{DESCRIPTION}

{Title of the Invention}

ELECTRIC MOBILITY VEHICLE

{Technical Field}

{0001}

The present disclosure relates to an electric mobility vehicle.

{Background Art}

{0002}

An electric mobility vehicle used in a facility is known in which a control device of the electric mobility vehicle detects obstacles using sensors provided on the electric mobility vehicle, and based on the detection results, causes the electric mobility vehicle to perform obstacle avoidance operation, stopping, autonomous driving, and the like. For example, see PTL 1.

{Citation List}

{Patent Literature}

{0003}

{PTL 1} International Publication No. 2021/085446

{Summary of Invention}

{Technical Problem}

{0004}

Such an electric mobility vehicle is used by users having various physical characteristics, races, clothing, and the

like. For example, the physical characteristics of users include height, weight, and the like, and in some cases a curved spine. Blocking of the sensor detection range by the body of the user, clothing, or the like affects the accuracy of obstacle avoidance, stopping, autonomous driving, and the like, and also affects comfortable of the user.

{0005}

Further, improving the accuracy of detection of the obstacle by the sensor is useful for safe travel of the electric mobility vehicle. In addition, reducing the cost of the electric mobility vehicle is useful for enabling the use of such electric mobility vehicle in many facilities. These factors are also related to the comfortable use of the electric mobility vehicle by the user.

{0006}

In view of the above circumstances, there is a demand for an electric mobility vehicle capable of making travel more comfortable for a greater number of people.

{Solution to Problem}

{0007}

According to one aspect of the present invention, there is provided an electric mobility vehicle including: a mobility body; and a sensor attached to the mobility body, the sensor having a viewing angle in a predetermined direction and having a detection range defined by rotating the viewing angle about

a predetermined axis line, and the sensor being capable of detecting an obstacle, wherein the sensor is attached to the mobility body such that the predetermined axis line extends in a vehicle width direction.

{Brief Description of Drawings}

{0008}

{Fig. 1}

Fig. 1 is a front perspective view of an electric mobility vehicle according to an embodiment of the present invention.

{Fig. 2}

Fig. 2 is a side view of the electric mobility vehicle according to the present embodiment.

{Fig. 3}

Fig. 3 is a plan view of the electric mobility vehicle according to the present embodiment.

{Fig. 4}

Fig. 4 is a front view of the electric mobility vehicle according to the present embodiment.

{Fig. 5}

Fig. 5 is a longitudinal sectional view of the electric mobility vehicle according to the present embodiment.

{Fig. 6}

Fig. 6 is a perspective view of a push handle of the electric mobility vehicle according to the present embodiment.

{Fig. 7}

Fig. 7 is a longitudinal sectional view of a part of the push handle of the electric mobility vehicle according to the present embodiment.

{Fig. 8}

Fig. 8 is a rear perspective view of a part of the electric mobility vehicle according to the present embodiment.

{Fig. 9}

Fig. 9 is a perspective view of a luggage basket of the electric mobility vehicle according to the present embodiment.

{Fig. 10}

Fig. 10 is a longitudinal sectional view of a part of the electric mobility vehicle according to the present embodiment.

{Fig. 11}

Fig. 11 is a longitudinal sectional view of a part of the electric mobility vehicle according to the present embodiment.

{Fig. 12}

Fig. 12 is a longitudinal sectional view of a part of the electric mobility vehicle according to the present embodiment.

{Fig. 13}

Fig. 13 is a longitudinal sectional view of a part of a modified example of the electric mobility vehicle according to the present embodiment.

{Fig. 14}

Fig. 14 is a longitudinal sectional view of a part of the

modified example of the electric mobility vehicle according to the present embodiment.

{Fig. 15}

Fig. 15 is a side view of the electric mobility vehicle according to the present embodiment mounted on a cart.

{Fig. 16}

Fig. 16 is a block diagram of a control device of the electric mobility vehicle according to the present embodiment.

{Fig. 17}

Fig. 17 is a schematic view of an airport passenger terminal in which the electric mobility vehicle according to the present embodiment is used.

{Fig. 18}

Fig. 18 is a view illustrating an example of operation of the electric mobility vehicle according to the present embodiment in the passenger terminal.

{Fig. 19}

Fig. 19 is a bottom view of a modified example of the electric mobility vehicle according to the present embodiment.

{Fig. 5}

{Description of Embodiments}

{0009}

A system in a facility such as an airport or the like according to an embodiment of the present invention, and an electric mobility vehicle M used in the facility, will be

described below with reference to the drawings. As shown in Fig. 17, this system includes a plurality of electric mobility vehicles M placed in an airport terminal T, and a server 100 which is a management server configured to manage the plurality of electric mobility vehicles M. The management server 100 may be located outside the airport.

{0010}

First, the electric mobility vehicle M according to the present embodiment, on which one person sits to ride, will be briefly described. In the present system, an electric mobility vehicle different from the electric mobility vehicle M of the present embodiment may also be used.

As shown in Figs. 1 to 5, the electric mobility vehicle M includes a pair of front wheels (wheels) 10, a pair of rear wheels (wheels) 20, and a mobility body 30 supported by the front wheels 10 and the rear wheels 20. The mobility body 30 includes a seat unit S. In addition to the front wheels 10 and the rear wheels 20, other wheels may be provided, and the numbers of the front wheels 10 and the rear wheels 20 are not limited to those described above. Also, in some cases, one of the front wheels 10 and the rear wheels 20 may be omitted.

{0011}

The mobility body 30 has a motor MT for driving at least one of the pair of front wheels 10 or the pair of rear wheels 20. Also, when a spacer is interposed between a rotating

portion (an output portion) of the motor MT and a hub of the rear wheel 20 by a person attaching the rear wheel 20 to the motor MT, the rear wheel 20 is positioned outward in the width direction. With this configuration, for example, when the pair of rear wheels 20 are rotated in mutually opposite directions to turn the electric mobility vehicle M, the turning force can be increased without increasing the output of the motor MT.

{0012}

In the description of the present embodiment, with respect to a vehicle longitudinal direction shown in Fig. 3, the vehicle front-rear direction, a vehicle front direction, and a vehicle rear direction may hereinafter be referred to simply as a front-rear direction, a front direction, and a rear direction, respectively. Further, a vehicle width direction shown in Fig. 3 may hereinafter be referred to as a width direction or a left-right direction. Moreover, the vehicle front-rear direction coincides with a front-rear direction of the electric mobility vehicle M and the mobility body 30, and the vehicle width direction coincides with a width direction of the electric mobility vehicle M and the mobility body 30.

{0013}

In the present embodiment, the pair of rear wheels 20 are each connected to the motor MT, and each motor MT drives the

corresponding rear wheel 20. The driving force of each motor MT may be transmitted to the corresponding front wheel 10 by a power transmission means. The power transmission member is, for example, a belt, a gear, or the like.

{0014}

Each front wheel 10 includes a hub (not shown) attached to an axle 11, and a plurality of rotatable rollers (not shown in Figs. 1 to 5 and the like.) supported by the hub. In the present embodiment, each front wheel 10 is a known omnidirectional wheel. In one example of the omnidirectional wheel, an outer peripheral surface is formed by the plurality of rollers, and the plurality of rollers are each rotatable in a direction along the rotational axis of the omnidirectional wheel, whereby the omnidirectional wheel is movable also in a direction along the rotational axis. Each front wheel 10 may instead be another type of wheel, such as a caster wheel or the like.

{0015}

The structure of the mobility body 30 may be modified as appropriate. The mobility body 30 of the present embodiment includes a base portion 32 extending along the ground, and a seat support portion 33 extending upward from a rear end side or a central portion of the base portion 32. The seat unit S is attached to an upper end side of the seat support portion 33.

