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(54) **ASSISTING METHOD FOR CLEANING APPARATUS AND CLEANING APPARATUS**

(57) The embodiments of the present application provide an assisting method for a cleaning device and a cleaning apparatus. The method comprises the following steps: obtaining movement information of a cleaning device; identifying an operation intention of a user operating the cleaning device to move based on the movement information; and controlling an assisting apparatus

of the cleaning device to operate to provide assisting for the user operating the cleaning device to move according to the operation intention and the movement information. According to the technical solution provided by the embodiments of the present application, assisting is provided for the user operating the cleaning device to move, and the operation of the user is labor-saving and eased.

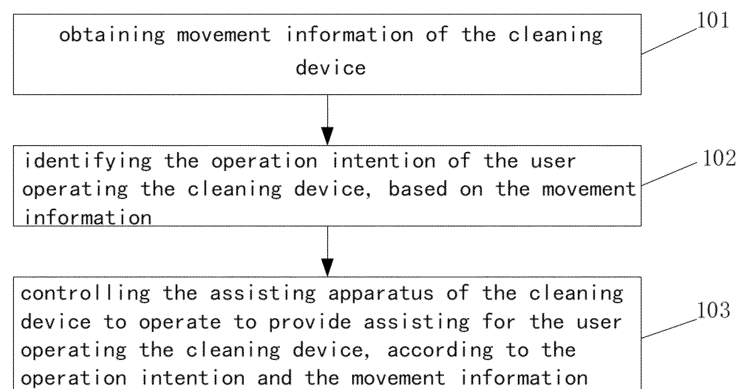


FIG. 7

Description**CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] The present application cites the Chinese patent applications in the following table, which are hereby incorporated by reference in their entireties.

priority date	priority number	application title
2022-03-30	202210332668.0	an assisting method for a cleaning device and a cleaning device
2022-04-29	202210474418.0	a control method for a cleaning device and a cleaning device

FIELD

[0002] The present application relates to the technical field of cleaning device, and in particular to an assisting method for a cleaning device and a cleaning device.

BACKGROUND

[0003] Cleaning device have been widely used in people's daily life. Commonly used are floor scrubbers, vacuum cleaners, etc. For example, some floor scrubbers or vacuum cleaners are equipped with an operating handle. When the user holds the handle to operate the machine, a forward friction force is generated when the roller brush rotates. When the user pushes the floor scrubber or vacuum cleaner forward, low labor may be cost, since the rolling of the roller brush generates a forward force. However, when pulling back, the user needs to overcome the forward force of the roller brush, which may be difficult for the user to operate.

SUMMARY

[0004] Aiming at the problems existed in the prior art, embodiments of the present application provide an assisting method for a cleaning device and a cleaning device.

[0005] Embodiments of the present application provide an assisting method for a cleaning device. The method comprises:

obtaining movement information of a cleaning device;
 identifying operation intention of a user operating the cleaning device to move based on the movement information;
 and
 controlling an assisting apparatus of the cleaning device to operate, to provide assisting for the user operating the cleaning device to move according to the operation intention and the movement information.

[0006] Embodiments of the present application further provide a cleaning device. The cleaning device comprises: a machine body, on which a floor brush is provided;

a handle, provided on the machine body, through which a user operates the roller brush of the cleaning device;
 an assisting apparatus, used to output assisting;
 a controlling apparatus, provided on the machine body and electrically connected to the assisting apparatus, and used to obtain movement information of the cleaning device; identify operation intention of a user operating the cleaning device based on the movement information; and control the assisting apparatus to operate according to the operation intention and the movement information, to provide assisting for the user operating the cleaning device.

[0007] Embodiments of the present application further provide an electronic device. The electronic device can be installed on the cleaning device. The electronic device comprises a processor and a memory, wherein,

the memory is used to store one or more computer instructions;
 the processor is coupled with the memory and is used for executing at least one or more computer instructions for implementing the steps in the embodiments of each method.

[0008] Embodiment of the present application further provide a computer program product. The computer program

product comprises a computer program or instruction, when the computer program or the instruction is executed by a processor, enables the processor to accomplish the steps in embodiments of each method.

[0009] According to the technical solution provided by the embodiments of the present application, assisting is provided for the user operating the cleaning device to move, and the operation of the user is labor-saving and eased.

[0010] According to the technical scheme provided by embodiments of the present application, the cleaning device in different movement states always has an adaptive assisting strategy; during assisting controlling, the assisting apparatus of the cleaning device is controlled to operate according to the movement information of the cleaning device and the assisting strategy adapted to the current movement state, to provide assisting for the user operating the cleaning device to move, accordingly the operation of the user is labor-saving and eased.

[0011] Embodiments of the present application further provide a cleaning device controlling method, being applied to a cleaning device, wherein the cleaning device is provided with an assisting apparatus, and the method comprises:

obtaining an operating parameter of the assisting apparatus in the cleaning device;
identifying a state of the assisting apparatus by the operating parameter; and
adjusting an output power of the assisting apparatus based on the state of the assisting apparatus.

[0012] In one optional implementation, the obtaining of the operating parameter of the assisting apparatus in the cleaning device comprises:

obtaining a speed and an acceleration of the assisting apparatus in the cleaning device; the identifying the state of the assisting apparatus by the operating parameter comprises:

identifying the state of the assisting apparatus by the speed and the acceleration.

[0013] In one optional implementation, the identifying the state of the assisting apparatus by the speed and the acceleration comprises:

determining an acceleration dispersion degree corresponding to the acceleration according to a preset acceleration dispersion degree determination cycle;

judging whether the acceleration dispersion degree is less than a preset first dispersion degree threshold, and judging whether the speed is more than a preset speed threshold;

if the acceleration dispersion degree is less than the preset first dispersion degree threshold and the speed is more than the preset speed threshold, identifying the assisting apparatus being in a slipping or suspended state.

[0014] In one optional implementation, if the acceleration difference is within the preset acceleration error range, identifying the assisting apparatus being in a slipping or suspended state comprises:

if the acceleration difference is within the preset acceleration error range, counting a first duration during which the acceleration difference is within the preset acceleration error range;

judging whether the first duration reaches a preset first duration threshold;

if the first duration reaches the preset first duration threshold, identifying the assisting apparatus being in a slipping or suspended state.

[0015] In one optional implementation, the identifying the assisting apparatus being in a slipping or suspended state comprises:

judging whether the speed is more than a preset speed threshold;

if the speed is more than the preset speed threshold, identifying the assisting apparatus being in a slipping or suspended state.

[0016] In one optional implementation, the obtaining the operating parameter of the assisting apparatus in the cleaning device comprises:

obtaining an operating current of the assisting apparatus in the cleaning device;

the identifying the state of the assisting apparatus by using the operating parameter comprises:

identifying the state of the assisting apparatus by the operating current.

[0017] In one optional implementation, the adjusting the output power of the assisting apparatus based on the state of the assisting apparatus comprises:

if the assisting apparatus being in a slipping or suspended state, adjusting the assisting apparatus to reverse, and

reducing the output power of the assisting apparatus to cause the speed of the cleaning device being zero;
if the assisting apparatus is not in a slipping or suspended state, maintaining the output power of the assisting apparatus.

[0018] Embodiments of the present application further provides a cleaning device, comprising:

a machine body, on which a floor brush is provided;
a handle, provided on the body, through which a user operates the cleaning device to move;
an assisting apparatus, used to output assisting; and
a controlling apparatus, provided on the machine body and electrically connected to the assisting apparatus, and is used to implement the method steps described above.

[0019] According to the technical solution provided in the embodiments of the present application, the operation parameter of the assisting apparatus in the cleaning device is obtained, the state of the assisting apparatus is identified by the operation parameter, and the output power of the assisting apparatus is adjusted based on the state of the assisting apparatus. By obtaining the operation parameter of the assisting apparatus in the cleaning device and identifying the state of the assisting apparatus by the operation parameter, the output power of the assisting apparatus is adjusted, thereby ensuring that the assisting apparatus operates normally, avoiding waste of resources, and improving user experience.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] In order to explain the technical solutions of the embodiments of the present application more clearly, the drawings used in the embodiments will be briefly introduced below. The drawings here are incorporated into the specification and constitute one part of the specification. These drawings illustrate embodiments consistent with the present application, which are used together with the description, serving to explain the technical solutions of the present application. It should be understood that the following drawings only illustrate certain embodiments of the present application, and therefore should not be regarded as limiting the scope. For those of ordinary skill in the art, other relevant drawings can also be obtained based on these drawings without exerting creative efforts.

FIG. 1 is a schematic diagram of a cleaning device in an upright posture provided by an embodiment of the present application;
FIG. 2 is a schematic top-view diagram of a cleaning device in an upright posture provided by an embodiment of the present application;
FIG. 3 is a schematic diagram of a cleaning device in a tilted posture during use provided by an embodiment of the present application;
FIG. 4 is a schematic diagram of a rear wheel in a cleaning device provided by an embodiment of the present application;
FIG. 5a is a schematic cross-sectional diagram of a rear wheel in a cleaning device provided by an embodiment of the present application;
FIG. 5b is a schematic exploded diagram of a photoelectric sensor in a cleaning device provided by an embodiment of the present application;
FIG. 6 is a schematic diagram of a pulse signal generated by a detection signal of a photoelectric sensor provided at a rear wheel in a cleaning device provided by an embodiment of the present application;
FIG. 7 is a schematic flow chart of an assisting method for a cleaning device provided by an embodiment of the present application;
FIG. 8 is a schematic diagram of a rear wheel speed and acceleration curve in an assisting method for a cleaning device provided by an embodiment of the present application;
FIG. 9 is a schematic diagram of an assisting apparatus forward advancing assisting output power curve determined based on movement information in an assisting method for a cleaning device provided by an embodiment of the present application;
FIG. 10 is a schematic diagram of an assisting apparatus backward advancing assisting output power curve determined based on movement information in an assisting method for a cleaning device provided by an embodiment of the present application;
FIG. 11 is a schematic flow chart of an assisting method for a cleaning device provided by an embodiment of the present application;
FIG. 12 is a schematic flow chart of a further implementation of the assisting method for the cleaning device shown in FIG. 11;
FIG. 13 is a schematic diagram of an implementation flow of a cleaning device controlling method provided by an

embodiment of the present application;

FIG. 14 is a schematic diagram of another implementation flow of another cleaning device controlling method provided by an embodiment of the present application;

FIG. 15 is a schematic diagram of an implementation flow of a state identifying method of an assisting apparatus provided by an embodiment of the present application;

FIG. 16 is a schematic diagram of an implementation flow of an acceleration dispersion degree determining method provided by an embodiment of the present application;

FIG. 17 is a schematic diagram of another implementation flow of a state identifying method of an assisting apparatus provided by an embodiment of the present application;

FIG. 18 is a schematic diagram of another implementation flow of a state identifying method of an assisting apparatus provided by an embodiment of the present application;

FIG. 19 is a schematic diagram of another implementation flow of cleaning device controlling method provided by an embodiment of the present application;

FIG. 20 is a schematic diagram of an implementation flow of a state identifying method of an assisting apparatus provided by an embodiment of the present application;

FIG. 21 is a schematic diagram of an implementation flow of a current dispersion degree determining method provided by an embodiment of the present application;

FIG. 22 is a schematic diagram of another implementation flow of a state identifying method of an assisting apparatus provided by an embodiment of the present application;

FIG. 23 is a schematic diagram of another implementation flow of a state identifying method of an assisting apparatus provided by an embodiment of the present application;

FIG. 24 is a schematic diagram of another implementation flow of a cleaning device controlling method provided by an embodiment of the present application; and

FIG. 25 is a schematic diagram of an implementation flow of a method for reducing an output power of an assisting apparatus provided by an embodiment of the present application.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

[0021] In order to enable those skilled in the prior art to better understand the present application, the technical solution provided by various embodiments of the present application are illustrated in detail and completely in conjunction with the drawings.

[0022] In some of the processes described in the description, claims, and the above drawings of the present application, a plurality of operations occurring in a particular order are included, which may be performed out of the order herein or be performed in parallel. The sequence numbers of the operations, such as 101, 102, etc., are merely used to distinguish between the various operations, and the sequence numbers themselves do not represent any order of execution. In addition, the processes may include more or fewer operations, and the operations may be performed sequentially or in parallel. It should be noted that the expressions herein of "first", "second", etc. are intended to distinguish between different messages, devices, modules, etc., and are not intended to represent a sequential order, nor is it intended to limit that "first" and "second" are of different types. Furthermore, the embodiments described hereafter are merely a part of the embodiments of the present application and not all the embodiments. Based on the embodiments of the present application, all other embodiments obtained by those ordinarily skilled in the art without paying creative work fall within the protection scope of the present application.

[0023] FIGs. 1, 2 and 3 show schematic structural diagrams of a cleaning device provided by an embodiment of the present application. As shown in the drawings, the cleaning device includes: a machine body 2, a handle 1, an assisting apparatus (not shown in the drawings) and a controlling apparatus (not shown in the drawings). The machine body 2 is provided with a floor brush 3, and the floor brush 3 is provided with a roller brush 5. The handle 1 can be provided on the machine body 2 via an extension rod. A user operates the cleaning device to move by the handle 1, to push or pull the cleaning device to move, so that the cleaning device cleans the surface to be cleaned that it moves over. The assisting apparatus is used to output assisting. The controlling apparatus is provided on the machine body 2 or the floor brush 3 and is electrically connected to the assisting apparatus, to obtain the movement information of the cleaning device; based on the movement information, operation intention of the user operating the cleaning device is identified; according to the operation intention and the movement information, the assisting apparatus is controlled to operate to provide assisting for the user operating the cleaning device.

