25 and N26 in fig. 8).

[0043]

Path setting section 62, in a case in which the previous is none of the raising operation, the lowering operation, or turning on the power (S12: no), that is, the requested operation is the standing operation and the previous operation was the sitting operation, or the requested operation was the sitting operation and the previous operation was the standing operation, acquires the current state of holding member 21 (S13). In the embodiment, path setting section 62 acquires current position Pc of holding member 21 as the current state.

[0044]

Continuing, path setting section 62 selects one of standing path 81 or sitting path 82 based on the current position of holding member 21 and area information 73, and sets that path as the reference path of the requested operation (S14). Specifically, if the area to which current position Pc of holding member 21 belongs is standing priority area Ar, standing path 81 is set as the reference path of the requested operation. On the other hand, if the area to which current position Pc of holding member 21 belongs is sitting priority area As, sitting path 82 is set as the reference path of the requested operation.

[0045]

In other words, if the requested operation is the standing operation and the previous operation is the sitting operation, if the area to which current position Pc belongs is standing priority area Ar, standing path 81 is set as the reference path (pattern N13 in fig. 7). As a result, similar to S15, the reference path of the requested operation is set as the movement path (standing path 81) corresponding to the requested operation. On the other hand, if the area to which current position Pc belongs is the sitting priority area As, sitting path 82 is set as the reference path (pattern N14 of fig. 7). As a result, the reference path of the requested operation is set as the movement path (sitting path 82) that does not correspond to the requested operation (standing operation).

[0046]

Further, if the requested operation is the sitting operation and the previous operation is the standing operation, if the area to which current position Pc belongs is sitting priority area As, sitting path 82 is set as the reference path (pattern N22 in fig. 8). As a result, similar to S15, the reference path of the requested operation is set as the movement path (sitting path 82) corresponding to the requested operation. On the other hand, if the area to which current position Pc belongs is the standing priority area Ar, standing path 81 is set as the reference path (pattern N21 of fig. 8). As a result, the reference path of the requested operation is set as the movement path (standing path 82) that does not correspond to the requested operation (sitting operation).

[0047]

As described above, path setting section 62 selects a movement path that does not correspond to the requested operation and sets that movement path as the reference path in accordance with the current state of holding member 21 (pattern N14 of fig. 7 and pattern N21 of fig. 8). Accordingly, during subsequent operation, holding member 21, instead of being moved along the movement path corresponding to the requested operation, is moved along a movement path that does not correspond to the requested operation (that is, the movement path corresponding to the previous operation). Such control means that operation according to the desire of the operator is performed while considering safety based on the loaded state of the body weight of care receiver M with respect to holding member 21 and the like.

[0048]

After reference path setting processing has been performed, holding member 21 is moved from the current position and the current angle along the reference

path by control of driving control section 63. In this manner, assistance robot 1 moves holding member 21 along a movement path in accordance with various usage states, so as to assist a standing operation and a sitting operation of care receiver M.

5 [0049]

Effects of embodiment

Assistance robot 1 is provided with: base 10, holding member 21 configured to hold an upper body of care receiver M; driving device 23 configured to move holding member 21 in an up-down direction and a left-right direction of base
10 10; and control device 60 configured to control operation of driving device 23. Control device 60 includes: memory section 61 configured to memorize standing path 81 that is a movement path of holding member 21 corresponding to a standing operation of care receiver M, and sitting path 82 that is a movement path of holding member 21 corresponding to a sitting operation of
15 care receiver M, path setting section 62 configured to, in a case in which the standing operation or the sitting operation has been entered as a requested operation, select one of standing path 81 or sitting path 82 that corresponds to the requested operation, or one of standing path 81 or sitting path 82 that does not correspond to the requested operation, based on a usage state including
20 current position Pc of holding member 21, and set the selected movement path as a reference path, and driving control section 63 configured to move holding member 21 based on the set reference path.