The base portion 32 of the present embodiment includes a plastic component 32b attached to a metal base frame 32a shown in Fig. 1. The component 32b is used as a footrest portion or the like for a rider (a user) seated on the seat unit S. In some cases, a part or all of the footrest portion may be constituted by a frame forming the base portion 32, and in some cases the footrest portion may have another configuration.

{0016}

In the present embodiment, the seat unit S includes the backrest portion 40 and the seat surface portion 50. The backrest portion 40 extends upward from a rear end of the seat surface portion 50. The cushion 51 of the seat surface portion 50 is detachable, and when the cushion 51 is removed, an upper surface of the seat support portion 33 and/or a lower structure 52 of the seat surface portion 50 is exposed.

{0017}

A battery accommodating portion 34 extending in a vertical direction is formed in the seat support portion 33, and the battery BA is accommodated in the battery accommodating portion 34. A connector (not shown) is provided in the battery accommodating portion 34, and when the battery BA is accommodated in the battery accommodating portion 34, the battery BA is connected to the connector. Moreover, by removing the cushion 51 of the seat surface portion 50, an

operator can access the battery BA for replacement of the battery BA and the like.

{0018}

At an upper end portion of the seat support portion 33, as shown in Fig. 5, a seating sensor 53 is provided as a part of the lower structure 52 of the seat surface portion 50. The seating sensor 53 of the present embodiment includes a flexible member 54 supported by the upper end portion of the seat support portion 33, and a detection device 55 disposed below the flexible member 54. The detection device 55 is a switch, a pressure sensor, or the like. In the present embodiment, the detection device 55 is a switch. Thus, the detection device 55 may be any device capable of detecting that a user has seated on the seat surface portion 50. Further, as the seating sensor 53, another type of sensor which detects that the user is seated on the seat surface portion 50 may be used.

{0019}

The seat unit S has the right arm 43 and the left arm 43.

The armrest 43a is fixed to an upper surface of each arm 43. For example, the rider (user) puts both arms respectively on the armrests 43a of the pair of arms 43. In another example, the rider places both hands respectively on upper ends of the pair of arms 43. In the present embodiment, both the arms 43 and the armrests 43a are provided, however, only

the arms 43 or only the armrests 43a may be provided. In this case, the rider can place at least one of the arm or the hand on the arm 43, or can place at least one of the arm or the hand on the armrest 43a. Each arm 43 is a member to which the armrest 43a is attached.

{0020}

A pair of guard members 46 arranged in the vehicle width direction is provided in the seat unit S. Each guard member 46 is fixed to the seat unit S so as to be positioned outward in the vehicle width direction with respect to at least one of a thigh or a knee of the user seated on the seat unit S. In the present embodiment, each guard member 46 is provided so as to extend downward from the lower surface of the arm 43, and the lower end of the guard member 46 is positioned below the upper surface of the seat surface portion 50 in a state where the user is not seated.

{0021}

As shown in Figs. 1, 5, and the like, a portion 46a of each guard member 46 is positioned at a front side relative to a front end 50a of the seat surface portion 50. The guard members 46 reduce protrusion of clothing, a thigh, or a knee of the user on the seat unit S from the seat unit S.

Further, as shown in Figs. 1, 3, 4, and the like, each guard member 46 has an inclined portion 46b inclined inward in the vehicle width direction toward the lower side. By the

inclined portion 46b, the clothing and the like of the user on the seat unit S are guided inward in the vehicle width direction, and protrusion of the clothing and the like of the user from the seat unit S is reduced. Moreover, in the present embodiment, since the inclined portion 46b is provided in the lower end side of the guard member 46, the protrusion of the clothing of the user is more effectively reduced.

{0022}

As shown in Fig. 8 and the like, at the rear side portion of the mobility body 30, for example, at the rear end portion of the seat unit S, a pair of mounting portions 111 arranged in the vehicle width direction are fixed, and the left and right proximal end portions 112 of the push handle 110 are attached to the pair of mounting portions 111, respectively. Specifically, as shown in Fig. 7 and the like, each proximal end portion 112 of the push handle 110 is attached to a shaft 113 supported by the mounting portion 111 so as to be swingable in the vertical direction about a central axis 113a of the shaft 113. In the present embodiment, one shaft 113 extending in the left-right direction has one end and the other end supported by the pair of mounting portions 111, and the proximal end portions 112 of the push handle 110 are attached to the one end and the other end sides, respectively. Moreover, a shaft may be provided for the pair of mounting portions 111, and each proximal end portion 112 may be

attached to each shaft.

{0023}

In the present embodiment, as shown in Figs. 6, 8, and the like, the pair of mounting portions 111 is fixed to an upper wall or the like of a box structure portion 41 of the mobility body 30. The box structure portion 41 includes a front wall, a rear wall, an upper wall, side walls, and the like, each of which is made of a metal plate such as a steel plate, an aluminum plate, or the like. In some cases, a part or all of each wall may be made of a reinforced plastic plate. This configuration is useful for preventing deformation of the mobility body 30 due to a large force applied to the push handle 110.

{0024}

The push handle 110 is swingable to a first swing position (Fig. 8), a second swing position lower than the first swing position (Figs. 6 and 7), a third swing position at the uppermost side, and a fourth swing position lower than the second swing position (Fig. 15).

{0025}

As shown in Fig. 6 and the like, the push handle 110 includes a pair of extending portions 114 extending from the pair of proximal end portions 112, and a grip portion 115 extending in the width direction and provided so as to connect the distal ends of the pair of extending portions 114. At the

first swing position, the grip portion 115 at the distal end of the push handle 110 is positioned at a height that is easy for a person who pushes the electric mobility vehicle M to grip. Preferably, this height is a predetermined height defined by a standard and is 70 cm or more. At the first swing position, the grip portion 115 is positioned toward a rear side of the vehicle and obliquely upward relative to the proximal end portions 112 of the push handle 110. At the first swing position, it can be said that the push handle 110 is positioned for pushing the electric mobility vehicle M.

{0026}

Further, at the second swing position, the pair of extending portions 114 of the push handle 110 is, for example, positioned such that an upper surface thereof is at the same height as the upper edge 121a of a side portion 123 of the luggage basket 120, or is arranged along the upper edge 121a (Fig. 2). At the second swing position, it can be said that the push handle 110 is positioned at a stored position. At the stored position, when the extending portions 114 are arranged along the upper edge 121a, the push handle 110 does not interfere when loading or unloading luggage in the luggage basket 120.

{0027}

As shown in Fig. 7, each proximal end portion 112 of the push handle 110 is provided with an engagement notch 112a that

can engage with an engagement member 116 provided on the mounting portion 111 in the vertical direction and/or in the front-rear direction. The engagement member 116 is movable in a predetermined direction, and the engagement member 116 is urged in one side of the predetermined direction by a biasing member 116a such as a coil spring, a torsion spring, or the like. In the present embodiment, the engagement member 116 is a shaft member extending in the left-right direction. Further, a long hole 111a, a notch, or the like extending in the predetermined direction is formed in each mounting portion 111, and this configuration allows the engagement member 116 to move in the predetermined direction. Moreover, the biasing member 116a is provided on each mounting portion 111, and biasing members 116a urge the both sides of the engagement member 116 in the left-right direction toward one side of the predetermined direction.

{0028}

The push handle 110 is positioned at the first swing position when the urged engagement member 116 is engaged with the engagement notch 112a. In the present embodiment, each of the left and right ends of the engagement member 116 engages with the engagement notch 112a of the corresponding left and right proximal end portions 112 of the push handle 110. Therefore, in order for the push handle 110 to swing from the first swing position, it is necessary to withdraw each of the

left and right ends of the engagement member 116 from the respective engagement notches 112a, which is useful for safe use of the electric mobility vehicle M.