[0024] FIGs. 1 and 2 show the posture of the cleaning device when it is in a non-operating state, for example, the posture of the cleaning device when it is placed on a base or in a docked state. FIG. 3 shows the posture of the cleaning device when being used. The user can hold the handle 1 and tilt the machine body 2 to push, pull and turn the floor brush 3 to clean the floor, carpet and other cleaning surfaces.

[0025] As shown in FIG. 4 and FIG. 5a, the method provided in the embodiment may further include a sensor 6. As shown

in FIGs. 1 to 4, the floor brush is provided with a rear wheel 4. The sensor 6 is used to detect a movement signal of the rear wheel 4. The controlling apparatus is electrically connected to the sensor 6, and is used to determine the movement information of the rear wheel 4 according to the movement signal detected by the sensor 6. The assisting apparatus provides assisting by driving the rear wheel. When there is a user operation, the movement information of the rear wheel includes information reflecting the user operating the cleaning device; when there is no user operation, the movement information of the rear wheel reflects the movement of the cleaning device.

[0026] As shown in FIG. 5a, the assisting apparatus 7 may be a motor, a first output shaft of the motor is connected to a high-speed end of a deceleration mechanism 8, and the rear wheel 4 is connected to the low-speed end of the deceleration mechanism. The sensor 6 may be provided at the high-speed end of the deceleration mechanism. In a specific feasible technical solution, the sensor 6 may be a photoelectric sensor. The motor further has a second output shaft, and the second output shaft outputs the same power as the first output shaft. The photoelectric sensor may be provided on the second output shaft side of the motor. For example, as shown in FIG. 5a, the photoelectric sensor includes a transmitter 62, a receiver 63, and a grating code disk 61. The grating code disk 61 is connected to the second output shaft of the motor. When the motor is not operated (i.e., not outputting power to the outside), the rotation of the rear wheel drives the grating code disk in the photoelectric sensor to rotate by the deceleration mechanism. When the motor operates to drive the rear wheel to rotate (i.e., providing assisting), the two output shafts of the motor output the same power to drive the grating code disk and the rear wheel to rotate respectively. That is to say, the rear wheel and the grating code disk always rotate simultaneously, and the speed ratio is fixed, that is, the deceleration ratio (or transmission ratio) of the deceleration mechanism. Light-transmitting areas and non-light-transmitting areas are evenly distributed along the whole circumference of the grating code disk 61. The transmitter 62 and the receiver 63 are provided opposite to each other on two sides of the grating code disk 61. The grating code disk 61 rotates simultaneously with the rear wheel, but the rotation speed of the grating code disk 61 is higher than the rotation speed of the rear wheel. During the process of the grating code disk 61 and the rear wheel rotating simultaneously, the light signal emitted by the transmitter 62 is blocked when encountering the non-light-transmitting area, and reaches the receiver 63 when encountering the light-transmitting area. The receiver 63 receives the light signal emitted by the transmitter and generates a pulse signal. In this way, the pulse signal shown in FIG. 6 is generated. In practice, when the light signal emitted by the transmitter 62 passes through the light-transmitting area of the grating code disk 61, since the light emitted by the transmitter 62 has a diffusion angle and the light-transmitting area has a certain width, there may be a situation where the transmitter 62 has not yet turned to the light-transmitting area, but light has already passed through the light-transmitting area and been detected. At this time, the high-and-low-level ratios of the pulse signal will be offset, resulting in inaccurate detection results. In order to solve this problem, as shown in FIG. 5b, a circular/ring-shaped code disk light-limiting plate 65 is provided on the inner side of the code disk back cover 64 on which the transmitter 62 is installed. The code disk light-limiting plate 65 is located between the transmitter 62 and the receiver 63. A 0.2 mm wide slit is provided on the code disk light-limiting plate 65 at the position corresponding to the transmitter 62, while the remaining positions are not light-transmissive; thereby limiting the light emitted by the transmitter 62, so that the receiver 63 can detect the light signal only when the transmitter 62 is rotated to the light-transmitting area. Of course, the code disk light-limiting plate 65 can also be installed on the code disk front cover. After repeated tests, it was found that when the size of the slit on the code disk light-limiting plate 65 is between 0.1 mm and 0.3 mm, the detection result is most accurate. When it is less than 0.1 mm, it will affect the normal reception of the light. When it is greater than 0.3 mm, the detection result has a large error.

[0027] Furthermore, the photoelectric sensor may also include a detection circuit, which is used to detect the received electrical signal and get the effective signal by filtering, and transmit it to the controlling apparatus so that the controlling apparatus can determine the direction of movement, calculate the speed, acceleration, etc. based on the received electrical signal. The photoelectric sensor is provided on the second output shaft side of the motor. The rotation speed of the grating code disk of the photoelectric sensor is higher than that of the rear wheel. In this way, the photoelectric sensor can obtain sufficient movement data when the rear wheel rotates a very small angle. The movement data may include: movement direction, movement speed, etc.

[0028] The method for calculating the speed based on the pulse signal generated by the photoelectric sensor may include: assuming that the total number of pulses of the grating code disk rotating one circle is C; setting the statistical time to T (in seconds); the number of pulses detected within T being M; accordingly, the rotation speed n of the grating code disk of the photoelectric sensor being:

$$n=M/(C*T)$$

[0029] The acceleration of the grating code disk: $a=\Delta n/t$; where Δn is the speed change and t is the time taken for the speed change.

[0030] Since the rotation speed of the grating code disk is greater than the rotation speed of the rear wheel, when the

deceleration ratio of the deceleration mechanism is known, the rotation speed of the rear wheel can be calculated based on the rotation speed n of the grating code disk by the deceleration ratio (or transmission ratio).

[0031] As shown in FIG. 4, in order to detect the movement direction of the rear wheel, the photoelectric sensor in this embodiment may include two groups of transceivers. As shown in FIG. 4, the photoelectric sensor includes: a first group of transceiver 601 and a second group of transceiver 602. Each transceiver group includes one transmitter 62 and one receiver 63. The two groups of transceivers are provided at a certain distance. For example, as shown in FIG. 4, a first line connecting the first transceiver group 601 and the rotation center of the grating code disk 61 and a second line connecting the second transceiver group 602 and the rotation center of the grating code disk 61 form an acute angle. The distance between the two groups of transmitters satisfies that the phase difference between the two groups of signals is 90° , that is, the distance between the two groups of transmitters can be $NT + 1/4T$, N is a natural number, T is the periodic distance of the signal, and one high level and one low level constitute one period. The receivers in the two groups of transceivers can both receive the optical signals sent by the corresponding transmitters, or both cannot receive the optical signals sent by the corresponding transmitters. By determining the initial phase of the electrical signals output by the two groups of transceivers, the rotation direction of the rear wheel can be detected.

[0032] In this embodiment, the movement direction, speed and acceleration of the cleaning device are completely detected and obtained by the photoelectric sensor of sensor 6, that is, the three information, the movement direction, speed and acceleration of the cleaning device can be obtained by one sensor. The operation of the user and the movement of the cleaning device can be detected by one sensor 6.

[0033] It should be noted here that the forward, backward, forward pushing, backward pulling, etc. mentioned below are all defined from the user's perspective when the cleaning device is operated. As shown in FIG. 3, when the user holds the handle and pushes it in the direction of the forward arrow in the figure, it is forward pushing; when the user holds the handle and pulls it in the direction of the backward arrow in the figure, it is backward pulling.

[0034] When the user holds the handle shown in FIG. 3 and pushes the cleaning device forward, the rear wheel 4 will roll forward along with the user's operation, and timely reflects the user's operation. The inventor of the present application has actually measured that when the user makes a forward pushing operation, since the photoelectric sensor is provided at the high-speed end of the deceleration mechanism, when the rear wheel of the cleaning device accelerates and rotates forward a very small distance, such as 5 mm or less, at the instant (in a short time) when the user makes the operation, the photoelectric sensor can amplify the change in the speed of the rear wheel and sense the sudden acceleration of the rear wheel in time. At this time, the operation intention of the user can be identified as forward pushing. The controlling apparatus controls the assisting apparatus to operate to drive the rear wheel to roll forward according to the movement information of the cleaning device and the operation intention of the user. In this way, the cleaning device can move forward under the action of the forward-rolling roller brush and the forward-rolling rear wheel. The user does not need to apply forward thrust by holding the handle, but only needs to lightly hold the handle, which gives the effect that the user does not need to make any effort to follow the cleaning device forward. Of course, when the cleaning device moves forward, no assisting may be provided, that is, the assisting apparatus does not operate. Because the rotation of the roller brush generates a forward friction force, this friction force can serve as a boost.

[0035] If the user holds the handle as shown in FIG. 3 and pushes the cleaning device forward, and feels that the cleaning device is moving at an appropriate speed under the forward pushing assisting, the assisting apparatus can maintain the current operating parameter (such as forward output power or output speed) to drive the rear wheel to rotate forward. The user can hold the handle and follow the cleaning device without applying force all the time, which is labor-saving and eased. If the user feels that the cleaning device is moving too fast with forward assisting, and wants to slow down, the user only needs to lightly pull the handle once, and the rear wheel 4 will slow down due to the braking force generated by the user's instantaneous backward pulling. Similarly, since the photoelectric sensor is provided at the high-speed end, it can amplify the change in the speed of the rear wheel and sense the speed reduction of the rear wheel in time. At this time, it can be identified that the operation intention of the user is backward pulling or slowing down, and the controlling apparatus controls the assisting apparatus to adjust the operating parameter (such as forward power-assisting output power) to reduce the speed of the rear wheel rolling forward. If the speed of the cleaning device is appropriate after deceleration, the user can continue to hold the handle and follow the cleaning device. If the cleaning speed is still high after the deceleration, the user can gently pull the handle again and repeat the above process.

[0036] Furthermore, if the user wants to pull back to make the cleaning device forward advance and stop or backward advancing, the user's pulling back operation will cause the rear wheel to have a tendency of quickly slowing down. Because the movement of the rear wheel of the cleaning device can reflect the user's operation, when the user pulls the cleaning device backward and wants it to forward advance and stop or backward advance, the movement of the rear wheel will have a tendency of forward stop trend. In the case of backward pulling mentioned above, when the user pulls lightly, the rear wheel will slow down but not very much, and there will be no tendency of approaching zero or being equal to zero, so it can be identified that the operation intention of the user is forward pushing with a deceleration. In practical applications, the speed and acceleration of the rear wheel can be used to analyze whether the movement of the rear wheel has a tendency of forward stop trend. For example, the movement of the rear wheel with a forward speed being lower than a first threshold

(such as 0.5 m/s) and being continuously decelerated can be used to determine that the rear wheel has a tendency of forward stop trend. When the rear wheel has a tendency of forward stop trend, it is identified the operation intention of the user as forward advancing and stopping or backward pulling. For the case of forward advancing and stopping, for example, when the user holds the handle and follows the cleaning device to clean, the user sees a place being very dirty and wants the cleaning device to stop to clean it. For the case of backward pulling, for example, the user holds the handle and follows the cleaning device to move forward and enter a narrow passage, and pulls the cleaning device out of the passage after cleaning to the end; or, the user adopts a way in which pushes forward and pulls backward repeatedly, to make the cleaning device clean the floor. Regardless of the user's intention being forward advancing and stopping or backward pulling, the situation may occur in which the speed of the rear wheel reducing to zero. When the user wants the cleaning device to stop or wants the cleaning device turn to a backward movement from a frontward movement, the way the user backward pulling the handle of the cleaning device will be different from the user's light pulling in the above case of forward pushing with a deceleration. If the user wants to forward advance and stop or backward pull, the user's backward pulling operation will be reflected on the rear wheel as a rapid decrease in forward speed. Because the photoelectric sensor is at the high-speed end, it can amplify and promptly detect the tendency of forward stop trend of the rear wheel due to user's operation. The controlling apparatus controls the assisting apparatus to output backward assisting based on the movement information of the rear wheel (such as speed, acceleration, etc.) detected by the photoelectric sensor. The backward assisting balances the forward power of the roller brush and further provides backward assisting for the cleaning device, to accelerate the deceleration of the forward speed of the cleaning device, allowing the cleaning device to stop quickly and stay in place, or allowing the forward speed of the cleaning device to quickly drop to zero and then turn to backward.

[0037] The cleaning device is currently backward advancing. If the user wants to push forward to make the cleaning device backward advance and stop or forward advance, the user's forward pushing operation will cause the rear wheel to have a tendency of slowing down rapidly. Because the movement of the rear wheel of the cleaning device can reflect the user's operation, when the user pushes the cleaning device forward and wants it to backward advance and stop or forward advance, the movement of the rear wheel will have a tendency of backward stopping trend. In a specific implementation, whether the movement of the rear wheel has a tendency of backward advancing and stopping may be analyzed based on the speed and acceleration of the rear wheel. For example, if the backward speed of the rear wheel is lower than the second threshold and is continuously decelerated, it can be determined that the rear wheel has the tendency of backward advancing and stopping. When the rear wheel has the tendency of backward advancing and stopping, it is identified the operation intention of the user as backward advancing and stopping or forward pushing. For the case of backward advancing and stopping, for example, when the user holds the handle and follows the backward advancing of the cleaning device to clean, the user sees a placing being very dirty and wants the cleaning device to stop to clean it. For the case of forward pushing, the user adopts a way in which pushes forward and pulls backward the cleaning device repeatedly to clean the floor. Regardless of the user's intention to being backward advancing and stopping or forward pushing, the situation may occur in which the speed of the rear wheel reducing to zero. Because the photoelectric sensor is at the high-speed end, it can amplify and promptly detect the tendency of backward stop trend of the rear wheel due to user's operation. The controlling apparatus controls the assisting apparatus to output forward assisting based on the movement information of the rear wheel (such as speed, acceleration, etc.) detected by the photoelectric sensor, to accelerate the deceleration of the backward speed of the cleaning device, or controls the assisting apparatus not to operate, only using the forward rolling force of the roller brush as the assisting to make the cleaning device to stop quickly and stay in place, or to make the cleaning device to quickly drop to zero in the backward direction and then turn forward.