[0050]

According to such a configuration, the reference path is switched based on the
25 current state of holding member 21. Thus, compared to a case in which the movement path is always selected according to the requested operation, the movement path can be set in accordance with the current state of holding

member 21, that is, the usage state of assistance robot 1. This allows care receiver M to be assisted in a standing operation or a sitting operation without any discomfort to care receiver M or an operator operating assistance robot 1.
[0051]

5 Also, path setting section 62, when determining that the requested operation and the previous operation that moved holding member 21 to current position Pc are the same (S11: yes), sets the movement path of holding member 21 corresponding to the requested operation as the reference path regardless of the current state of holding member 21 (S15). If the previous state and the
10 requested state as the same (S11: yes), for example, it can be assumed that it is being requested to perform the requested operation in stages. Here, in such a case, a movement path corresponding to the requested operation (standing path 81 if the requested operation is the standing operation; sitting path 82 if the requested operation is the sitting operation) is set as the reference path
15 without switching the reference path based on the current state of holding member 21. Accordingly, the control processing load is reduced, and control can respond quickly to requests of the operator.

[0052]

Further, memory section 61 also memorizes area information 73 representing
20 multiple areas demarcated by specified position Pr of holding member 21 in at least one of the up-down direction and the front-rear direction with respect to base 10. Included in the multiple areas are standing priority area Ar in which standing path 81 is made the reference path, and sitting priority area As in which sitting path 82 is made the reference path. Path setting section 62 sets
25 the reference path of the requested operation based on current position Pc of holding member 21 and area information 73. According to such a configuration, due to area information 73 being used in setting the reference path of the

requested operation, the control processing load is reduced, and control can respond quickly to requests of the operator.

[0053]

Further, driving device 23 includes raising and lowering section 30 that moves in
5 an up-down direction with respect to base 10, and oscillating section 40 that
moves holding member 21 with respect to raising and lowering section 30 in
the front-rear direction of base 10, and rotates holding member 21 around an
axis parallel to the left-right direction of base 10, such that holding member 21
is at an angle regulated with respect to the position of holding member 21 in
10 the front-rear direction. Specified position Pr is a position of holding member 21
in the front-rear direction with respect to base 10 and is set based on the angle
of holding member 21. When setting the reference path of the requested
operation, one indicator is the posture of care receiver M, in particular, to what
extent buttock portion Mb of care receiver M is raised from seat 91. Here,
15 during operation of assistance robot 1, if holding member 21 holding care
receiver M is rotated by a specified angle or greater, buttock portion Mb of care
receiver M will be raised from seat 91. With regard to this, by setting specified
position Pr to demarcate areas based on the angle of holding member 21 as
described above, it is possible to appropriately demarcate areas, and care
20 receiver M can be assisted in a standing operation and a sitting operation
without care receiver M or an operator feeling discomfort.

[0054]

Further, standing priority area Ar is positioned to the rear of sitting priority area
As. According to such a configuration, areas are appropriately demarcated, and
25 care receiver M can be assisted in a standing operation and a sitting operation
without care receiver M or an operator feeling discomfort.

[0055]

Alternative embodiments

Path setting processing

In the embodiment above, path setting section 62 selects one of standing path 81 or sitting path 82 based on the current position of holding member 21 and area information 73, and sets that path as the reference path of the requested operation (S14). However, path setting section 62 may be configured to set the reference path of the requested operation based on the angle included in the current state of holding member 21.

[0056]

- 10 In such a configuration, the current angle of holding member is included in the current state of holding member 21. Also, in a case in which a requested operation has been input, path setting section 62 sets the reference path of the requested operation based on at least one of current position Pc and the angle of holding member 21 included in the current state. The angle of holding
- 15 member 21 may be acquired, for example, based on a detection result of an angle detecting apparatus on at an arm driving device that drives arm 42.

[0057]

According to such a configuration, path setting section 62 switches the reference path in accordance with the current angle of holding member 21.

- 20 Thus, by setting the reference path according to the angle of holding member 21 in addition to current position Pc of holding member 21, it is possible to perform a more detailed setting. Further, by setting the reference path according to the angle of holding member 21 in addition to current position Pc of holding member 21, it is possible to set the reference path in accordance with
- 25 the posture of care receiver M.