{0029}

Further, in the present embodiment, the engagement member 116 is pressed against the engagement notch 112a by the own weight of the push handle 110, and due to this pressing, the engagement member 116 is less likely to be withdrawn from the engagement notch 112a. This is also useful for the safe use described above. In the present embodiment, the user can smoothly withdraw the engagement member 116 from the engagement notch 112a by using an operation member 117 described later while slightly lifting the distal end side of the push handle 110.

{0030}

An operation member 117, such as a lever, a knob, or the like for moving the engagement member 116 in the other side of the predetermined direction against the biasing member 116a is attached to one or both of the pair of mounting portions 111. The operation member 117 is fixed to one end of a lever shaft 117a extending in the left-right direction, and both ends of the lever shaft 117a are rotatably supported by the pair of mounting portions 111, respectively. A projecting member 118 that moves the engagement member 116 in the other side of the predetermined direction in association with rotation of the

lever shaft 117a is fixed to the lever shaft 117a. In one example, the projecting member 118 extends in a radial direction of the lever shaft 117a or in a normal direction of an outer peripheral surface of the lever shaft 117a, and when the lever shaft 117a rotates, applies a force to the engagement member 116 toward the other side of the predetermined direction. The operation member 117 may be any member capable of applying a rotational force to the lever shaft 117a. When the user rotates the lever shaft 117a in a predetermined rotational direction by means of the operation member 117, the engagement member 116 moves in the other side of the predetermined direction, and the engagement between the engagement member 116 and the engagement notch 112a is released. As a result, the push handle 110 is brought into a state in which it can swing to the second or third swing position.

{0031}

When the push handle 110 swings to the second swing position, each of both ends of the engagement member 116 urged in the predetermined direction engages with an engagement portion 112b of the pair of proximal end portions 112 of the push handle 110. As a result, the push handle 110 is prevented from swinging downward beyond the second swing position.

{0032}

In this state, when the user moves the engagement member 116 in the other side of the predetermined direction by operating the operation member 117, the engagement between the engagement member 116 and the engagement portion 112b is released, and the push handle 110 is brought into a state in which it can swing to the fourth swing position. Note that the push handle 110 can swing from the second swing position to the first swing position without operation of the operation member 117. In other words, the engagement portion 112b does not restrict upward swinging of the push handle 110. As shown in Fig. 7, a portion between the engagement portion 112b and the engagement notch 112a in each proximal end portion 112 of the push handle 110 has a cam shape disposed at a position farther from a central axis line 113a than the engagement portion 112b. With this structure, when the push handle 110 is swung from the second swing position to the first swing position, the engagement member 116 moves in the other side of the predetermined direction against the biasing member 116a, thereby generating a resistance force.

{0033}

When the push handle 110 swings to the fourth swing position, the grip portion 115 of the push handle 110 moves forward relative to the second swing position. As a result, as shown in Fig. 15, the size of the electric mobility vehicle M in the front-rear direction with the luggage basket 120

removed can be reduced, and this configuration is useful for placing the electric mobility vehicle M on a cart 500. The cart 500 is a cart referred to as a moving cage, a cage trolley, a cage cart, or the like. An inner dimension (an accommodatable dimension) L1 of the cart 500 in a first horizontal direction shown in Fig. 15 is 110 cm or less, and an inner dimension (an accommodatable dimension) of the cart 500 in a second horizontal direction, which is a direction perpendicular to the plane of Fig. 15, is also 110 cm or less. Since an outer dimension in the first horizontal direction is often 110 cm, when a diameter of pipes constituting the cart 500 is about 3 cm, the inner dimension in the first horizontal direction is 104 cm. The outer dimension in the second horizontal direction is often 100 cm or less.

{0034}

The luggage basket 120 of the present embodiment is detachably attached to the mobility body 30. The luggage basket 120 is attached to a rear portion of the mobility body 30, for example, to a rear surface portion of the seat unit S. The configuration in which the luggage basket 120 is detachably attached to the rear portion of the mobility body 30 as in the present embodiment is useful when placing the mobility body 30 on the cart 500 having fixed dimensions. In one example, the detached luggage basket 120 is placed on the seat unit S.

{0035}

In the present embodiment, as shown in Fig. 9, an upper engagement portion 121, such as a hook or the like, is provided on an upper side at a vehicle front side of the luggage basket 120, and a lower engagement portion 122, such as a shaft or the like, is provided on a lower side at the vehicle front side of the luggage basket 120. On the other hand, as shown in Fig. 8, a lock mechanism 130, such as a snatch lock or the like, is provided below the shaft 113 in the mobility body 30.

{0036}

By engaging the upper engagement portion 121 of the luggage basket 120 with the shaft 113 (upper fixing portion) from above, and, in that state, engaging the lower engagement portion 122 with the lock mechanism 130 (lower fixing portion) so as to be locked thereto, the luggage basket 120 is attached to the mobility body 30. Instead of the lock mechanism 130, the lower side of the luggage basket 120 may be fixed to the mobility body 30 by using a bolt or the like. As shown in Fig. 9, a configuration in which the upper engagement portion 121 is curved along an upper surface of the shaft 113 effectively prevents the luggage basket 120 from falling when the lower engagement portion 122 is engaged with the lock mechanism 130. Also, in another example, the upper engagement portion 121 engages from above with another portion of the

rear side portion of the mobility body 30.

{0037}

As shown in Fig. 8, a release member 131 for releasing the locking of the lower engagement portion 122 by the lock mechanism 130 is provided above the lock mechanism 130 in the mobility body 30. The release member 131 is connected to the lock mechanism 130 by connecting members 132. In the present embodiment, the user can operate the release member 131 via a part of the backrest portion 40, or can operate the release member 131 from below the backrest portion 40 or from the rear side thereof.

{0038}

The above-described configuration may also be used to detachably attach accessories such as an oxygen cylinder holder, an IV holder, a map acquisition jig, a sunshade for outdoor travel, and the like to the mobility body 30. In this case, the accessory is provided with one or a plurality of upper engagement portions 121, and one or a plurality of lower engagement portions 122 are also provided below the upper engagement portion(s) 121. Instead of the lower engagement portion(s) 122, another structure such as a bolt and the like that can be fixed to the lower fixing portion may be used.

As shown in Figs. 1 and 2, the electric mobility vehicle M includes a display device 200 that protrudes upward from an upper end surface of the left arm 43. The display device 200

is supported on the left arm 43 by a support member 210 extending upward from the upper end surface of the left arm 43.

{0039}

In one example, the display device 200 is a tablet computer; however, it may be another known display device.

Information is sent to the display device 200 from a control device 80, which will be described later, either by wire or wirelessly, and the display device 200 displays the received information. The information includes, for example, at least one of: information on the traveling speed of the electric mobility vehicle M; information on the state of the battery BA; information on the position of the obstacle detected by sensors 90, 95, and 96; information on a determination result as to whether the obstacle hinders traveling; map information; or information on a traveling route. Further, the display device 200 includes input means such as a touch screen function and the like, and information input to the display device 200 is sent to the control device 80 (Fig. 16).

{0040}

Also, the display device 200 may include a control device having a processor, a storage device, and the like, and the control device may perform part or all of the functions of the control device 80 described later. Further, the display

device 200 may be detachably attached.

{0041}

As shown in Fig. 16, the control unit 60 includes motor drivers 70 that drive respective motors MT, and a control device 80.

The motor driver 70 is connected to the battery BA. Also, the motor driver 70 is also connected to each motor MT, and supplies drive power to each motor MT. The battery BA also supplies power to other devices such as the control device 80 and the like.