[0038] A method embodiment will be provided below to illustrate the intelligent assistance solution for the cleaning device provided in this application.

[0039] FIG. 7 is a schematic flow chart of the assisting method for the cleaning device provided by an embodiment of the present application. As shown in the drawings, the method includes:

101. obtaining movement information of the cleaning device;
102. identifying the operation intention of the user operating the cleaning device, based on the movement information;
103. controlling the assisting apparatus of the cleaning device to operate to provide assisting for the user operating the cleaning device, according to the operation intention and the movement information.

[0040] In the above 101, the movement information of the cleaning device may include but is not limited to: movement direction, speed, acceleration, etc. The movement information may be detected by a sensor provided on the cleaning device. For example, the floor brush of the cleaning device is provided with a movement monitoring apparatus to monitor the movement information of the floor brush, or being the sensor mentioned above, such as photoelectric sensor. The sensor can be provided at the rear wheel of the floor brush. The assisting apparatus provides assisting by driving the rear wheel. That is, in an achievable technical solution, the step 101 of "obtaining the movement information of the cleaning device" in this embodiment may specifically include:

- 1011. detecting a movement signal of the rear wheel by a sensor; and
- 1012. generating the movement information based on the detected movement signal.

[0041] Furthermore, the step 1012 of "generating the movement information based on the detected movement signal" in this embodiment may include:

- S11, determining the movement direction and speed of the rear wheel based on the movement signal continuously detected by the sensor; and
- S12, calculating the acceleration of the rear wheel according to the speeds of the rear wheel corresponding to a plurality of consecutive moments;

where the movement information includes: movement direction, speed and acceleration. The movement direction of the rear wheel is essentially the rotation direction of the rear wheel, such as counterclockwise rotation and clockwise rotation.

[0042] As mentioned above, the sensor is a photoelectric sensor. As shown in FIG. 5a, the assisting apparatus 7 may be a motor, a first output shaft of the motor is connected to the high-speed end of the deceleration mechanism 8, and the rear wheel 4 is connected to the low-speed end of the deceleration mechanism. The grating code disk in the photoelectric sensor rotates simultaneously with the rear wheel. The rotation speed of the grating code disk is higher than the rotation speed of the rear wheel, and can reflect the movement of the rear wheel in time. The photoelectric sensor generates a pulse signal as shown in FIG. 6 when follows the rear wheel to rotate. The movement signal in the above step S11 may be a pulse signal as shown in FIG. 6. The speed of the rear wheel can be calculated using the speed calculation method mentioned above.

[0043] The movement direction (or rotation direction) of the rear wheel can be measured by the initial phase of the electrical signal output by the receivers in the two groups of transceivers in the photoelectric sensor. After the speed of the rear wheel is obtained, the acceleration of the rear wheel can be calculated based on the speed of the rear wheel.

[0044] There are two ways to identify the operation intention of the user operating the cleaning device, which are as follows.

[0045] Method 1: identifying the movement information of the rear wheel.

[0046] That is, the step of "identifying the operation intention of the user operating the cleaning device based on the movement information of the rear wheel" in this embodiment. More specifically, the step may include:

- 1021. analyzing the movement trend of the rear wheel according to the movement information of the rear wheel; and
- 1022. identifying the operation intention of the user based on the movement trend.

[0047] More detailed contents of the above steps 1021 and 1022 will be described below.

[0048] Method 2: identification by the sensor or an interactive apparatus.

[0049] For example, a sensor capable of sensing user operation or a user-touchable interactive apparatus is provided on the handle of the cleaning device. Assuming that a sensor is provided, a pressure sensor may be provided on the handle to detect the direction and magnitude of the force applied by the user. The user's push or pull force is detected by the pressure sensor to identify the operation intention of the user. If an interactive apparatus is provided, a touch component capable of sensing user touch may be provided on two sides of the handle, for example, the holding area of the handle. As shown in FIG. 2, a touch key or touch area 11 is provided above the handle, lightly tapping or touching performed by the user can be detected. A touch key or touch area is also provided under the handle. For example, when the user holds the handle at the position marked 12, the user's thumb can touch the touch key or touch area 11 above the handle, and the user's index finger can easily touch the touch key or touch area under the handle. When the user's thumb touches the upper touch key or touch area 11, it can be identified that the operation intention of the user is forward pushing, and when the user's index finger touches the lower touch key or touch area, it can be identified that the operation intention of the user is backward pulling.

[0050] Furthermore, the controlling apparatus may control the assisting apparatus to operate based on the user's operation and the current movement state of the cleaning device, to output an adaptive assisting. For example, when the cleaning device is currently in a forward advancing state, the user touches the upper touch key or touch area 11 once, and based on the current movement direction and moving speed, the controlling apparatus controls the assisting apparatus to output forward assisting to increase the forward speed of the cleaning device. If the user touches the upper touch key or touch area 11 once again, the forward speed will be increased again, and the controlling apparatus will control the assisting apparatus to increase the forward assisting output power to further assist the cleaning device to increase the forward speed. If the cleaning device is currently in a forward advancing state, the user touches the lower touch key or touch area once, and the controlling apparatus controls the assisting apparatus to output backward assisting, to accelerate the reducing of the forward speed, so that the forward speed of the cleaning device is reduced to zero. If the user no longer touches any touch key or touch area, the cleaning device stays at the place to clean the location where it stops. If the user

touches the lower touch key or touch area once again, the controlling apparatus controls the assisting apparatus to increase the backward assisting output power, to assist the cleaning device to move backward.

[0051] When the above method 1 is specifically implemented, it can be explained in conjunction with the speed and acceleration curves shown in FIG. 8 for easy understanding. The speed and acceleration curves shown in FIG. 8 are a continuous forward-pushing and backward-pull operation process of the cleaning device. It should be noted in advance that in the curves shown in FIG. 8, such as in stages ② and ⑤, there is a short section of the acceleration curve, and the section circled in FIG. 8 appears to be zero. In fact, the straight acceleration curve segment displayed as zero in stages ② and ⑤ is not zero, but because under the vertical axis annotation value shown in FIG. 8, the value of the acceleration corresponding to the vertical axis cannot be distinguished from the zero value line.

[0052] In addition, in FIG. 8, the speed with a positive value is the forward speed of the cleaning device, and the speed with a negative value is the backward speed of the cleaning device.

[0053] As shown in FIG. 8, the stage ① is a stage in which the cleaning device is not turned on and is in a static state, and the speed and acceleration of the cleaning device are both zero. Alternatively, the cleaning device is turned on and is in a stopping at the spot state. For example, after the cleaning device is turned on, the user holds the handle and tilts the machine body of the cleaning device, and the roller brush rotates, and the rotation of the roller brush produces a forward force. When the user has no intention of forward pushing or backward pulling, the controlling apparatus controls the assisting apparatus to output backward assisting to drive the rear wheel to roll backward, to offset the forward power of the roller brush, so that the floor brush can stay in place and the force applied by the user on the handle approaches 0. If there is no assisting, because of the forward power of the roller brush, the user needs to pull the cleaning device, and the pulling force of the user is essentially a backward pulling force. With the assistance provided by the assisting apparatus, the user can feel that as long as lightly holding the handle, the cleaning device will stay in place without having to pull or drag it.

[0054] In stage ②, the value of the speed of the cleaning device is positive and the cleaning device is in a forward advancing state. In stage ②, the speed curve and acceleration curve of the cleaning device can be analyzed to show that the cleaning device accelerates forward and then decelerates forward, and the movement trend of the cleaning device (i.e. the movement trend of the rear wheel) is a tendency of forward advancing.

[0055] In stage ③, the forward speed of the cleaning device is lower than the first threshold, and the forward speed is continuously decelerated, which is reflected in the movement trend of the cleaning device (i.e., the movement trend of the rear wheel) as a tendency of forward stop trend.

[0056] The above stage ④ is a stage in which the speed of the cleaning device drops to zero and the acceleration is zero, which is reflected in the movement trend of the cleaning device (i.e. the movement trend of the rear wheel) as a stationary stage after a forward stop.

[0057] In the above stage ⑤, the cleaning device accelerates in the reverse direction, and the acceleration curve shows its acceleration process, which is reflected in the movement trend of the cleaning device (i.e. the movement trend of the rear wheel) as a tendency of backward advancing.

[0058] The above stage ⑥ is a stage in which the backward speed of the cleaning device drops to zero and the acceleration is zero, which is reflected in the movement trend of the cleaning device (i.e. the movement trend of the rear wheel) as a stationary stage after a backward stop.

[0059] The above stages ① to ⑥ are speed and acceleration curves of a continuous movement of the cleaning device from stationary when it is turned on, forward pushing to backward pulling. In fact, if the cleaning device is pulled back and then pushed forward, after a brief stationary in stage ⑥ in FIG. 8 (similar to stage ④), a curve similar to stages ① to ⑤ may appear again.

[0060] The movement trend of the rear wheel can be analyzed from the speed and acceleration curves shown in FIG. 8. For example, stage ① corresponds to staying static; stage ② corresponds to the tendency of forward advancing; stage ③ corresponds to the tendency of forward stop trend; stage ⑤ corresponds to the tendency of backward advancing. Furthermore, stage ⑤ can be further divided into stage 51 and stage 52, stage 51 corresponds to the tendency of backward advancing, and stage 52 corresponds to the tendency of backward stop trend.

[0061] Accordingly, in the above step 1022, the step of "identifying the operation intention of the user based on the movement trend" may include at least one of the following:

- when the movement trend is a tendency of forward advancing, identifying the operation intention of the user as forward pushing;
- when the movement trend is a tendency of forward stop trend, identifying the operation intention of the user as forward pushing and stopping or backward pulling;
- when the movement trend is a tendency of backward advancing, identifying the operation intention of the user as backward pulling;
- when the movement trend is a backward stop trend, identifying the operation intention of the user as backward pulling and stopping or forward pushing; and
- when the movement trend is staying static, identifying the operation intention of the user as stopping at the spot;

where the tendency of forward stop trend refers to a movement trend in which a forward speed is less than a first threshold and continuously decelerated; and
the backward stop trend refers to a movement trend in which a backward speed is less than a second threshold and continuously decelerated.

[0062] The first threshold may be any value between 0.3 m/s and 0.7 m/s. For example, the first threshold may be 0.5 m/s. The second threshold may be equal to or different from the first threshold, which is not limited in this embodiment. If the first threshold is too large, the stage ③ shown in FIG. 8 will entered in advance, and the assisting of the assisting apparatus will intervene in advance to accelerate the deceleration of the forward speed of the cleaning device. This may result in a situation where the user just wants to forward pushing with a deceleration, but the forward speed quickly drops to zero because the assisting intervenes in advance. Therefore, the selection of the first threshold and the second threshold must be reasonable, and can be determined through a variety of monitoring methods or algorithms during specific implementation.

[0063] Furthermore, the tendency of forward stop trend can also be determined by the forward deceleration acceleration. For example, when the absolute value of the forward deceleration acceleration reaches the first set maximum value (the third threshold shown in FIG. 8), such as 0.075m/s^2 , and the deceleration acceleration continues for a set time, it can be determined that the movement trend of the cleaning device is a tendency of forward stop trend. Similarly, the tendency of backward stop trend can also be determined by the backward deceleration acceleration. For example, when the absolute value of the backward deceleration acceleration reaches the second set maximum value, such as 0.075m/s^2 , and the deceleration acceleration continues for a set time, it can be determined that the movement trend of the cleaning device is a tendency of backward stop trend.

[0064] The above content is analyzing the movement trend of the rear wheel based on movement information of the rear wheel, to identify the operation intention of the user. Another implementation scheme is the case where a movement monitoring apparatus (such as a speed sensor, etc.) is provided on the floor brush as mentioned above. In this embodiment, the movement information in step 102 is the movement information of the cleaning device (more specifically, the floor brush). Accordingly, the step 102 of "identifying the operation intention of the user operating the cleaning device based on the movement information" in this embodiment may include at least one of the following:

- when analyzing the movement trend of the cleaning device as a tendency of forward advancing based on the movement information, identifying the operation intention of the user as forward pushing;
- when analyzing the movement trend of the cleaning device as a forward stop trend based on the movement information, identifying the operation intention of the user as forward pushing and stopping or backward pulling;
- when analyzing the movement trend of the cleaning device as a tendency of backward advancing based on the movement information, identifying the operation intention of the user as backward pulling;
- when analyzing the movement trend of the cleaning device as a tendency of backward stop trend based on the movement information, identifying the operation intention of the user as backward pulling and stopping or forward pushing; and
- when analyzing the movement trend of the cleaning device as staying static based on the movement information, identifying the operation intention of the user as stopping at the spot;
- where the forward stop trend refers to a movement trend in which a forward speed is less than a first threshold and continuously decelerated; and
- the tendency of backward stop trend refers to a movement trend in which a backward speed is less than a second threshold and continuously decelerated.