[0058]

Area information

In the above embodiment specified position Pr that demarcates moving region Rn of holding member 21 is set based on the angle (specified angle θ_t) of holding member 21. However, specified position Pr may be configured to be set in addition to or instead of the angle of holding member 21. Accordingly,

5 standing priority area Ar and sitting priority area As can be demarcated, for example, along a boundary line inclined with respect to the vertical axis.

[0059]

Also, as shown in fig. 9, multiple specified positions, $Pr1$ and $Pr2$, may be set in the front-rear direction of holding member 21 to demarcate three areas. In this configuration, included in the multiple areas is intermediate area Am positioned
10 between standing priority area Ar and sitting priority area As . Here, as shown in the lower section of fig. 9, specified positions $Pr1$ and $Pr2$ are positions in the front-rear direction of holding member 21 corresponding to, for example, first angle θ_{t1} and second angle θ_{t2} of holding member 21.

15 [0060]

Further, intermediate area Am , when holding member 21 is positioned in that area, may be an area for which path setting section 62 gives priority to setting the movement path of holding member 21 corresponding to the previous operation as the reference path. According to such a configuration, for example,
20 in a case in which the requested operation is the standing operation and the previous operation is the sitting operation, if the area to which current position Pc belongs is intermediate area Am , a movement path (sitting path 82) that does not correspond to the requested operation (standing operation) is set as the reference path.

25 [0061]

Similarly, in a case in which the requested operation is the sitting operation and the previous operation is the standing operation, if the area to which current

position Pc belongs is intermediate area Am, a movement path (standing path 81) that does not correspond to the requested operation (sitting operation) is set as the reference path. According to such a configuration, compared to a case of demarcating two priority areas, it is possible to set the reference path in more
5 detail in accordance with the current state.

[0062]

Driving device 23

In the above embodiment, driving device 23 is configured from raising and lowering section 30 that moves in an up-down direction with respect to base 10,
10 and oscillating section 40 that oscillates holding member 21. However, driving device 23 may come in various forms so long as it supports holding member 21 to be movable with respect to the up-down direction and the front-rear direction of the base, and moves holding member 21 along multiple different movement paths.

15 [0063]

Specifically, oscillating section 40, in addition to rotating arm 42 and rotating oscillation main body 41 around an axis while moving oscillation main body 41 in the front-rear direction, for example, may be configured to support oscillation main body 41 by a rail inclined in the front-rear direction on an upper section of
20 raising and lowering section 30. With such a configuration, due to the movement of oscillation main body 41 along the rail, it is possible to move holding member 21 attached to oscillation main body 41 in the front-rear direction and to make holding member 21 inclined.

[0064]

25 Further, driving device 23 may be configured from a rotation member provided on base 10 that rotates around an axis that is parallel to the left-right direction, and an extending arm that is provided on the rotation member and is

extendable in the diameter direction of the rotation member. Also, driving device 23 may be configured including a first rotation member that rotates around a shaft parallel to the left-right direction, and a second rotation member that is provided on the first rotation member and that rotates around an axis parallel to the rotation axis of the first rotation member.

[0065]

According to such a configuration, by holding member 21 being attached to the extending arm or the second rotation member, holding member 21 is able to move in the up-down direction and the front-rear direction of base 10, and is able to move in accordance with multiple movement paths. Also, when moving holding member 21 along multiple movement paths, by setting the reference path of the requested operation based on the current state of holding member 21, similar effects to the main embodiment are achieved.