{0042}

As shown in Fig. 16, the controller 80 includes a processor 81 such as a CPU and the like, a storage unit 82 having a non-volatile storage, a ROM, a RAM, and the like, and a transmitting and receiving portion 83 which transmits and receives information by wire or wireless. A travel control program 82a which controls the electric mobility vehicle M is stored in the storage unit 82. The processor 81 sends drive signals for driving the respective motors MT to the motor drivers 70 based on the travel control program 82a.

{0043}

As shown in Figs. 1, 2, and 4, the sensors 90 are respectively mounted so as to protrude in the vehicle width direction from mounting surfaces 46c, which are width-direction outer surfaces of the pair of guard members 46. The

guard members 46 are members provided below the arms 43. In the present embodiment, as shown in Fig. 1, each sensor 90 is mounted on the guard member 46, which is a member located below the arm 43 or the armrest 43a, so as to protrude outward in the vehicle width direction. The sensor 90 may alternatively be mounted on the armrest 43a or the arm 43 so as to protrude outward in the vehicle width direction. Further, the sensor 90 may be mounted on a member other than the guard member 46, in which the member is located below the armrest 43a or below the arm 43, so as to protrude outward in the vehicle width direction. In these cases as well, a similar or the same effects are achieved.

{0044}

The sensor 90 is a known distance measuring sensor such as LiDAR (Light Detection and Ranging or Laser Imaging Detection and Ranging). The sensor 90 detects obstacles three-dimensionally and is therefore also referred to as a three-dimensional sensor, a three-dimensional distance sensor, or the like. In the present embodiment, as shown in Fig. 4, each sensor 90 has a viewing angle α in an elevation direction (a predetermined direction) and/or in a depression direction (the predetermined direction) of the sensor. In the present embodiment, the elevation direction of the sensor is a direction along an axis line 91 of the sensor 90. Further, each sensor 90 has a detection area DA1 (Fig. 3) formed by

rotating the viewing angle α shown in Fig. 4 about the predetermined axis line 91 extending in the vehicle width direction. A part of the detection area DA1 may be blocked by the electric mobility vehicle M, the user, or the like. One example of the sensor 90 is MID-360 manufactured by Livox (registered trademark). In the present embodiment, the sensor 90 also has a viewing angle in the depression direction. The viewing angle in the depression direction is several degrees, for example 2° or more. Further, the viewing angle in the depression direction may be 3° or less, 5° or less, 8° or less, or the like. By the sensor 90 having such a viewing angle in the depression direction, detection of the obstacle in front of the electric mobility vehicle M using the sensor 90 can be performed more accurately.

{0045}

As shown in Fig. 2, a rear side sensor 95 that is a LiDAR, is attached to the rear end side of the mobility body 30 or below the luggage basket 120. In this embodiment, the rear side sensor 95 scans the laser beam throughout a detection area DA2 of Fig. 3, and the rear side sensor 95 detects reflected light hit on and reflected by an object. Using the detection result (detection data), the control device 80 detects the position of the obstacle (object to be avoided) in the detection area DA2, which is outward in the width direction of the electric mobility vehicle M and

rearward thereof. The obstacle is, for example, a human, an animal, a plant, a clothing of people, belongings of people, and the like. The obstacle is, for example, walls, relatively larger objects, steps, and the like. In another example, the rear side sensor 95 may detect, as the obstacle (object to be avoided), steps, holes, ditches, and the like into which the rear wheel 20 may fall or get caught. Further, over the detection area DA1 shown in FIG. 3, the obstacle is detected by each sensor 90, and over detection areas DA3 and DA4 described later, the obstacle is detected by a lower side sensor 96.

{0046}

The lower side sensor 96 (Figs. 2, 3) is attached to a lower surface of the electric mobility vehicle M. In this embodiment, the lower side sensor 96 is a LiDAR which is attached to a lower surface of the footrest portion, a lower surface of another part in the base portion 32, or the like. By this, in this embodiment, the lower side sensor 96 is located at a position lower than a footrest surface of the footrest portion or lower than a lower surface portion of the base portion 32. A laser beam (detection wave) emission portion of the lower side sensor 96 should be placed at a position lower than the footrest surface 32c. Also, in this embodiment, the lower side sensor 96 is placed at an approximately center position of the electric mobility vehicle

M in the vehicle width direction.

{0047}

For example, lower side sensor 96 scans the laser beam throughout the detection area DA3, which is shown in Fig. 3, the lower side sensor 96 receives the reflected light hit on and reflected by the object. That is, the lower side sensor 96 can detects a positon of the obstacle (object to be avoided) located in a region at a front side of the electric mobility vehicle M from under the footrest surface or under the mobility body 30. Also, the lower side sensor 96 scans the laser beam to vehicle side direction from a space between the front wheel 10 and the rear wheel 20, and the lower side sensor 96 can detect the obstacle which exists in the space between the front wheel 10 and the rear wheel 20 or the obstacle which might enter into the space. In some cases, the lower side sensor 96 may perform detection of only one of detection area DA3 and detection area DA4.

{0048}

In order to prevent damage to the structure related to the sensing of the lower side sensor 96, as shown in Fig. 19, one or more sensor protection members 150 may be attached so as to protrude downward from the lower surface of the mobility body 30. The sensor protection member 150 shown in Fig. 19 is also indicated by a two-dot chain line in Fig. 2. Each sensor protection member 150 is disposed in an area of the sensing

area of the lower side sensor 96 in which the front wheel 10 or the rear wheel 20 exists (an area indicated by a one-dot chain line in Fig. 19). That is, each sensor protection member 150 does not affect detection of the object to be avoided by the lower side sensor 96. In Fig. 19, each sensor protection member 150 is attached to a lower surface of the base frame 32a of the mobility body 30, thereby protruding downward from the lower surface of the mobility body 30. The lower surface may be formed by the base frame 32a, by a plastic component covering the base frame 32a, or by another component forming the lower surface of the mobility body 30.

{0049}

Preferably, the lower end of each sensor protection member 150 is disposed below the lower end of the lower side sensor 96, or is disposed at a position having the same height as the lower end of the lower side sensor 96. Such a configuration is useful for preventing damage to the lower side sensor 96. Also, the same effect may be achieved even when the lower end of each sensor protection member 150 is disposed approximately 2 cm or 3 cm above the lower end of the lower side sensor 96. Further, a horizontal distance between each sensor protection member 150 and the lower side sensor 96 is preferably 20 cm or less, more preferably 15 cm or less, and still more preferably 10 cm or less.

{0050}

For example, each sensor 90 emits laser light over the detection area DA1 shown in Fig. 3, and the sensor 90 receives reflected light reflected from the object. In other words, each sensor 90 is capable of detecting a position of the obstacle (object to be avoided) located at a front side or a rear side of the electric mobility vehicle M along the vehicle side surface of the electric mobility vehicle M.

{0051}

In the present embodiment, the rear side sensor 95 and the lower side sensor 96 are two-dimensional LiDARs. This leads to reduction in the cost of the sensors and reduction in an amount of data processing required for detection results of the sensors.

In the present embodiment, the rear side sensor 95 and the lower side sensor 96 are two-dimensional LiDARs; however, distance sensors such as three-dimensional LiDARs, radars, millimeter-wave sensors, and other distance sensors may also be used.

{0052}

In the present embodiment, a height position of the detection area DA2 of the rear side sensor 95 is within a range of 50 cm or less from a horizontal floor surface on which the front wheels 10 and the rear wheels 20 are in contact, more preferably within a range of 40 cm or less, and further preferably within a range of 30 cm or less. Also, in

the present embodiment, a height position of the detection areas DA3 and DA4 of the lower side sensor 96 is within a range of 30 cm or less from the horizontal floor surface on which the front wheels 10 and the rear wheels 20 are in contact, more preferably within a range of 20 cm or less, and further preferably within a range of 15 cm or less.