[0065] It is understandable that when the user operates the cleaning device to move to clean the floor, regarding a relatively clean area, the user may push the cleaning device quickly, and regarding a relatively dirty area, the user may push it slowly, or may push forward and pull backward repeatedly, until the dirt is cleaned. In another scenario, for a long and narrow space, the user pushes forward to clean the narrow passage, and then continues to pull back to pull it out of the narrow passage. At this time, the user may push the cleaning device forward to clean, and then pull it back. Therefore, when the user pushes forward, the user may push forward with an acceleration, the user may also push forward with a deceleration. That is, the forward pushing can be divided into: push forward with an acceleration and push forward with a deceleration. That is, the step of "when the movement trend is a forward moving trend, identifying the operation intention of the user as forward pushing" in this embodiment may include:

- when the movement trend is a tendency of forward acceleration, identifying the operation intention of the user as forward pushing with an acceleration; and
- when the movement trend is a tendency of forward deceleration and keeping advancing, identifying the operation intention of the user as forward pushing with a deceleration;

where the tendency of forward deceleration and keeping advancing is a movement trend in which a forward speed after a deceleration is not less than the first threshold.

[0066] It should be added here that: if the user wants to keep the cleaning device forward advancing at a constant speed, the user can push the cleaning device lightly, which may generate a movement trend of forward acceleration. At this time, it can be identified that the operation intention of the user is forward pushing with an acceleration. The controlling apparatus controls the assisting apparatus to operate to provide forward assisting and increase the movement speed of the floor brush of the cleaning device. If the user is satisfied with the current speed and the change in the current speed does not exceed the fourth threshold, it means that the current user intention is to push the machine forward at a constant speed. At this time, as long as the assisting apparatus continues to maintain the current output power, the power-assisting speed of the rear wheel can be maintained. The user only needs to lightly hold the handle, and the cleaning device will move forward at a constant speed with the help of the assisting apparatus. If the user feels that the forward movement speed of the cleaning device is too fast, the user can lightly pull the handle to produce a tendency of forward deceleration and keeping advancing. The controlling apparatus of the cleaning device controls the assisting apparatus to reduce the output power, to reduce the rotation speed of the rear wheel. In this way, the cleaning device can slow down and move forward according to the forward speed after the deceleration. In addition, it should be added that: this embodiment does not specifically limit the value of the fourth threshold, which can be determined according to actual conditions; it can be preliminarily determined that: the fourth threshold is greater than the first threshold.

[0067] Afterwards, if the user wants to pull the cleaning device backward so that the cleaning device stops at a certain place for cleaning or moves backward, the user can intermittently pull the handle lightly multiple times or continuously pull the handle lightly, and a movement trend of forward deceleration will continue to be generated. If the movement trend continues until the forward speed is lower than the first threshold and continuous decelerated approaching zero or being equal to zero, it can be identified that the operation intention of the user is forward pulling and stopping or backward pulling.

[0068] Similarly, when pulling backward, the user may backward pull with an acceleration, and may also backward pull with a deceleration. That is, the backward pulling can be divided into: backward pulling with an acceleration and backward pulling with a deceleration. That is, the step of "when the movement trend is a tendency of backward advancing, identifying the operation intention of the user as backward pulling" in this embodiment may include:

when the movement trend is a tendency of backward acceleration, identifying the operation intention of the user as backward pulling with an acceleration;
when the movement trend is a tendency of backward deceleration and keeping advancing, identifying the operation intention of the user as backward pulling with a deceleration;
where the tendency of backward deceleration and keeping advancing refers to a movement trend in which the backward speed after a deceleration is not less than the second threshold.

[0069] If the user wants to keep the cleaning device backward advancing at a constant speed, the user can pull the cleaning device lightly, which may generate a movement trend of backward acceleration. At this time, it can be identified that the operation intention of the user as backward pulling with an acceleration. The controlling apparatus controls the assisting apparatus to operate, to provide forward assisting and increase the backward movement speed of the floor brush of the cleaning device. If the user is satisfied with the current backward speed and the change in the current backward speed does not exceed the fifth threshold, it means that the current user intention is to pull the machine backward at a constant speed. At this time, as long as the assisting apparatus continues to maintain the current output power, the power-assisting speed of the rear wheel can be maintained. The user only needs to lightly hold the handle, and the cleaning device will move backward at a constant speed with the help of the assisting apparatus. If the user feels that the backward movement speed of the cleaning device is too fast, a brief stop will provide a resistance, which will produce a tendency of backward deceleration and keeping advancing. The controlling apparatus of the cleaning device controls the assisting apparatus to reduce the output power, to reduce the rotation speed of the rear wheel. In this way, the cleaning device can slow down and move backward according to backward speed after the deceleration. In addition, it should be added that: this embodiment does not specifically limit the value of the fifth threshold, which can be determined according to actual conditions; it can be preliminarily determined that: the fifth threshold is greater than the second threshold.

[0070] In an achievable technical solution, the step 103 of "controlling the assisting apparatus of the cleaning device to operate according to the operation intention and the movement information" in this embodiment includes:
1031. when the operation intention is forward pushing, controlling the assisting apparatus to output an adaptive forward assisting or to stop operating, based on the movement information.

[0071] When the assisting apparatus stops operating and does not output assisting to the outside, the forward power of the roller brush of the cleaning device can be used as an assisting. As shown in FIG. 9, when the operation intention is forward pushing, in stage ② the assisting apparatus operates according to the forward output power curve shown in the drawings, to output forward assisting adapting to the speed and acceleration of the cleaning device in real time. Referring

to stage ② of FIG. 9, the speed of the cleaning device is a positive value, and the cleaning device is in a forward advancing state. The cleaning device is continuously accelerated in the front part of stage ②, and the operation intention of the user can be identified as forward pushing based on the forward acceleration trend. The forward assisting output power of the assisting apparatus gradually increases with the increase of speed and acceleration, to provide adaptive forward assisting, to meet the demand for continuous forward acceleration of the cleaning device. In the middle of stage ②, the forward speed of the cleaning device slows down (i.e., the acceleration does not change much), and the forward assisting output power of the assisting apparatus reaches the peak at this time. At the latter part of stage ②, the forward speed of the cleaning device slows down, and the reverse acceleration increases continuously (i.e., the speed is in the opposite direction of the acceleration). The forward assisting output power of the assisting apparatus gradually decreases with the continuous decrease of the forward speed, to reduce the output torque, and the forward speed of the cleaning device decreases accordingly.

[0072] In FIG. 10, the assisting apparatus does not provide assisting in stage ②, i.e., does not operate.

[0073] 1032. when the operation intention is forward pushing and stopping or backward pulling, if the movement information indicates that the cleaning device is in a forward pushing and advancing state, then controlling the assisting apparatus to output an adaptive backward assisting, to accelerate a forward deceleration of the cleaning device, based on the movement information.

[0074] Referring to stage ③ shown in FIG. 9, the movement trend of the cleaning device in this stage is forward pushing and stopping. In this stage ③, the assisting apparatus does not provide forward assisting, but turns to output backward assisting as shown in FIG. 10. When the forward speed of the cleaning device at the latter part of stage ② drops to the first threshold and there is a trend of continued deceleration, stage ③ is entered. In stage ③, the forward speed of the cleaning device slows down and the reverse acceleration reaches the maximum (that is, the absolute value of the acceleration reaches the maximum value). At this time, the operation intention of the user can be determined as forward pushing and stopping or backward pulling. That is, in stage ③, the controlling apparatus controls the assisting apparatus to output backward assisting, to intervene in advance to accelerate the forward deceleration of the cleaning device and make it drop to zero quickly. In stage ③, the backward assisting output power of the assisting apparatus is continuously increased, to continuously increase the backward assisting torque. After the speed of the cleaning device drops to zero, the stage ④ of forward stop is entered, which is a transition period for turning to enter backward advancing. In stage ④, the backward assisting output power of the assisting apparatus can be maintained at the same level as at the end of stage ③. In stage ④, the assisting provided by the backward assisting power output of the assisting apparatus to the rear wheel balances the forward power of the roller brush. For the convenience of the following description, the backward assisting output power of the assisting apparatus in stage ④ may be referred as the backward starting power. The backward assisting output power in stage ③ is less than the backward starting power.

[0075] 1033. when the operation intention is backward pulling, if the movement information indicates that the cleaning device is in a backward pulling and advancing state, then controlling the assisting apparatus to output an adaptive backward assisting, based on the movement information.

[0076] Refer to stage ⑤ shown in FIG. 10, at this time, the controlling apparatus controls the assisting apparatus to output an output power adapted to the speed and acceleration of the cleaning device in real time, to provide the cleaning device with a suitable assisting torque at each moment, thereby assisting the cleaning device to complete the movement of backward pulling and advancing. As shown in FIG. 10, in the front part of stage ⑤, the backward speed of the cleaning device continues to increase, and the acceleration of the backward speed also continues to increase. At this time, the assisting apparatus needs to continuously increase the backward assisting output power on the base of the backward starting output power of stage ④, to resist the forward power of the roller brush while providing assisting of backward acceleration for the rear wheel. Therefore, in the entire stage ⑤, compared with stage ② in FIG. 9, when the absolute values of speed and acceleration are the same or similar, the output power of the assisting apparatus in stage ⑤ is greater. In the middle of stage ⑤, the backward speed increases to the peak interval, and the acceleration rate of the backward speed slows down or is not large. At this time, the backward assisting output power of the assisting apparatus also reaches the peak. In the latter part of stage ⑤, the backward speed decreases and the acceleration of the backward speed increases in the opposite direction (that is, as shown in FIG. 10, the backward speed and acceleration are both negative values). At this time, the backward assisting output power of the assisting apparatus also decreases and returns to the backward starting power.

[0077] 1034. when the operation intention is backward pulling and stopping or forward pushing, if the movement information indicates that the cleaning device is in a backward pulling and advancing state, then controlling the assisting apparatus to output an adaptive forward assisting to accelerate a backward deceleration of the cleaning device, or controlling the assisting apparatus to stop operating to utilize a forward power of the roller brush to accelerate the backward deceleration of the cleaning device, based on the movement information.

[0078] Referring to stage ⑥ in FIG. 10, that is the backward pulling and stopping, the assisting apparatus outputs a backward starting power, to assist the rear wheel and balance the forward power of the roller brush, so that the cleaning device can be pulled back and stopped.

[0079] In this embodiment, FIG. 9 and FIG. 10 only show the process of the cleaning device from being pushed forward, pulled backward, to being pulled backward and stopped, and do not show the process of being pulled backward and then pushed forward. It can be understood that the backward pulling and advancing stage, i.e. stage ⑤, may include two sub-stages, such as the first sub-stage 51 corresponding to the tendency of backward advancing, and the second sub-stage 52 corresponding to the tendency of backward stop trend. In the second sub-stage 52, the controlling apparatus may control the assisting apparatus to output forward assisting to accelerate the backward speed reduction, to enable the cleaning device to quickly reduce the backward speed to zero and then turn to move forward. At each stage, the controlling apparatus can control the assisting apparatus in real time to operate at an adaptive output power based on the current movement information (movement direction, speed and acceleration) of the cleaning device, to output appropriate assisting and help the cleaning device complete the movement change.

[0080] 1035. when the operation intention is stopping at the spot, controlling the assisting apparatus to output a backward assisting adapted to a forward power of the roller brush, to balance the forward power of the roller brush.

[0081] As shown in stage ④ and stage ⑥ of FIG. 10, when the speed and acceleration of the cleaning device are zero, the assisting apparatus can be controlled to output a backward assisting that is balanced with the forward power of the roller brush, based on the forward power of the roller brush.

[0082] In another feasible technical solution, the step 103 of "controlling the assisting apparatus of the cleaning device to operate according to the operation intention and the movement information" in this embodiment includes:

1031', determining an assisting direction according to the operation intention;

1032', dynamically determining an output power of the assisting apparatus according to the movement information; and

1033', controlling the assisting apparatus of the cleaning device to operate in accordance with an assisting parameter; wherein the assisting parameter comprises the assisting direction and the output power.

[0083] Furthermore, the above step 1031' of determining an assisting direction according to the operation intention" includes at least one of the following:

when the operation intention is forward pushing, determining the assisting direction to be forward;

when the operation intention is to forward pushing and stopping, determining the assisting direction to be backward;

when the operation intention is backward pulling and stopping at the spot, determining the assisting direction to be forward;

when the operation intention is backward pulling, determining the assisting direction to be backward; and

when the operation intention is stopping at the spot, determining the assisting direction to be backward.

[0084] Accordingly, the step 1032' of "dynamically determining an output power of the assisting apparatus according to the movement information" includes: obtaining a calculation model; using the movement information as an input parameter of the calculation model, and executing the calculation model to obtain the output power; or obtaining a preconfigured correspondence table of movement information and output power, querying the output power corresponding to the movement information, or calculating the output power corresponding to the movement information by an interpolation algorithm.