Reference Signs List

[0066]

1: assistance robot; 2: floor surface;

10: base;

11: frame; 12: support column;

13: footrest; 13a: contact mark;

14: fixed cover; 15: wheel;

20: supporting device;

21: holding member; 21a: torso receiving section; 21b: underarm

receiving section; 22: lower limb contacting section; 22a: support

member; 22b; lower limb contacting main body; 23: driving device;

30: raising and lowering section;

31: raising and lowering main body; 32: oscillation support

section; 32a: oscillating shaft center; 33: raising and lowering
 cover;
 40: oscillating section;
 41: oscillation main body; 42: arm; 43: grip;
 5 50: controller;
 51: standing switch; 52: sitting switch;
 53: raising switch; 54: lowering switch;
 60: control device;
 61: memory section; 62: path setting section; 63: driving control section;
 10 71: standing operation data; 72: sitting operation data; 73: area
 information;
 81: standing path; 82: sitting path;
 90: chair; 91: seat;
 Rn: moving range (of holding member);
 15 Ar: standing priority area; As: sitting priority area; Am: intermediate area;
 M: care receiver; Mb: buttock portion (of care receiver)
 P1: first position; P2: second position; P3: third position;
 Pc: current position (of holding member); Pr: specified position;
 θ : angle (of holding member); θ_t : specified angle (of holding member);
 20 θ_{t1} : first angle (of holding member); θ_{t2} : second angle (of holding member);
 N11 to N16: operation patterns when standing switch 51 is pushed;
 N21 to N26: operation patterns when sitting switch 52 is pushed

Claims

1. An assistance robot comprising:

a base;

5 a holding member configured to hold an upper body of a care receiver;

a driving device configured to move the holding member in an up-down direction and a left-right direction of the base; and

10 a control device configured to control operation of the driving device, the control device including

a memory section configured to memorize a standing path that is a movement path of the holding member corresponding to a standing operation of the care receiver, and a sitting path that is a movement path of the holding member corresponding to a sitting operation of the care receiver,

15 a path setting section configured to, in a case in which the standing operation or the sitting operation has been entered as a requested operation, select one of the standing path or the sitting path that corresponds to the requested operation, or one of the standing path or the sitting path that does not correspond to the requested operation, based on a usage state including a current position of the holding member, and set the selected movement path as a reference path, and

20 a driving control section configured to move the holding member based on the set reference path.

2. The assistance robot according to claim 1, wherein

the driving device is configured to rotate the holding member around
a shaft parallel to a left-right direction of the base,
a current angle of the holding member is included in the current state
of the holding member, and

5 the path setting section is configured to, when the requested
operation has been entered, set the reference path of the requested
operation based on at least one of the current position or the
current angle of the holding member included in the current state.

10 3. The assistance robot according to claim 1 or 2, wherein
the path setting section is configured to, in a case in which the
requested operation and the previous operation of moving the
holding member to the current position are equal, set as the
reference path a movement path of the holding member
15 corresponding to the requested operation regardless of the current
state of the holding member.

4. The assistance robot according to any one of the claims 1 to 3, wherein
the memory section is also configured to memorize area information
20 representing multiple areas demarcated by a specified position of
the holding member in at least one of the up-down direction and
the front-rear direction with respect to the base,
the multiple areas include a standing priority area for which the
standing path is made the reference path, and a sitting priority area
25 for which the sitting path is made the reference path, and
the path setting section is configured to set the reference path of the
requested operation based on the area information and the current

position of the holding member.

5. The assistance robot according to claim 4, wherein

the driving device includes

5 a raising and lowering section configured to move in the up-down
direction with respect to the base, and
a pivoting section configured to move the holding member in a
front-rear direction of the base with respect to the raising and
lowering section and to rotate the holding member around an
10 axis parallel to a left-right direction of the base, such that the
holding member is at an angle regulated with respect to the
position of the holding member in the front-rear direction, and
the specified position is a position of the holding member in the
front-rear direction with respect to the base and is set based on
15 the angle of the holding member.

6. The assistance robot according to claim 5, wherein

the standing priority area is positioned to the rear of the sitting priority
area.

20

7. The assistance robot according to any one of the claims 4 to 6, wherein

the multiple areas further include an intermediate area for which a
movement path of the holding member corresponding to a
previous operation in which the holding member was moved to the
25 current position is the reference path.