{0053}

Thus, in the present embodiment, the configuration employs the rear side sensor 95 and the lower side sensor 96 to detect areas at lower positions in the front and rear of the electric mobility vehicle M. This configuration leads to a reduction in the cost of the sensors and a decrease in the amount of data processing required for the sensor detection results. As a result, various facilities can more easily purchase and start using the electric mobility vehicle M, which in turn contributes to improving the convenience for the users of the facilities.

{0054}

Also, in the present embodiment, as shown in Fig. 3, the pair of left and right sensors 90 can detect the obstacles along the vehicle sides of the electric mobility vehicle M, both at a front side and a rear side of the vehicle. This configuration is advantageous in terms of both functionality and cost. The obstacles include, as mentioned above, the steps such as descending stairs, as well as the gaps, the

holes, and the like.

In the present embodiment, the detection areas DA1 of the sensors 90 do not cover the front and rear areas along the widthwise center of the electric mobility vehicle M. However, in combination with the rear side sensor 95 and/or the lower side sensor 96, the pair of sensors 90 is useful within facilities.

{0055}

For example, when a single-leg table having a tabletop supported by a single central column is positioned directly in front of the electric mobility vehicle M and the electric mobility vehicle M moves in that direction, the tabletop is detected by one of the pair of sensors 90. If the tabletop is not detected, it is a tabletop smaller than the width of the electric mobility vehicle M. Such small tables are rare, and even if present, they can be avoided by including information about the tabletop in the autonomous driving map data or through similar measures.

{0056}

Moreover, the case in which the electric mobility vehicle M moves backward is overwhelmingly less frequent than that of forward movement. Also, for example, when the electric mobility vehicle M moves backward to enter an elevator car CA, the rear side sensor 95 detects, within the detection area DA2, the feet of surrounding people and the walls inside the

elevator car CA, and the pair of left and right sensors 90 detect, with respect to areas such as the lateral sides of the rear wheels 20 or the like, areas higher than the detection area DA2. Since movements of surrounding people inside the elevator car CA and in its vicinity are restricted, detection by the rear side sensor 95 and the pair of left and right sensors 90 is effective in terms of function and cost.

{0057}

As shown in Figs. 1 and 4, the mounting surface 46c of each sensor 90 in the arm 43 is disposed inward in the vehicle width direction by a dimension L2 relative to the outer surface 43b disposed on the outer side in the vehicle width direction of the arm 43. The dimension L2 is preferably 2 cm or more, and more preferably 3 cm or more. In the present embodiment, the outer position of each sensor 90 in the vehicle width direction is disposed inward in the vehicle width direction relative to the outer surface 43b. This configuration leads to the prevention of failure, damage, or the like of the sensor 90 due to contact with the obstacles, other objects, or the like. On the other hand, in the present embodiment, a part of the arm 43 protrudes outward in the vehicle width direction above the sensor 90, and the outer surface of the protruding portion is disposed above the sensor 90. That is, in the present embodiment, the outer surface is disposed behind and over the sensor 90. This arrangement is

useful for both detecting the obstacles for the travel of the electric mobility vehicle M and preventing failure, damage, or the like. It should be noted that a configuration in which the outer surface 43b is disposed only above the sensor 90 is also possible, and in this case, the same or a similar effect can be achieved.

{0058}

Instead of the sensors 90, it is also conceivable to install a single LiDAR, which is disposed on the upper part of the electric mobility vehicle M, having a predetermined viewing angle in the vertical direction and having a detection area obtained by rotating the viewing angle about an axis line extending in the vertical direction. In this case, unlike the present embodiment, it is not possible to detect the obstacles immediately adjacent to the front wheel 10 and the rear wheel 20. Further, when the single LiDAR is used together with the sensors 90, although the cost increases, there is no significant advantage in obstacle detection.

{0059}

The control device 80 (Fig. 16) causes the electric mobility vehicle M to perform an evading operation based on an evading control program 82b stored in the storage device 82, and causes the electric mobility vehicle M to move by autonomous drive based on the autonomous driving program 82c stored in the storage device 82. The evading operation

includes stopping of the electric mobility vehicle M, deceleration, movement in a direction away from the object to be avoided, and the like. The control device 80 creates or obtains a distance image (detection data) based on the detection results (detection data) of the sensors 90, 95, and 96. The control device 80 detects the position of the obstacle (object to be avoided) with respect to the electric mobility vehicle M in the distance image.

{0060}

The control device 80, based on the autonomous driving program 82c stored in the storage device 82, moves the electric mobility vehicle M by autonomous driving using the detection result and the map data of the airport (facility) stored in the storage device 82. Typically, the control device 80 moves the electric mobility vehicle M along a route set by route setting described later. The detection result is the result detected by a GPS receiver, an odometer, the sensors 90, 95, 96, and the like provided in the electric mobility vehicle M. In the present embodiment, the control device 80 performs self-position estimation on the map data using the detection result. The self-position estimation can be performed by a known method. Further, the control device 80, based on the autonomous driving program 82c, can perform, for example, route setting from a departure point to a destination and autonomous driving by using the detected

object to be avoided, the map data stored in the storage device 82, and the result of the self-position estimation. Part or all of the route setting and the autonomous driving may be performed by another computer such as the server 100 and the like.

{0061}

The control device 80 controls the electric mobility vehicle M to enter the elevator car CA in reverse during the autonomous driving. In the present embodiment, as shown in Fig. 18, the control device 80 changes the orientation of the electric mobility vehicle M so that the rear part of the electric mobility vehicle M is positioned toward the elevator car CA using at least the result of the self-position estimation and the map data.

{0062}

For example, when a predetermined area near the elevator car CA in the map data includes an instruction, information, trigger, or the like for the direction change, the control device 80 performs the direction change based on the instruction, information, trigger, or the like.

{0063}

The control device 80 may perform the direction change by using at least the information of the set route and the result of the self-position estimation. For example, when a predetermined area near the elevator car CA in the information

of the route includes an instruction, information, trigger, or the like for the direction change, the control device 80 performs the direction change based on the instruction, information, trigger, or the like.

The control device 80 may perform the direction change based on an instruction, information, trigger, or the like from a transmitter such as an antenna or the like disposed near the compartment CA. The information may be, for example, a distance from the transmitter or the like.

{0064}

Thus, in the present embodiment, the control device positions the mobility body in front of the elevator car CA before the mobility body enters the elevator car CA such that the rear of the vehicle is positioned toward the elevator car CA. This configuration is useful for allowing the electric mobility vehicle M to enter and exit a not-large elevator car CA in a short time and smoothly. This may contribute to reduction of stress of the user of the electric mobility vehicle M and surrounding people.

{0065}

In the present embodiment, as described above, movement of surrounding people is restricted inside the elevator car CA and in the vicinity thereof, and the direction change of the electric mobility vehicle M is performed in advance at a stage before entering the elevator car CA. Therefore, surrounding

people can clearly recognize that the electric mobility vehicle M will use the elevator. These configurations and recognition are useful for allowing the electric mobility vehicle M to enter the elevator car CA in a short time and smoothly.

{0066}

Further, in the present embodiment, when the electric mobility vehicle M moves in backward movement toward a target position inside the elevator car, the detection results obtained by the rear side sensor 95 and the pair of left and right sensors 90 are used. Since movement of surrounding people is restricted inside the elevator car CA and in the vicinity thereof, detection results of positions of feet of surrounding people inside the elevator car CA in the detection area DA2 (Fig. 3) is useful for safe backward movement of the electric mobility vehicle M. In the present embodiment, the obstacles moving so as to enter the rear side of the vehicle are further detectable by the pair of left and right sensors 90, and such a configuration is useful for safer backward movement of the electric mobility vehicle M.