[0085] The above calculation model can be derived based on actual measurement and data calculation process. The above correspondence table of movement information and output power can be obtained based on actual measurement data. For example, how the control parameter for controlling the assisting apparatus to operate by the controlling apparatus based on the cleaning device (i.e., the movement of the rear wheel) is obtained in this embodiment. One possible solution is to build a test system that connects the cleaning device to a computer or other device. The signal detected by the sensor provided at the rear wheel of the cleaning device can be uploaded to the computer, and the speed and acceleration curve diagram similar to that shown in FIG. 8 can be generated by computer processing. Testers can simulate the process of the user using cleaning device to clean, such as pushing the cleaning device forward, pulling the cleaning device backward, stopping at the spot, etc. For example, the sampling testers' actions at different pushing speeds of 0 to 1 m/s, and how much thrust is required for the cleaning device to move at speeds from 0 to 0.1 m/s can all be determined by the testers based on the currently measured data. The denser the sampling points, the more accurate the data will be. The experiment simulates a variety of push-pull scenarios, samples the speed and acceleration corresponding to multiple time points, and the torque required for the rear wheel is actually testing the required assisting. The purpose of the technical solution provided in this embodiment is to accurately perform assisting controlling when the user pushes forward or pulls backward so that the rear wheel moves 5 mm or less, and then causing the assisting wheel to output corresponding assisting, so that the user can hold the handle and push the cleaning device forward without exerting force.

[0086] Sensor at the rear wheel of the cleaning device can upload the collected signals to a computer. Of course, the higher the sensor's collecting frequency, the higher the accuracy of the data, which will help improve the accuracy of

subsequent determination of the power output of the assisting apparatus.

[0087] When the tester pushes the cleaning device, the rear wheel responds to the user's pushing by rotating accordingly. In other words, the photoelectric sensor at the rear wheel can detect the movement changes of the rear wheel in a timely manner. After obtaining a speed and acceleration curve similar to that shown in FIG. 8, the tester can determine the driving force required to be provided to the rear wheel to cause the cleaning device to move according to the speed and acceleration curve shown in FIG. 8. The driving force is the reference data for the controlling apparatus to control the assisting apparatus.

[0088] If the tester wants to push the stationary cleaning device forward, this forward pushing action will be directly reflected in the rotation of the rear wheel. If the cleaning device is to produce a movement similar to that shown in FIG. 8, the output power and assisting direction of the assisting apparatus can be derived, so that the assisting apparatus can operate according to an output power curve similar to that shown in FIG. 9 to dynamically output adaptive power to drive the rear wheel to rotate. It should be noted here that this embodiment does not specifically limit the testing and derivation process.

[0089] Furthermore, the operation intention of the user includes various intentions; at least some intentions of the various intentions are set as requiring assisting. In this embodiment, after the step 102 of "identifying the operation intention of the user operating the cleaning device", further includes:

judging whether the identified operation intention of the user is one of the at least some intentions being set as requiring assisting in the various intentions; if so, triggering the step of determining the determining assisting parameter according to the operation intention and the movement information. For example, forward pushing providing no assisting; other intentions such as stopping at the spot and pulling backward providing assisting.

1 movement trend	2 operation intention		3 assisting	4 assisting direction
5 forward advancing	6 forward pushing	7 forward pushing with acceleration	8 NO or YES	9 when YES, the assisting direction is forward
		10 forward pushing with deceleration		
11 forward stop trend	12 forward pushing and stopping or backward pulling		13 YES	14 backward
15 staying static	16 stopping at the spot		17 YES	18 backward
19 backward advancing	20 backward pulling	21 backward pulling with acceleration	22 YES	23 backward
		24 backward pulling with deceleration		
25 backward stop trend	26 backward pulling and stopping or forward pushing		27 NO or YES	28 when assisting, assisting direction is forward

[0090] In other feasible embodiments, the process of the cleaning device being pulled backward by the user does not require forward assisting. The reason is that the roller brush always has a forward rolling force, and this forward rolling force is a resistance to backward movement; secondly, when the user pulls back, the user's posture during use (such as the backward bending posture of the arm) will give the device a backward resistance. Therefore, in another embodiment of the present application, when the cleaning device backward advances, the assisting apparatus may not provide forward assisting. Specifically, as shown in FIG. 10, stage ⑤ is the backward pulling stage, and stage ⑥ is the backward pulling and stopping stage. During the entire backward pulling stage, the cleaning device provides the backward assisting. In the front part of stage ⑤, the backward speed of the cleaning device continues to increase, and the acceleration of the backward speed also continues to increase. At this time, the assisting apparatus needs to continuously increase the backward assisting output power on the base of the backward starting output power of stage ④, to resist the forward power of the roller brush while providing backward acceleration assistance to the rear wheel. Therefore, in the entire stage ⑤, compared with stage ② in FIG. 9, when the absolute values of speed and acceleration are the same or similar, the output power of the assisting apparatus in stage ⑤ is greater. In the middle part of stage ⑤, the backward speed increases to the peak interval, and the acceleration rate of the backward speed slows down or is not large. At this time, the backward assisting output power of the assisting apparatus also reaches the peak. In the latter part of stage ⑤, the backward speed decreases and the acceleration of the backward speed increases in the opposite direction (that is, as shown in FIG. 10, the backward speed and acceleration are both negative values). At this time, the backward assisting output power of the assisting apparatus also decreases and returns to the backward starting power. Subsequently, when the backward pulling

speed is reduced to zero, that is, when the backward pulling and stopping in stage ⑥, the assisting apparatus outputs backward starting power, to assist the rear wheel and balance the forward power of the roller brush, so that the cleaning device can be pulled backward and stopped. The backward assisting output power in stage ⑥ is greater than the backward starting power. At this time, the assisting scheme of the cleaning device is shown in the following table:

5

	29 movement trend	30 operation intention		31 as-sisting	32 assisting direction
10	33 forward advancing	34 forward pushing	35 forward pushing with acceleration	36 NO or YES	37 when assisting is YES, assisting direction is forward
			38 forward pushing with deceleration		
15	39 forward stop trend	40 forward pushing and stopping or backward pulling		41 YES	42 backward
	43 staying static	44 stopping at the spot		45 YES	46 backward
20	47 backward advancing	48 backward pulling	49 backward pulling with acceleration	50 YES	51 backward
			52 backward pulling with deceleration		

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FIG. 11 is a schematic flow chart showing the assisting method for the cleaning device provided in this embodiment. As shown in the drawings, the method includes:

201. obtaining a current movement state of the cleaning device;
 202. determining an assisting strategy adapted to the movement state;
 203. obtaining movement information of the cleaning device; and
 204. controlling an assisting apparatus of the cleaning device to operate, to provide assisting for a user operating the cleaning device, according to the movement information and the assisting strategy.

[0091] In the above 201, the movement state of the cleaning device may include but is not limited to: a forward pushing and advancing state, a backward pulling and advancing state, stopping at the spot state, etc. The movement state of the cleaning device can be detected by a sensor. For example, the cleaning device in this embodiment includes a floor brush, and the floor brush is provided with a rear wheel. The assisting apparatus provides assisting by driving the rear wheel. Accordingly, the above step 201 of "obtaining the current movement state of the cleaning device" includes:

2011. detecting a movement signal of the rear wheel by a sensor; and
 2012. determining the current movement state of the cleaning device according to the movement signal of the rear wheel;

where, the above step 2012 "determining the current movement state of the cleaning device according to the movement signal of the rear wheel" may include at least one of the following:

- when determining based on the detected movement signal that the rear wheel is forward advancing, the cleaning device is currently in a forward pushing and advancing state;
 when determining based on the detected movement signal that the rear wheel is backward advancing, the cleaning device is currently in a backward pulling and advancing state; and
 when determining based on the detected movement signal that the rear wheel is staying static, the cleaning device is currently in a stopping at the spot state.

[0092] In an achievable technical solution, the above step 203 of "obtaining the movement information of the cleaning device" includes:

2031. determining the movement direction and speed of the rear wheel based on the movement signal continuously detected by the sensor;

2032. calculating an acceleration of the rear wheel according to the speeds of the rear wheel corresponding to a plurality of consecutive moments;

where the movement information comprises: the movement direction, the speed, and the acceleration. The sensor may be a photoelectric sensor. For details about the setting method, movement direction measurement, speed calculation, and acceleration calculation of the photoelectric sensor, please refer to the corresponding contents above and will not be elaborated here.

[0093] In one case, as shown in FIG. 12, the assisting strategy determined in step 202 of this embodiment is adapted to the forward pushing and advancing state. Accordingly, the above step 204 of "controlling an assisting apparatus of the cleaning device to operate according to the movement information and the assisting strategy" includes:

2041. identifying whether the user operation causes the cleaning device to have a tendency of forward stop trend, according to the movement information;

2042. if there is a tendency of forward stop trend, controlling the assisting apparatus to output an adaptive backward assisting, to accelerate the deceleration of the forward speed of the cleaning device, based on the movement information; and

2043. if there is no tendency of forward stop trend, controlling the assisting apparatus to output an adaptive forward assisting or to stop operating, based on the movement information.

[0094] Furthermore, prior to the above step 2041 of "identifying whether the user operation causes the cleaning device to have a tendency of forward stop trend, according to the movement information" also includes:

S31, identifying whether the user operation has a tendency of backward pulling operation, according to the movement information;

S32. if there is a tendency of backward pulling operation, triggering the step of identifying whether the user operation causes the cleaning device to have a tendency of forward stop trend, according to the movement information (i.e., triggering the above step 2041);

S33. if there is no tendency of backward pulling operation, controlling the assisting apparatus to output an adaptive forward assisting or to stop operating according to the movement information.

[0095] More specifically, the movement information is the operation information of the rear wheel on the cleaning device. Accordingly, the process of identifying whether the user operation has a tendency of backward pulling operation in the above step S31 and step 2041 may adopt the following method, namely, "identifying whether the user operation has a tendency of backward pulling operation or identifying whether the user operation causes the cleaning device to have a tendency of backward stop trend, according to the movement information", which may include:

S41, analyzing the movement trend of the rear wheel according to the movement information;

S42. when analyzing that the rear wheel has a movement trend of a backward speed being decelerated and the rear wheel after the deceleration having a speed not less than a second threshold, identifying that the user operation has a tendency of backward pulling operation; or

S43. when analyzing that the rear wheel has a movement trend of a backward speed being less than the second threshold and being continuously decelerated toward zero or equal to zero, identifying that the user operation causes the cleaning device to have a tendency of backward stop trend.

[0096] In another case, as shown in FIG. 12, the assisting strategy determined in step 202 of this embodiment is adapted to the backward pulling state. Accordingly, the above step 204 of "controlling the assisting apparatus of the cleaning device to operate according to the movement information and the assisting strategy" includes:

2044. determining the assisting direction of the assisting apparatus being backward;

2045. dynamically determining the output power of the assisting apparatus based on the movement information; and

2046. controlling the assisting apparatus of the cleaning device to operate in accordance with the assisting parameter; wherein the assisting parameter comprises the assisting direction and the output power.

[0097] In another case, as shown in FIG. 12, the assisting strategy determined in step 202 of this embodiment is adapted to stopping at the spot state. Accordingly, the above step 204 of "controlling the assisting apparatus of the cleaning device to operate according to the movement information and the assisting strategy" includes:

2047. determining the assisting direction of the assisting apparatus being backward;

2048. obtaining a rotation speed of the roller brush of the cleaning device;
 2049. determining the output power of the assisting apparatus according to the rotation speed of the roller brush; and
 2050. controlling the assisting apparatus of the cleaning device to operate in accordance with the assisting parameter;
 where the assisting parameter comprises the assisting direction and the output power.

[0098] It should be noted here that: the specific implementation content of at least some steps in this embodiment can be found in the description of the above embodiments, that is to say, the content that is not fully explained in this embodiment can be understood through the above, and the repeated content will not be repeated here.

[0099] In summary, the design idea of the technical solutions provided in each embodiment of the present application is: actively identify the operation intention of the user, provide assisting to the cleaning device according to the operation intention of the user, so that the result directly reflected on the user's handle is: the force exerted by the user on the handle is very small or even zero.

[0100] In order to realize the above design idea, the inventor of the present application has designed a method using a sensor, the signal detected by the sensor can reflect the operation intention of the user and the movement state of the cleaning device, that is, as described above, a photoelectric sensor being arranged at the rear wheel of the cleaning device. Then, based on the signal detected by the sensor, the movement information of the cleaning device is determined, and the operation intention of the user can also be identified based on the movement information of the cleaning device; then, according to the operation intention of the user and current movement information, the assisting apparatus is controlled to output adaptive assisting, and the user's direct feeling is the effect of lightly holding the handle without exerting force to follow the movement of the cleaning device.

[0101] In order to demonstrate the effect of the technical solution provided in the embodiment of the present application, the following is an illustration through relevant data from the test. As in the test scenario mentioned above, in order to make the user experience more intuitive, the inventors set a pressure sensor on the handle of the cleaning device for sensing the user pushing and pulling the handle. A cleaning device with an active assisting function corresponding to the technical solution provided by an embodiment of the present application is tested, and the entire process from forward pushing, stopping to backward pulling is shown in FIG. 8. In a very short time (instantaneous) at the beginning of stage ②, the user applies a forward pushing force, and in the alternating period between stages ② and ③, the user applies a backward pulling force. From stages ① to ⑥, except for the first two places, the user's force in the remaining entire period is close to zero or even equal to zero. A second cleaning device may also be added during the test, but the second cleaning device does not have the active assisting function corresponding to the technical solution provided in the embodiment of the present application. The following is a comparison of the situations where the user needs to apply a larger push or pull force:

53	54 the second cleaning device (with no assisting)	55 the first cleaning device (with assisting)
56	57 the force applied by the user	58 the force applied by the user (N)
59 Stopping at the spot	60 $F_1 > 0$	61 0
62 pushing forward with an acceleration	63 $F_2 > F_1$	64 0.01
65 pulling backward with an acceleration	66 $ F_3 > F_1$	67 -0.002

[0102] The technical solutions provided in the above embodiments are based on the movement information of the cleaning device (more specifically, the rear wheel on the floor brush) to control the operation of the assisting apparatus, to provide appropriate assisting at the right time, making it easier and more labor-saving for users to use. In addition to controlling the operation of the assisting apparatus based on the movement information, the operation of the assisting apparatus may also be controlled according to the advancing distance of the cleaning device.