{0067}

In the present embodiment, as shown in Figs. 2 and 8, the electric mobility vehicle M further includes a rear step sensor 97. The control device 80 causes the electric mobility vehicle M to perform the evading operation based on the

evading control program 82b in accordance with a detection result of the rear step sensor 97. With such a configuration, safety of the user who uses the electric mobility vehicle M is further improved.

{0068}

Moreover, when a rear step of the electric mobility vehicle M is detected by each sensor 90 or the like, a sensor configuration in which the rear step sensor 97 is not provided becomes possible.

In the present embodiment, the rear step sensor 97 is a TOF (Time of Flight) sensor as a distance measuring sensor; however, other sensors such as an ultrasonic sensor, a radar sensor, or the like may also be used.

{0069}

In the present embodiment, a pair of rear step sensors 97 is attached to the seat unit S or the rear surface portion of the mobility body 30. The rear surface portion is a recessed portion opened rearward. Further, a rear side of the rear surface portion is covered by the luggage basket 120 attached to the mobility body 30. Therefore, regardless of whether the luggage basket 120 is attached to the mobility body 30, the rear step sensors 97 are unlikely to be damaged. As shown in Fig. 2, each rear step sensor 97 detects a step located rearward of the electric mobility vehicle M through a gap between the rear surface portion and the luggage basket 120

attached to the rear surface portion. The step includes a downward step, a downward staircase, and the like.

{0070}

Note that a controller may be provided, for example, at the upper end portion of the arm 43 of the electric mobility vehicle M, and a case is also possible in which the user manually moves the electric mobility vehicle M using the controller such as a joystick or an operating device implemented in a tablet computer by an application. Even in this case, the above-described sensor configuration can be used, and the sensor configuration is advantageous in terms of functionality and cost as described above, and provides the above-described effects in forward movement or backward movement.

{0071}

The lower side sensor 96 may be fixed to the base portion 32 or the like as shown in Fig. 5 and the like. In this case, the lower side sensor 96 is always positioned at a sensing position at which the object to be avoided can be detected. On the other hand, as shown in Figs. 10 to 14, the lower side sensor 96 may be attached to the mobility body 30 so as to be movable in the vertical direction via a sensor moving mechanism 140. In this case, when the battery BA is mounted in the battery accommodating portion 34 of the mobility body 30, the lower side sensor 96 is positioned at the sensing

position, at which the object to be avoided can be detected, by the sensor moving mechanism 140. Further, when the battery BA is removed from the battery accommodating portion 34 of the mobility body 30, the lower side sensor 96 is positioned at a retracted position above the sensing position by the sensor moving mechanism 140.

{0072}

In the example shown in Figs. 10 to 12, the base end portion of the swing member 141 is supported by the mobility body 30, and the swing member 141 is swingable in the vertical direction about the base end portion. The lower side sensor 96 is attached to a distal end side of the swing member 141, and when the swing member 141 is disposed at the lower swing position shown in Fig. 10, the lower side sensor 96 is disposed at the sensing position. In a state in which the lower side sensor 96 is disposed at the sensing position, downward swinging of the swing member 141 is restricted by the mobility body 30. In Fig. 10, a distal end component 141a provided on the distal end side of the swing member 141 engages, from above, with a lower side component 34a of the battery accommodating portion 34 (Fig. 12), and downward swinging of the swing member 141 is restricted.

{0073}

Further, a spring member 142 is attached to the distal end side of the swing member 141, and, in a state in which the

lower side sensor 96 is disposed at the sensing position, the spring member 142 is elastically deformed between the battery BA and the swing member 141. That is, in a state in which the battery BA is inserted to a predetermined position of the battery accommodating portion 34 and the battery BA is connected to the connector, a cantilever-shaped spring member 142 is bent, as the elastic deformation, by a lower portion of the battery BA. A restoring force of the bending applies a downward force to the swing member 141, whereby the lower side sensor 96 is maintained at the sensing position. The spring member 142 may have a double-supported beam form, a coil spring form, or the like.

{0074}

Further, a biasing member for retraction 143, such as a coil spring, a torsion spring, or the like, that biases the swing member 141 so as to swing upward is provided. In the present embodiment, the biasing member for retraction 143 is a coil spring.

{0075}

When the battery BA is removed, the cushion 51 is removed, and the battery BA moves upward in a manner that disconnects the battery BA from the connector. In a state in which the battery BA has been removed from the battery housing portion 34, the swing member 141 swings upward by the biasing member for retraction 143 as shown in Fig. 11, and the lower

side sensor 96 is disposed at the retracted position. Since the battery BA is often removed when transporting the electric mobility vehicle M or when packing the electric mobility vehicle M before transportation, such a configuration is useful for preventing breakage or the like of the lower side sensor 96 during transportation or during packing before transportation.

{0076}

At the retracted position, preferably, the lower end of the lower side sensor 96 is disposed above the lower surface of the mobility body 30. In some cases, the lower end of the lower side sensor 96 may be disposed several millimeters or several centimeters below the lower surface. The lower surface is, for example, a lower surface of the base frame 32a of the base portion 32, a lower surface of the footrest portion, or the like.

{0077}

At least one of the spring member 142 or the biasing member for retraction 143 may bias the battery BA upward in association with upward movement of the battery BA. For example, when the cushion 51 is removed, when connection of the battery BA to the connector is released, or the like, the battery BA may be automatically moved upward by a predetermined distance by at least one of the spring member 142 or the biasing member for retraction 143. Such a

configuration is useful for facilitating a removal operation of the battery BA.

{0078}

In the example of the sensor moving mechanism 140' shown in Figs. 13 to 14, a vertical movement member 144 is supported by the mobility body 30 via a slider mechanism 144a such as a linear guide and the like, and the vertical movement member 144 is movable in the vertical direction. The lower side sensor 96 is attached to a lower side of the vertical movement member 144, and when the vertical movement member 144 is disposed at a lower position shown in Fig. 13, the lower side sensor 96 is disposed at the sensing position. In a state in which the lower side sensor 96 is disposed at the sensing position, downward movement of the vertical movement member 144 is restricted by the mobility body 30. In this example, downward movement of the vertical movement member 144 is restricted by a stopper member (not shown) of the slider mechanism 144a. Downward movement of the vertical movement member 144 may be restricted by a part of the vertical movement member 144 engaging the mobility body 30 from above.

{0079}

Further, the spring member 145 is attached to the vertical movement member 144, and in a state in which the lower side sensor 96 is disposed at the sensing position, the spring member 145 is elastically deformed between the battery

BA and the vertical movement member 144. That is, in a state in which the battery BA is inserted to a predetermined position of the battery accommodating portion 34 and the battery BA is connected to the connector, the spring member 145 such as a coil spring and the like is compressed as the elastic deformation by the lower portion of the battery BA. A restoring force of the compression applies a downward force to the vertical movement member 144, whereby the lower side sensor 96 is maintained at the sensing position. In the present embodiment, a guide pin 145a that guides the spring member 145 extends upward from a bottom wall of the vertical movement member 144. The spring member 145 may be in a form of a cantilever beam, a form of a double-supported beam, a form of a coil spring, or the like.

{0080}

Further, a biasing member for retraction 146 such as a coil spring, a torsion spring, or the like that biases the vertical movement member 144 upward is provided. In the present embodiment, the biasing member for retraction 146 is a coil spring.

{0081}

When the battery BA is removed, the cushion 51 is removed, and the battery BA moves upward in a manner that disconnects the connection with the connector. In a state in which the battery BA is removed from the battery accommodating

portion 34, as shown in Fig. 14, the vertical movement member 144 is moved upward by the biasing member for retraction 146, and the lower side sensor 96 is disposed at the retracted position. At the retracted position, preferably, the lower end of the lower side sensor 96 is disposed above the lower surface of the mobility body 30. The lower end of the lower side sensor 96 may be disposed several millimeters or several centimeters below the lower surface. The lower surface is, for example, the lower surface of the base frame 32a of the base portion 32, the lower surface of the footrest portion, or the like.