[0103] If the user finds that a certain place is dirty, the user may want to push and pull the machine back and forth to clean it. Typically, the user stands staying static, stretches their arm forward, pushes the cleaning device, and then pulls it back. Therefore, in this case, it is possible to determine whether the user intends to pull back based on the advancing distance of the cleaning device. That is, the present application also provides an embodiment, and the assisting method for the cleaning device described in this embodiment may include the following steps:

301. obtaining an advancing distance and an advancing direction of the cleaning device; and
 302. controlling the assisting apparatus to operate according to the advancing distance and the advancing direction, to

provide assisting for the user operating the cleaning device to operate.

[0104] The above step 302 may specifically include:

- 3021. if the advancing direction is forward, determine whether the advancing distance is within a first set range;
- 3022. if the advancing distance is within the first set range, controlling the assisting apparatus to output backward assisting, to assist the cleaning device to backward advance; and
- 3023. if the advancing distance is not within the first set range, the assisting apparatus does not operate.

[0105] The first set range may be set with reference to the user's arm length and/or stride length. For example, the length of an adult's arm is generally between 65cm and 75cm. When the user pushes the cleaning device forward, the cleaning device is tilted at a mostly about 45° angle. The farthest distance the user can reach by pushing the cleaning device forward at one time is between 46cm and 53cm. Alternatively, some users are accustomed to taking one step before pushing the cleaning device forward.

[0106] In this case, the first set range can be set with reference to 70% to 90% of the farthest distance the user can reach by pushing the cleaning device forward + 70% to 90% of the length of one step. The length of one step of an adult is generally between 50 and 80 cm. Therefore, the assisting apparatus can be controlled to output backward assisting, when the advancing distance of the cleaning device reaches between 65 and 120 cm. It should be noted that the above advancing distance is the distance between the roller brush of the cleaning device and the user. Of course, in an ideal situation, it can also be the distance that the roller brush of the cleaning device advancing forward. Alternatively, the above step 302 may specifically include:

- 3024. if the advancing direction is backward, determining whether the advancing distance is within a second set range;
- 3025. if the backward pulling distance is within the second set range, controlling the assisting apparatus to output the backward and forward assisting, to assist the cleaning device to stop the tendency of backward pulling; and
- 3026. if the backward pulling distance is not within the second set range, the assisting apparatus outputting backward assisting.

[0107] The second set range may also be set with reference to the user's arm length and/or stride length. When the user pulls the cleaning device backward, the cleaning device is tilted at a mostly about 45° angle. The user pulls back the cleaning device that has been pushed forward to the farthest distance. Alternatively, some users are accustomed to taking one step back while pulling back. The above second set range can be designed with reference to 70% to 90% of pulling back the cleaning device at the farthest distance + 70% to 90% of the length of one step. Therefore, the assisting apparatus can be controlled to output forward assisting, when the cleaning device is pulled back to a distance between 65 and 120 cm. The above backward pulling distance is the distance that the cleaning device advances backward.

[0108] In another embodiment, the above step 302 may further include:

- 3027. if the advancing direction is backward, determining whether the advancing distance is within a second set range;
- 3028. if the backward pulling distance is within the second set range, the assisting apparatus being controlled not to operate;
- 3029. if the backward pulling distance is not within the second set range, the assisting apparatus outputting backward assisting.

[0109] In yet another embodiment, the above step 302 may further include:

3030. if the advancing direction is backward, controlling the assisting apparatus to output backward assisting.

[0110] Furthermore, the cleaning device in the embodiment of the present application has machine learning capabilities and can determine the above set range by collecting parameter of the user's daily usage habit. For example, the set range is determined by collecting the user's forward pushing distance in one or several forward pushing and pulling operations, and then the above set range is determined based on the one or several recorded forward pushing distances.

[0111] The following describes the effects of the technical solutions provided in various embodiments of the present application in combination with some application scenarios.

Scenario one

[0112] The user holds the handle of the cleaning device to clean the floor at home. The user pushes the cleaning device forward, and due to the forward power of the roller brush, the user can push the cleaning device to move around the house to clean the floor without any effort. When cleaning the kitchen, the user found that there was a dirty spot on the floor, so the user pulls the cleaning device backward. At this time, the rear wheel of the cleaning device responds promptly to the user's

pulling backward operation, and there is a tendency of slowing down. When the controlling apparatus of the cleaning device determines the user wants to pull the cleaning device backward based on the signal detected by the photoelectric sensor at the rear wheel that, the assisting apparatus is then controlled to start outputting backward assisting, to accelerate the forward speed of the rear wheel to zero and then to drive the rear wheel to backward advance. The user only needs to pull the cleaning device lightly, and the cleaning device will backward advance autonomously with the assist of the assisting apparatus. The user can complete the backward pulling without any effort. This process is labor-saving and convenient, and the operation is very flexible and eased.

Scenario two

[0113] The user holds the handle of the cleaning device and pushes the cleaning device to clean the carpet. When the user pushes the cleaning device forward, the user only needs to push the cleaning device lightly, and the controlling apparatus will be able to identify the user's intention to push forward based on the signal detected by the photoelectric sensor at the rear wheel. Then, the controlling apparatus controls the assisting apparatus to output forward thrust, to drive the rear wheel to forward advance, and the user only needs to lightly hold the handle to follow the cleaning device.

[0114] FIG. 1 is a schematic diagram of a cleaning device in an upright posture provided by an embodiment of the present application. As shown in FIG. 1, the cleaning device includes: a machine body 2, a handle 1, an assisting apparatus (i.e., a rear wheel 4, where the rear wheel 4 is an assisting wheel), and a controlling apparatus (not shown in the drawings). The machine body 2 is provided with a floor brush 3, and the floor brush 3 is provided with a roller brush 5 and a rear wheel 4. The handle 1 can be arranged on the machine body 2 by an extension rod. The user can operate the roller brush 5 of the cleaning device by the handle 1, to push or pull the cleaning device to move, so that the cleaning device cleans the cleaning surface it moves over. The assisting apparatus is used to output assisting to provide assisting to the user. The controlling apparatus is provided on the machine body 2 or the floor brush 3 and is electrically connected to the assisting apparatus, to implement the cleaning device control method described later, thereby ensuring that the assisting apparatus operates normally, avoiding waste of resources, and improving user experience.

[0115] As shown in FIG. 13, it is a schematic diagram of an implementation flow of a cleaning device control method provided by an embodiment of the present application. The method is applied to cleaning device (such as a floor scrubber or a carpet cleaning machine), and specifically may include the following steps:

S201, obtaining an operating parameter of an assisting apparatus in the cleaning device.

[0116] In an embodiment of the present application, an assisting apparatus is provided for the cleaning device, and the assisting apparatus may be an assisting wheel. There are usually two assisting apparatuses. For example, for a floor scrubber, two assisting wheels, a left assisting wheel and a right assisting wheel, are provided. Each assisting wheel includes a rear wheel and a driving mechanism, and the two assisting wheels are driven separately. The driving mechanism of the assisting wheel is a driving motor, which drives the rear wheel to rotate forward or reverse, so that when the user pushes or pulls the cleaning device forward or backward for cleaning, the user's pushing and pulling force can be reduced, thereby providing assisting for the user's cleaning operation. The assisting apparatus controls the speed of rear wheel rotation by controlling the output power of the driving motor, thereby controlling the amount of rear wheel assisting. In this embodiment, the rear wheel 4 shown in FIG. 1 is an assisting wheel.

[0117] Based on this, the embodiment of the present application obtains the operating parameter of the assisting apparatus in the cleaning device, where the assisting apparatus can be any assisting apparatus in the cleaning device. For example, the operating parameter of any one of the two assisting wheels, the left assisting wheel and the right assisting wheel, in the floor scrubber are obtained. The operating parameter decied here is related parameter generated by the assisting wheel during its operating process.

[0118] S202: identifying the state of the assisting apparatus according to the operating parameter.

[0119] In the embodiment of the present application, with respect to the operating parameter of the assisting apparatus in the cleaning device, the state of the assisting apparatus can be identified by the operating parameter. The state here may include a normal operating state, a slipping state, or a suspended state, which is not limited in the embodiment of the present application.

[0120] For example, with respect to the operating parameter of the assisting wheel in the floor scrubber, the state of the assisting wheel in the floor scrubber can be identified by the operating parameter. Here, the assisting wheel may be in a normal operating state, may be in a slipping state, or may be in a suspended state, and the embodiments of the present application are not limited to this.

[0121] S203: adjusting the output power of the assisting apparatus based on the state of the assisting apparatus.

[0122] In the embodiment of the present application, with respect to the state of the assisting apparatus in the cleaning device, the output power of the assisting apparatus can be adjusted based on the state of the assisting apparatus. This ensures that the assisting apparatus operates normally, avoids waste of resources, and improves user experience. If the assisting apparatus is in a normal operating state, the output power of the assisting apparatus is maintained; if the assisting apparatus is in a slipping or suspended state, the output power of the assisting apparatus is reduced. This ensures that the

assisting apparatus operates properly, avoids waste of resources, and improves user experience. Here, adjusting the output power of the assisting apparatus is adjusting the output power of the driving motor of the rear wheel.

[0123] For example, if the assisting wheel in the floor scrubber is in a normal operating state, the output power of the assisting wheel is maintained; if the assisting wheel in the floor scrubber is in a slipping or suspended state, the output power of the assisting wheel is reduced. This ensures that the assisting wheels operates normally, avoids waste of resources, and improves user experience.

[0124] By the above description of the technical solution provided by the embodiment of the present application, the operating parameter of the assisting apparatus in the cleaning device is obtained, the state of the assisting apparatus is identified by the operating parameter, and the output power of the assisting apparatus is adjusted based on the state of the assisting apparatus.

[0125] By obtaining the operating parameter of the assisting apparatus in the cleaning device and identifying the state of the assisting apparatus by the operating parameter, the output power of the assisting apparatus can be adjusted, thereby ensuring that the assisting apparatus operates normally, avoiding waste of resources, and improving user experience.

[0126] FIG. 14 is a schematic diagram of an implementation flow of another cleaning device control method provided by an embodiment of the present application. As shown, the method is applied to cleaning device (such as a floor scrubber, a carpet cleaning machine), and specifically may include the following steps:

S301, obtaining a speed and an acceleration of the assisting apparatus in the cleaning device.

[0127] In an embodiment of the present application, a cleaning device, such as a floor scrubber, includes a photoelectric sensor, and the floor brush is provided with an assisting rear wheel. The photoelectric sensor is provided on the assisting rear wheel to detect the speed of the rear wheel. The speed of the rear wheel is the speed of the assisting wheel, and the acceleration of the assisting wheel is calculated based on the speed of the assisting wheel.

[0128] The driving mechanism of the assisting wheel (assisting apparatus 7) can generally be a motor, and the first output shaft of the motor is connected to the high-speed end of the deceleration mechanism 8, and the rear wheel 4 is connected to the low-speed end of the deceleration mechanism. The photoelectric sensor 6 can be provided on the output shaft side of the motor, and the photoelectric sensor 6 generally includes a transmitter 62, a receiver 63, and a photoelectric code disk 61, as shown in FIG. 5a.

[0129] There are light-transmitting areas and non-light-transmitting areas evenly distributed along the whole circumference of the grating code disk. The transmitter and the receiver are provided opposite to each other on two sides of the grating code disk. The grating code disk rotates simultaneously with the rear wheel, but the rotation speed of the grating code disk is higher than that of the rear wheel.

[0130] During the process of the grating code disk 61 and the rear wheel rotating simultaneously, the light signal emitted by the transmitter is blocked when encountering the non-light-transmitting area, and reaches the receiver when encountering the light-transmitting area. The receiver receives the light signal emitted by the transmitter and generates a pulse signal, thereby calculating the speed of the rear wheel, that is, the speed of the assisting wheel, based on the pulse signal.

[0131] For example, within M seconds, the number of pulses generated is X, where the grating code disk generates 40 pulses in one rotation, and the deceleration ratio (or transmission ratio) between the grating code disk and the rear wheel is N. Assuming $N=1/26$, the circumference of the rear wheel is D, then the speed V of the rear wheel can be calculated by the following formula.

$$\frac{\frac{X}{40} * \frac{1}{26} * D}{M} = V$$

[0132] Based on this, in an embodiment of the present application, the speed of the assisting apparatus in the cleaning device can be calculated by the photoelectric sensor, and then the acceleration of the assisting apparatus can be calculated by the speed of the assisting apparatus, to obtain the speed and acceleration of the assisting apparatus in the cleaning device.

[0133] For example, the speed of the assisting rear wheel of the cleaning device, that is, the speed of the assisting wheel, is calculated by the photoelectric sensor, and then the acceleration of the assisting wheel is calculated based on the speed of the assisting wheel, to obtain the speed and acceleration of the assisting wheel in the floor scrubber.

[0134] S302: identifying the state of the assisting apparatus according to the speed and the acceleration.

[0135] In the embodiment of the present application, the speed and acceleration of the assisting apparatus can be used to identify the state of the assisting apparatus. For example, with respect to the speed and acceleration of the assisting wheel, the state of the assisting wheel can be identified by the speed and acceleration of the assisting wheel.

[0136] FIG. 15 is a schematic diagram of an implementation flow of a method for identifying the state of an assisting apparatus provided by an embodiment of the present application. As shown, the method is applied to a cleaning device and

may specifically include the following steps:

S501, determining an acceleration dispersion degree corresponding to the acceleration according to a preset acceleration dispersion degree determination cycle.

[0137] In the embodiment of the present application, an acceleration dispersion degree determination cycle may be set in advance, for example, 100 ms, which means that the acceleration dispersion degree corresponding to the acceleration is determined once every 100 ms.

[0138] Therefore, the acceleration dispersion degree corresponding to the acceleration of the assisting apparatus can be determined according to the acceleration dispersion degree determination cycle.

[0139] The acceleration dispersion degree represents the degree of acceleration dispersion, and the variance is usually used to represent the acceleration dispersion degree.

[0140] Specifically, as shown in FIG. 16, it is a schematic diagram of an implementation flow of a method for determining acceleration dispersion degree provided by an embodiment of the present application. The method may specifically include the following steps:

S601, obtaining an acceleration variance corresponding to the acceleration within the acceleration dispersion degree determination cycle according to the preset acceleration dispersion degree determination cycle.

[0141] In the embodiment of the present application, obtaining an acceleration variance corresponding to the acceleration within the acceleration dispersion degree determination cycle according to the preset acceleration dispersion degree determination cycle means that the acceleration within the acceleration dispersion degree determination cycle participates in the calculation of the acceleration variance. The specific method for calculating the variance may refer to the existing method, and the embodiments of the present application will not be described in detail here.

[0142] For example, the embodiment of the present application obtains the acceleration variance corresponding to the acceleration once every 100 ms, wherein what is obtained is the acceleration variance corresponding to the acceleration within this 100 ms, which means that the corresponding acceleration variance is calculated from the acceleration within this 100 ms, so that an acceleration variance can be obtained every 100 ms.

[0143] S602: determining the acceleration variance as the acceleration dispersion degree of the acceleration within the acceleration dispersion degree determination cycle.

[0144] In the embodiment of the present application, with respect to the acceleration variance corresponding to the acceleration, the acceleration variance may be determined as the acceleration dispersion degree of the acceleration within the acceleration dispersion degree determination cycle.

[0145] For example, every 100 ms, the acceleration variance corresponding to the acceleration within this 100 ms is obtained, and the acceleration variance is determined as the acceleration dispersion degree of the acceleration within this 100 ms.

[0146] S502, judging whether the acceleration dispersion degree is less than a preset first dispersion degree threshold, and judging whether the speed is more than a preset speed threshold.

[0147] In the embodiment of the present application, the acceleration dispersion is characterized by the variance, thereby judging whether the acceleration dispersion degree is less than a preset first dispersion degree threshold. In addition, it can also be judged whether the speed is greater than a preset speed threshold. Therefore, the state of the assisting apparatus can be identified based on the above two judgment results.

[0148] S503: if the acceleration dispersion degree is less than the preset first dispersion degree threshold and the speed is more than the preset speed threshold, identifying the assisting apparatus being in a slipping or suspended state.

[0149] In an embodiment of the present application, if the acceleration dispersion degree is less than the preset first dispersion degree threshold, and the speed is more than the preset speed threshold, it means that the acceleration dispersion degree of the assisting apparatus is relatively low, the acceleration is basically maintained at around a certain value, and the speed is relatively high (because when the assisting wheel slips or is suspended, the assisting is still here, but the ground resistance is reduced, and the assisting wheel speed will increase). This can identify that the assisting apparatus is in a slipping or suspended state, otherwise the assisting apparatus is in a normal operating state.

[0150] In addition, FIG. 17 is a schematic diagram of an implementation flow of another method for identifying the state of an assisting apparatus provided by an embodiment of the present application. As shown, the method is applied to a cleaning device and may specifically include the following steps:

S701, obtaining an acceleration difference between the acceleration and a preset acceleration threshold.

[0151] In the embodiment of the present application, an acceleration threshold may be set in advance, so that the acceleration of the assisting apparatus may be compared with the acceleration threshold to obtain an acceleration difference between the acceleration and the acceleration threshold.

[0152] For example, the acceleration threshold may be set in advance to 0, and the acceleration of the assisting wheel in the floor scrubber may be compared with the acceleration threshold, to obtain the acceleration difference between the acceleration and the acceleration threshold.

[0153] S702: judging whether the acceleration difference is within a preset acceleration error range.

[0154] In the embodiment of the present application, an acceleration error range may be set in advance, so that with

respect to the acceleration difference between the acceleration and the acceleration threshold, it may be judged whether the acceleration difference is within the acceleration error range. In addition, it can also be judged whether the speed of the assisting apparatus is more than a preset speed threshold.

[0155] For example, based on actual measurements, an acceleration error range (0 to 0.084) may be set in advance, so that with respect to the acceleration difference between the acceleration and the acceleration threshold, it can be judged whether the acceleration difference is within the acceleration error range, which is actually to judge whether the acceleration is close to 0. In addition, it is judged whether the speed of the assisting wheel is more than a certain speed threshold. In this embodiment, the acceleration error range may be 1 to 2 units of speed resolution. According to the above calculation formula for calculating the rear wheel speed V , the speed resolution may be obtained. Here, the speed resolution is 0.042.

[0156] S703: if the acceleration difference is within the preset acceleration error range, identifying that the assisting apparatus is in a slipping or suspended state.

[0157] In the embodiment of the present application, if the acceleration difference is within the preset acceleration error range, it can be identified that the assisting apparatus is in a slipping or suspended state; otherwise, it can be identified that the assisting apparatus is in a normal operating state.

[0158] In addition, if the acceleration difference is within the preset acceleration error range, it is further determined whether the speed of the assisting apparatus is more than the preset speed threshold. If the speed is more than the preset speed threshold, it can be identified that the assisting apparatus is in a slipping or suspended state; otherwise, it is identified that the assisting apparatus is in a normal operating state.

[0159] For example, if the acceleration difference is within the range of 0 to 0.084, it means that the acceleration is close to 0 and the speed of the assisting wheel is more than the speed threshold. At this time, it can be identified that the assisting wheel is in a slipping or suspended state. Otherwise, it is identified that the assisting wheel is in a normal operating state.

[0160] In addition, due to the existence of unexpected situations, the acceleration difference is within the preset acceleration error range at a certain moment. At this time, the assisting apparatus is identified as being in a slipping or suspended state. However, the actual situation may be that the assisting apparatus is in a normal operating state, which causes the misidentification of the state of the assisting apparatus.

[0161] To this end, in order to solve the problem of misidentification of the state of the assisting apparatus, the embodiment of the present application can count the duration of the acceleration difference being within a preset acceleration error range. If the duration exceeds a certain threshold and the speed of the assisting apparatus is more than a certain threshold, it can be identified that the assisting apparatus is in a slipping or suspended state; otherwise, it can be identified that the assisting wheel is in a normal operating state.

[0162] Specifically, FIG. 18 is a schematic diagram of an implementation flow of another method for identifying the state of an assisting apparatus provided by an embodiment of the present application. As shown, the method is applied to a cleaning device (such as a carpet cleaning machine), and specifically may include the following steps:

S801: if the acceleration difference is within the preset acceleration error range, counting a first duration during which the acceleration difference is within the preset acceleration error range.

[0163] In the embodiment of the present application, if the acceleration difference is within the preset acceleration error range, a first duration during which the acceleration difference is within the preset acceleration error range is counted.

[0164] For example, if the acceleration difference is within the preset acceleration error range (0-0.084), the first duration T1 during which the acceleration difference is within the range of 0-0.084 is counted.

[0165] S802: judging whether the first duration reaches a preset first duration threshold.

[0166] In the embodiment of the present application, according to actual conditions, a first duration threshold may be set in advance to judge whether the first duration reaches the first duration threshold.

[0167] For example, according to actual conditions, a first duration threshold of 200 ms is preset to judge whether the first duration T1 reaches 200 ms.

[0168] S803: if the first duration reaches the preset first duration threshold, identifying the assisting apparatus being in a slipping or suspended state.

[0169] In the embodiment of the present application, if the first duration reaches a preset first duration threshold, it can be identified that the assisting apparatus is in a slipping or suspended state; otherwise, it can be identified that the assisting apparatus is in a normal operating state.

[0170] In addition, if the first duration reaches a preset first duration threshold, it is further judged whether the speed of the assisting apparatus is more than the preset speed threshold. If the speed is more than the preset speed threshold, it can be identified that the assisting apparatus is in a slipping or suspended state; otherwise, it can be identified that the assisting apparatus is in a normal operating state.

[0171] For example, if the first duration T1 reaches 200 ms and the speed of the assisting wheel is more than a certain threshold, it means that the acceleration of the assisting wheel is close to 0 and is maintained for 200 ms. At this time, it can be identified that the assisting wheel is in a slipping or suspended state. Otherwise, it can be identified that the assisting wheel is in a normal operating state.

[0172] S303: adjusting the output power of the assisting apparatus based on the state of the assisting apparatus.

[0173] In the embodiment of the present application, with respect to the state of the assisting apparatus in the cleaning device, the output power of the assisting apparatus can be adjusted based on the state of the assisting apparatus. This ensures that the assisting apparatus operates normally, avoids waste of resources, and improves user experience. FIG. 19 is a schematic diagram of an implementation flow of another cleaning device control method provided by an embodiment of the present application. As shown the method is applied to a cleaning device and may specifically include the following steps:

S901, obtaining an operating current of the assisting apparatus in the cleaning device.

[0174] In the embodiment of the present application, a cleaning device, such as a floor scrubber, is generally provided with a current sampling circuit, which is used to detect the operating current of the assisting wheel. Therefore, the operating current of the assisting apparatus in the cleaning device can be obtained through the current sampling circuit.

[0175] It should be noted that, with respect to the current sampling circuit, reference may be made to the existing current sampling circuit, and the embodiments of the present application will not be described in detail here.

[0176] S902: identifying the state of the assisting apparatus by the operating current.

[0177] In the embodiment of the present application, the state of the assisting apparatus can be identified by the operating current of the assisting apparatus. For example, with respect to the operating current of the assisting wheel, the state of the assisting wheel can be identified by the operating current of the assisting wheel.

[0178] FIG. 20 is a schematic diagram of an implementation flow of a method for identifying the state of an assisting apparatus provided by an embodiment of the present application. As shown the method is applied to a cleaning device and may specifically include the following steps:

S1001, determining the current dispersion degree corresponding to the operating current according to a preset current dispersion degree determination cycle.

[0179] In the embodiment of the present application, a current dispersion degree determination cycle may be set in advance, for example, 100 ms, which means that the current dispersion degree corresponding to the operating current is determined once every 100 ms.

[0180] Therefore, the cycle can be determined according to the preset current dispersion degree, and the current dispersion corresponding to the operating current can be determined.

[0181] The current dispersion degree represents the degree of dispersion of the operating current, and the variance is usually used to represent the current dispersion degree.

[0182] Specifically, FIG. 21 is a schematic diagram of an implementation flow of a method for determining current dispersion degree provided by an embodiment of the present application. As shown, the method is applied to a cleaning device and may specifically include the following steps:

S1101, obtaining a current variance corresponding to the operating current within the current dispersion degree determination cycle according to a preset current dispersion degree determination cycle.

[0183] In the embodiment of the present application, the current variance corresponding to the operating current in the current dispersion degree determination cycle is obtained, in accordance with the preset current dispersion degree determination cycle, which means that the operating current in the current dispersion degree determination cycle participates in the calculation of the current variance. The specific method for calculating the local difference may refer to the existing method, and the embodiments of the present application will not be described in detail here.

[0184] For example, the embodiment of the present application obtains the current variance corresponding to the operating current once every 100 ms, wherein what is obtained is the current variance of the operating current within this 100 ms, which means that the corresponding current variance is calculated from the operating current within this 100 ms, so that a current variance can be obtained every 100 ms.

[0185] S1102, determining the current variance as the current dispersion degree corresponding to the operating current within the current dispersion degree determination cycle.

[0186] In the embodiment of the present application, for the current variance corresponding to the operating current, the current variance may be determined as the current dispersion corresponding to the operating current within the current dispersion degree determination cycle.

[0187] For example, every 100 ms, the current variance corresponding to the operating current within this 100 ms is obtained, and the current variance is determined to be the current dispersion degree corresponding to the operating current within this 100 ms.

[0188] S1002, judging whether the current dispersion degree is less than a preset second dispersion degree threshold.

[0189] In the embodiment of the present application, the current dispersion is characterized by variance, thereby judging whether the current dispersion is lower than a preset second dispersion degree threshold, and thereby identifying the state of the assisting apparatus based on the determination result.

[0190] S1003: if the current dispersion degree is less than the preset second dispersion degree threshold, identifying the assisting apparatus being in a slipping or suspended state.