{0082}

When the battery BA moves upward, at least one of the spring member 145 or the biasing member for retraction 146 may bias the battery BA upward. For example, when the cushion 51 is removed, when the connection between the battery BA and the connector is released, or the like, the battery BA may be automatically moved upward by a predetermined distance by at least one of the spring member 145 or the biasing member for retraction 146. Such a configuration is useful for facilitating a removal operation of the battery BA.

{0083}

Further, an actuator such as a motor, an air cylinder, or the like for moving the swing member 141 and the vertical movement member 144 upward and downward may be provided. In

this case, when the battery BA is removed from the mobility body 30, the control device 80 detects connection or disconnection between the battery BA and the connector, and the control device 80 controls the actuator in accordance with a detection result to dispose the lower side sensor 96 at the retracted position. Instead of the detection result of connection or disconnection of the battery BA, the control device 80 may dispose the lower side sensor 96 at the retracted position by using the actuator in accordance with detection results of the sensors 90, 95, and 96.

{0084}

For example, when a protruding object protruding at a height of several centimeters or more than ten centimeters from the ground is detected within the detection area DA3 by the lower side sensor 96, the control device 80 controls the actuator to dispose the lower side sensor 96 at the retracted position. Most of floor surfaces of facilities in which the electric mobility vehicle M is used, such as an airport, a large commercial facility, a hospital, and the like, are constituted by flat surfaces or gentle slopes. Therefore, a configuration in which the lower side sensor 96 is disposed at the retracted position based on the protruding object protruding at the height of several centimeters or more than ten centimeters from the ground can effectively prevent damage to the lower side sensor 96. Scratches, distortion, and the

like on a surface relating to detection by the lower side sensor 96 affect accuracy of avoidance of the obstacle by the electric mobility vehicle M, accuracy of autonomous driving, and the like, and therefore the above configuration is useful in the technical field.

{0085}

As shown in Figs. 10 and 11, the vehicle front side of the lower side sensor 96 may be fixed to the swing member 141 by one or a plurality of bolts 96a, and the vehicle rear side of the lower side sensor 96 may be fixed to the swing member 141 by one or a plurality of bolts 96b. Also, the vehicle rear side of the lower side sensor 96 may be fixed to the swing member 141 by a hinge instead of the bolts 96b. The hinge supports the lower side sensor 96 so as to be swingable in the front-rear direction.

{0086}

In this case, a fastening strength of the bolts 96a may be set to be clearly lower than a fastening strength of the bolts 96b. For example, the fastening strength of the bolts 96a can be set to be low by reducing a nominal diameter of the bolts 96a, by making the bolts 96a with a material having clearly lower strength than a material of the bolts 96b such as plastic, wood, or the like, by intentionally providing the bolts 96a with a breakable portion configured to break, or the like. Thereby, when the lower side sensor 96 collides with

the protruding object during forward movement of the electric mobility vehicle M, fastening by the bolts 96a is released due to breakage of the bolts 96a or the like, and thereby breakage of a structure relating to sensing of the lower side sensor 96 can be prevented.

{0087}

Moreover, it is also possible to fix the lower side sensor 96 to the swing member 141 by using a magnet instead of the bolts 96a and 96b. Further, it is also possible to fix the lower side sensor 96 to the swing member 141 by using the magnet and the hinge. In these cases as well, effects the same as or similar to those described above can be achieved. It is also possible to employ the above-described technology in the configurations of Figs. 5, 13, and 14.

{0088}

Thus, in a fastening structure for fixing the lower side sensor 96 to the mobility body 30 side, by setting a fastening strength of a part of the fastening structure to be lower than a fastening strength of the other part, it becomes possible to prevent damage to the structure related to sensing of the lower side sensor 96. Alternatively, by fixing the lower side sensor 96 to the mobility body 30 side by the magnet, it becomes possible to prevent damage to the structure related to sensing of the lower side sensor 96.

{0089}

In the present embodiment, instead of the seating sensor 53, or together with the seating sensor 53, a user distance sensor 98 is provided. As the user distance sensor 98, a known distance measuring sensor such as a TOF (Time of Flight) sensor, an ultrasonic sensor, a radar sensor, a stereo camera, a LiDAR (Light Detection and Ranging or Laser Imaging Detection and Ranging), or the like can be used. In the present embodiment, a TOF sensor having a field of view within a predetermined angular range is used.

{0090}

As shown in Fig. 5, the user distance sensor 98 is fixed at the lower portion of the backrest portion 40 of the seat unit S in the mobility body 30 or the like. An optical axis 98a of the user distance sensor 98 extends toward the vehicle front and extends obliquely upward with respect to the horizontal plane. An angle γ formed by the optical axis 98a and the horizontal plane is, for example, 0° or more and 60° or less. The angle γ may be an angle outside the above range. The user distance sensor 98 has a detection area DA5, and the optical axis 98a is disposed at a center of the detection area DA5. Also, when the angle γ is 30° or more, the user distance sensor 98 tends to easily detect the buttocks, waist, and the like of the user standing on the footrest portion.

{0091}

For example, the seating sensor 53 does not detect the

user standing on the footrest portion. In contrast, the control device 80 obtains, by calculation or the like, a distance from, for example, the seat unit S of the mobility body 30 to the back of the user, based on the detection result of the user distance sensor 98. Then, the control device 80 determines, based on the distance, that the user is seated on the seat unit S, that the user is on the footrest portion, a possibility that the user is on the footrest portion, and the like.

{0092}

When a distance from the seating sensor 53 to a part of the seat unit S is input in advance to the control device 80, the control device 80 calculates a distance from the seat unit S to the back of the user by subtracting the distance from the detection result of the user distance sensor 98. Examples of the back of the user include the buttocks, waist, back, thigh, and the like of the user. The control device 80 may obtain the distance from the seating sensor 53 to the part of the seat unit S based on the detection result of the seating sensor 53. The part includes the front surface of the backrest portion 40, portions of the seat surface portion, including a central portion in a front-rear direction, a rear end, a front end, and the like.

{0093}

The configuration is useful for confirming a state of the

user on the electric mobility vehicle M. For example, when the control device 80 determines that the user is on the footrest portion, the control device 80 controls the electric mobility vehicle M so that the electric mobility vehicle M is in a state in which the motor MT is not driven, a state in which braking is applied to the electric mobility vehicle M by the motor MT or a brake (not shown), or the like. For the function, the user distance sensor 98 may be disposed at another location of the mobility body 30, such as the front end portion of the seat surface portion 50 or the like.

{0094}

Further, the configuration is useful for confirming seating of a lightweight user. Further, the configuration is also capable of detecting that the user is seated on the front end side of the seat surface portion 50, and in such a case, the control device 80 may inform the user of information regarding a seating position of the user by using a display device such as the display device 200, the sound generating unit 300, or the like. The information regarding the seating position includes information that prompts a change of the seating position, information indicating that the seating position is not appropriate, and the like.

{0095}

Further, in the configuration, the control device 80 may determine, by using the detection result of the user distance

sensor 98, whether or not an object such as a belonging of the user is placed on the seat unit S. In this case, the control device 80 may inform the user of information regarding the object on the seat unit S by using a display device such as the display device 200, the sound generating unit 300, or the like. The information regarding the object includes information for notifying that the object, which is considered to be the belonging of the user, remains on the seat unit S, and the like.

{0096}

Further, it is also possible to attach a plurality of user distance sensors 98 to the electric mobility vehicle M, and it is also possible to arrange the plurality of user distance sensors 98 so as to be aligned in a vehicle width direction. In these cases, even when one of the user distance sensors 98 fails, the above-described functions are maintained by the other user distance sensor 98.

{0097}

As shown in Fig. 5, an assistant controller 400 for an assistant may be provided in the electric mobility vehicle M. For example, the controller 400 includes a joystick 410 for controlling a traveling direction and a speed of the electric mobility vehicle M, and a cancellation button 420 that enables control by the joystick 410. In one example, only while the cancellation button 420 is being pressed, the electric

mobility vehicle M is in a state in which it can be operated by the joystick 410. As shown in Fig. 5, the controller 400 is attached, for example, to one of the pair of extending portions 114 of the push handle 110. For example, the assistant presses the cancellation button 420 with an index finger and operates the joystick 410 with a thumb. It is also possible to use another type of controller as the controller 400. For example, a controller that inputs the traveling direction and the speed via a liquid crystal screen, a controller that inputs the traveling direction and the speed by a plurality of buttons, and the like can be used.

{0098}

An example of the assistant is a person working at a facility such as an airport. For example, in a jet bridge connecting an aircraft and an airport facility, the assistant controls the electric mobility vehicle M on which the user is seated by operating the controller 400. Thereby, even in a narrow passage such as the jet bridge, the user and the electric mobility vehicle M can move smoothly. In one example, the controller 400 is connected to the electric mobility vehicle M by a cable (not shown).

{0099}

It should be noted that a hidden command, a hidden menu, or the like may be set in the display device 200 or the like. In this case, the electric mobility vehicle M is brought into

a state in which it can be operated by the controller 400 only when the hidden command, the hidden menu, or the like is operated. Thereby, erroneous use of the controller 400 by an unintended person such as the user seated on the electric mobility vehicle M or the like is prevented. Further, the configuration may be such that the automatic stop function is disabled when the electric mobility vehicle M becomes operable by the controller 400. Thereby, in a narrow passage, the user and the electric mobility vehicle M can move more smoothly.

{Reference Signs List}

{0100}

30 mobility body

43 arm

43a arm rest

46 guard member

46b inclined portion

50 seat surface portion

50a front end

80 control device

90 sensor

91 axis line

95 sensor

95 rear side sensor

96 lower side sensor

96 sensor

97 rear side sensor

98 user distance sensor

98a optical axis

100 server

110 push handle

115 grip portion

120 luggage basket

140 sensor moving mechanism

140’ sensor moving mechanism

141 swing member

142 spring member

143 biasing member for retraction

144 vertical movement member

145 spring member

146 biasing member for retraction

150 sensor protection member

500 cart

BA battery

CA elevator car

DA1 detection area

DA2 detection area

DA3 detection area

DA4 detection area

DA5 detection area

M electric mobility vehicle

S seat unit

α viewing angle

{CLAIMS}

{Claim 1}

An electric mobility vehicle comprising:

a mobility body; and

a sensor attached to the mobility body,

wherein the sensor has a detection range around a predetermined axis line which passes through the sensor and extends in a vehicle width direction, the detection range has a viewing angle in an elevation direction and/or a depression direction with regard to a surface perpendicular to the predetermined axis line, the detection range including a front side of the vehicle and a rear side of the vehicle, and the sensor is capable of detecting an obstacle at the front side of the vehicle and the rear side of the vehicle.

{Claim 2}

The electric mobility vehicle according to claim 1, wherein

the mobility body includes a seat unit on which a user sits,

the sensor is attached to an armrest of the seat unit, an arm to which the armrest is attached, a member below the armrest, a member below the arm, or a guard member, such that the sensor protrudes outward in the vehicle width direction, and

the guard member is a member provided on the seat unit to

reduce protrusion, in the vehicle width direction from the seat unit, of clothing of the user, a thigh of the user, or a knee of the user.

{Claim 3}

The electric mobility vehicle according to claim 1 or 2, further comprising a rear step sensor attached to the mobility body and configured to detect a step located behind the mobility body.

{Claim 4}

The electric mobility vehicle according to claim 1 further comprising

a control device configured to move the mobility body by autonomous driving,

wherein the control device is configured to change an orientation of the mobility body so that the rear side of the vehicle is positioned toward an elevator car before the mobility body enters the elevator car.

{Claim 5}

An electric mobility vehicle comprising:

a mobility body;

a sensor attached to the mobility body, the sensor having a detection range around a predetermined axis line which extends in a vehicle width direction, the detection range having a viewing angle in an elevation direction and/or a depression direction with regard to a surface perpendicular to

the predetermined axis line, and the sensor capable of detecting an obstacle;

a lower sensor provided on the mobility body and configured to detect the obstacle from at least one of an area between front wheels of the mobility body or an area between the front wheels and a rear wheel of the mobility body; and

a sensor moving mechanism configured to move the lower sensor between a sensing position at which the lower sensor is capable of detecting the obstacle and a retracted position located above the sensing position.

{Claim 6}

The electric mobility vehicle according to claim 5, wherein the mobility body includes a battery detachably mounted thereto, and wherein the sensor moving mechanism is configured to place the lower sensor at the sensing position when the battery is mounted to the mobility body and to place the lower sensor at the retracted position when the battery is removed from the mobility body.

{Claim 7}

An electric mobility vehicle comprising:

a mobility body;

a sensor attached to the mobility body, the sensor having a detection range around a predetermined axis line which extends in a vehicle width direction, the detection range having a viewing angle in an elevation direction and/or a

depression direction with regard to a surface perpendicular to the predetermined axis line, and the sensor capable of detecting an obstacle;

a lower sensor provided on the mobility body and capable of detecting the obstacle from at least one of an area between front wheels of the mobility body or an area between the front wheels and a rear wheel of the mobility body; and

a sensor protection member projecting downward from a lower surface of the mobility body,

wherein the sensor protection member is disposed in a horizontal area in which the front wheels or the rear wheel exists when seen from the lower sensor.

{Claim 8}

The electric mobility vehicle according to claim 1, wherein

the mobility body has a seat unit on which a user sits, and

a user distance sensor capable of detecting a front-rear distance between the seat unit and the user is attached to the mobility body.

{Claim 9}

An electric mobility vehicle comprising:

a mobility body;

a sensor attached to the mobility body, the sensor having a detection range around a predetermined axis line which

extends in a vehicle width direction, the detection range having a viewing angle in an elevation direction and/or a depression direction with regard to a surface perpendicular to the predetermined axis line, and the sensor capable of detecting an obstacle; wherein

the mobility body has a seat unit on which a user sits,

the seat unit includes a seat surface portion and a guard member that is disposed outward in the vehicle width direction relative to at least one of a thigh or a knee of the user seated on the seat unit, the guard member being configured to reduce protrusion of clothing of the user, a thigh of the user, or a knee of the user from the seat unit, and

a part of the guard member is positioned at a front side relative to a front end of the seat surface portion, and the guard member has an inclined portion that inclines inward in the vehicle width direction toward a lower side.

{Claim 10}

The electric mobility vehicle according to claim 1 or 2, further comprising a push handle attached to the mobility body so as to move in a swing manner,

wherein the push handle is movable to a first swing position in which a grip portion thereof is disposed at a height position for pushing the electric mobility vehicle, and is also movable to a second swing position that is a storage position and lower than the first swing position.

{Claim 11}

The electric mobility vehicle according to claim 1, wherein the mobility body has the seat unit on which a user sits,

wherein the electric mobility vehicle further comprises a luggage basket disposed behind the seat unit,

wherein the luggage basket is detachably attached to the mobility body so that the electric mobility vehicle can be placed on a cart having an allowable accommodation dimension of 110 cm or less in a first horizontal direction and 110 cm or less in a second horizontal direction orthogonal to the first horizontal direction.