[0191] In an embodiment of the present application, if the current dispersion is less than the preset second dispersion

degree threshold, it means that the operating current dispersion degree of the assisting apparatus is low, and the operating current is basically maintained at around a certain value, thereby identifying that the assisting apparatus is in a slipping or suspended state, otherwise the assisting apparatus is in a normal operating state.

[0192] In addition, FIG. 22 is a schematic diagram of an implementation flow of another method for identifying the state of an assisting apparatus provided by an embodiment of the present application. As shown, the method is applied to a cleaning device and may specifically include the following steps:

S1201, obtaining a current difference between the operating current and a preset current threshold, and judging whether the current difference is within a preset current error range.

[0193] In the embodiment of the present application, a current threshold may be set in advance, so that the operating current of the assisting apparatus may be compared with the current threshold to obtain the current difference between the operating current and the current threshold.

[0194] For example, the current threshold may be set in advance to 0, and the operating current of the assisting wheel in the floor scrubber may be compared with the current threshold to obtain the current difference between the operating current and the current threshold.

[0195] In addition, in the embodiment of the present application, a current error range may be set in advance, so that with respect to the current difference between the operating current and the current threshold, it may be determined whether the current difference is within the current error range.

[0196] For example, according to actual measurements, a current error range (0-N, N is a very small value) may be set in advance, so that with respect to the current difference between the operating current and the current threshold, it can be judged whether the current difference is within this current error range, which is actually to determine whether the operating current is close to 0.

[0197] S 1202: if the current difference is within the preset current error range, identifying the assisting apparatus being in a slipping or suspended state.

[0198] In the embodiment of the present application, if the current difference is within the preset current error range, it can be identified that the assisting apparatus is in a slipping or suspended state; otherwise, it can be identified that the assisting apparatus is in a normal operating state.

[0199] For example, if the current difference is within the range of 0 to N (N is a very small value), it means that the operating current is close to 0. At this time, it can be identified that the assisting wheel is in a slipping or suspended state. Otherwise, it can be identified that the assisting wheel is in a normal operating state.

[0200] In addition, due to the existence of unexpected situations, the operating current difference at a certain moment is within the preset current error range. At this time, the assisting apparatus is identified as being in a slipping or suspended state. However, the actual situation may be that the assisting apparatus is in a normal operating state, which causes the misidentification of the state of the assisting apparatus.

[0201] To this end, in order to solve the problem of misidentification of the state of the assisting apparatus, the embodiment of the present application can count the duration of the current difference being within a preset current error range. If the duration exceeds a certain threshold, it can be identified that the assisting apparatus is in a slipping or suspended state; otherwise, it is identified that the assisting wheel is in a normal operating state.

[0202] Specifically, FIG. 23 is a schematic diagram of an implementation flow of another method for identifying the state of an assisting apparatus provided by an embodiment of the present application. As shown, the method is applied to a cleaning device and may specifically include the following steps:

S1301: if the current difference is within the preset current error range, counting a second duration during which the current difference is within the preset current error range.

[0203] In the embodiment of the present application, if the current difference is within the preset current error range, a second duration of the current difference being within the preset current error range is counted.

[0204] For example, if the current difference is within the preset current error range, then the second duration T2 during which the current difference is within the preset current error range is counted.

[0205] S1302: judging whether the second duration reaches a preset second duration threshold.

[0206] In the embodiment of the present application, according to actual conditions, a second duration threshold may be set in advance to judge whether the second duration reaches the second duration threshold.

[0207] For example, according to actual conditions, a second duration threshold of 200 ms is set in advance to judge whether the second duration T2 reaches 200 ms.

[0208] S1303: if the second duration reaches the preset second duration threshold, identifying the assisting apparatus being in a slipping or suspended state.

[0209] In the embodiment of the present application, if the second duration reaches a preset second duration threshold, it can be identified that the assisting apparatus is in a slipping or suspended state; otherwise, it can be identified that the assisting apparatus is in a normal operating state.

[0210] For example, if the second duration T2 reaches 200 ms, it means that the operating current of the assisting wheel is close to 0 and is maintained for 200 ms. At this time, it can be identified that the assisting wheel is in a slipping or

suspended state. Otherwise, it can be identified that the assisting wheel is in a normal operating state.

[0211] S903: adjusting the output power of the assisting apparatus based on the state of the assisting apparatus.

[0212] In the embodiment of the present application, with respect to the state of the assisting apparatus in the cleaning device, the output power of the assisting apparatus can be adjusted based on the state of the assisting apparatus. This ensures that the assisting apparatus operates normally, avoids waste of resources, and improves user experience. FIG. 24 is a schematic diagram of an implementation flow of another cleaning device control method provided by an embodiment of the present application. As shown, the method is applied to a cleaning device and may specifically include the following steps:

S1401, obtaining the operating parameter of the assisting apparatus in the cleaning device.

[0213] In an embodiment of the present application, the operating parameter of the assisting apparatus in the cleaning device is obtained, the operating parameter described here may be speed and acceleration, or may be operating current.

[0214] S1402: identifying the state of the assisting apparatus by using the operating parameter.

[0215] In the embodiment of the present application, the operating parameter of the assisting apparatus in the cleaning device may be speed and acceleration, or may be operating current, so that the state of the assisting apparatus can be identified by the operating parameter.

[0216] S1403: if the assisting apparatus being in a slipping or suspended state, adjusting the assisting apparatus to reverse, and reducing the output power of the assisting apparatus to cause the speed of the cleaning device being zero.

[0217] In an embodiment of the present application, with respect to the state of the assisting apparatus in the cleaning device, if the assisting apparatus is in a normal operating state, the output power of the assisting apparatus can be maintained; if the assisting apparatus is in a slipping or suspended state, the output power of the assisting apparatus needs to be adjusted.

[0218] If the assisting apparatus is in a slipping or suspended state, it is necessary to reduce the output power of the assisting apparatus. Before this, the assisting apparatus needs to be adjusted to reverse, for example, the assisting wheel in the floor scrubber needs to be adjusted to reverse. In this way, the assisting apparatus is adjusted to reverse and the output power of the assisting apparatus is reduced, so that the speed of the floor scrubber can be reduced to 0. The output power of the assisting apparatus can be reduced according to a target ratio.

[0219] For example, if the assisting wheel in the floor scrubber is in a slipping or suspended state, the assisting wheel will be adjusted to reverse. At this time, the output power of the assisting wheel is reduced by 25% of the maximum output power of the assisting wheel, which means that the output power of the assisting wheel is reduced to 25% of the maximum output power. At this time, the force of this output power on the assisting wheel and the forward force generated by the rotation of the roller brush offset each other, so that the speed of the floor scrubber can be reduced to 0, that is, the floor scrubber remains stationary.

[0220] Taking the example of the assisting wheel being suspended in the air, when the floor scrubber is in operation, after the user lifts the floor scrubber, the rotation of the roller brush exerts a forward force on the floor scrubber. At this time, the assisting wheel is driven to reverse, and the force of the driving power on the rear wheel and the forward force generated by the rotation of the roller brush offset each other, so that the speed of the floor scrubber can be reduced to 0. In this way, after the user puts down the floor scrubber, the user can avoid feeling uncomfortable, for example, avoiding the floor scrubber from suddenly driving the user forward, thereby improving the user experience.

[0221] Based on this, as shown in FIG. 25, it is a schematic diagram of an implementation flow of a method for reducing the output power of an assisting apparatus provided by an embodiment of the present application. The method is applied to a cleaning device and may specifically include the following steps:

S 1501, determining a force generated by a movement of the roller brush, and searching a ratio corresponding to the force generated by the movement of the roller brush, wherein the ratio comprises a maximum output power ratio of the assisting apparatus.

[0222] In the embodiment of the present application, during the use of the floor scrubber, the rotation of the roller brush will generate a forward or backward force, and this force can be obtained by actual measurement, thereby determining the force generated by the movement of the roller brush. Alternatively, the acceleration a of the roller brush may be determined, and the weight m of the roller brush may be obtained. The force generated by the movement of the roller brush may be calculated using the calculation formula $F=m*a$.

[0223] In addition, in an embodiment of the present application, there is a corresponding ratio for the different forces generated by the roller brush movement. The ratio here is the maximum output power ratio of the assisting apparatus, which means that the force generated by the roller brush movement corresponds one-to-one to the maximum output power ratio of the assisting apparatus, as shown in Table 1 below.

force generated by the roller brush movement	maximum output power ratio of the assisting apparatus
F1	25%
F2	30%

(continued)

force generated by the roller brush movement	maximum output power ratio of the assisting apparatus
.....	

[0224] Therefore, in the embodiment of the present application, the ratio corresponding to the force generated by the movement of the roller brush is queried. For example, as shown in Table 1 above, for the force F₁ generated by the movement of the roller brush, the maximum output power ratio of the assisting wheel corresponding to F₁, 25%, can be queried.

[0225] S 1502: determining the ratio as a target ratio, and reducing the output power of the assisting apparatus according to the target ratio.

[0226] In an embodiment of the present application, the above ratio is determined as a target ratio, thereby reducing the output power of the assisting apparatus according to the target ratio, to avoid discomfort to the user when the assisting apparatus operates normally later, thereby improving the user experience.

[0227] For example, reducing the output power of the assisting wheel by 25% of the maximum output power of the assisting wheel means reducing the output power of the assisting wheel to 25% of the maximum output power. In this way, the force generated by driving the rear wheel to reverse can offset the forward force generated by the rotation of the roller brush, avoiding discomfort to the user.

[0228] S1404: if the assisting apparatus is not in a slipping or suspended state, maintaining the output power of the assisting apparatus.

[0229] In the embodiment of the present application, if the assisting apparatus is not in a slipping or suspended state, it means that the assisting apparatus is in a normal operating state, and the output power of the assisting apparatus can be maintained at this time.

[0230] In addition, if the assisting apparatus is in a slipping or suspended state, the driving current of the roller brush will also become smaller. However, there are many factors that lead to the decrease in this current. In addition to the assisting apparatus being in a slipping or suspended state, which causes the current to decrease, there are other factors, such as the roller brush not being installed or the roller brush being used for too long and the bristles becoming pliable. This may cause misjudgment, such as the roller brush not being installed or the roller brush being used for too long and the bristles becoming pliable.

[0231] If the roller brush is not installed, it will usually be detected when the machine is turned on. If the roller brush has been used for too long and the bristles have become pliable, it will usually be detected when the machine is turned on. This means that if the driving current of the roller brush is detected to be smaller after the cleaning device has been running for a period of time, it is most likely not caused by factors such as the roller brush not being installed or the bristles having become pliable due to use for too long, but caused by the assisting apparatus being in a slipping or suspended state.

[0232] Based on this, in order to prevent misjudgment, if the assisting apparatus is in a slipping or suspended state and the machine body has run for a preset time, it means that the driving current of the roller brush becomes smaller. It is most likely not caused by factors such as the roller brush not being installed or the roller brush being used for too long and the bristles becoming pliable, but by the assisting apparatus being in a slipping or suspended state. At this time, the alarm for triggering the roller brush abnormality can be prohibited to avoid misjudgment. The roller brush abnormality here refers to the roller brush not being installed or the roller brush being used for too long and the bristles becoming pliable.

[0233] In addition, an embodiment of the present application further provides a cleaning device, where the cleaning device comprises:

a machine body, on which a floor brush is provided;

a handle, provided on the body, by which a user operates the cleaning device to move; an assisting apparatus, used to output assisting; and

a controlling apparatus, provided on the machine body and electrically connected to the assisting apparatus, and is used to implement any of the method steps described above.

[0234] It should be noted that, in this document, relational terms such as first and second, etc. are merely used to distinguish one entity or operation from another entity or operation, and do not necessarily require or imply any actual relationship or order between these entities or operations. Furthermore, the terms "comprises," "comprising," or any other variations thereof are intended to cover non-exclusive inclusion, such that a process, method, article, or apparatus that includes a list of elements includes not only those elements but also other elements not expressly listed, or also includes elements inherent to such process, method, article, or apparatus. Without more constraints, an element defined by the phrase "comprising a..." does not exclude the existence of other identical elements in the process, method, article or apparatus comprising the element.

[0235] Each embodiment in this specification is described in a related manner, and the same or similar parts between the embodiments can be referenced to each other, and each embodiment focuses on the differences from other embodiments. In particular, for the system embodiment, since it is basically similar to the method embodiment, the description is relatively simple, and the relevant parts can be referred to the partial description of the method embodiment.

[0236] The above is only the embodiment of the present disclosure and not intended to limit the present disclosure. Those skilled in the art may make various modifications and variations to the present disclosure. Any modifications, equivalent replacements, improvements and the like made within the spirit and principle of the present disclosure shall fall within the scope of the claims of the present disclosure.

[0237] The apparatus embodiments described above are merely illustrative, where the units described as separate components may or may not be physically separated, and the components displayed as units may or may not be physical units, i.e., may be located at a place, or may be distributed to multiple network units. Some or all of the modules may be selected according to actual needs to achieve the purpose of the scheme of this embodiment. Those of ordinary skill in the art can understand and implement without creative work.

[0238] Through the description of the above implementation modes, those skilled in the art can clearly understand that various implementation modes may be implemented by means of software and a necessary general hardware platform, and of course, by hardware. Based on such understanding, the essence of the foregoing technical solutions or portions making contribution to the prior art may be embodied in the form of software products. The computer software products may be stored in a computer-readable storage medium such as a ROM/RAM, a magnetic disk and an optical disc, including instructions for causing a computer device (which may be a personal computer, a server, or a network device, etc.) to perform the methods described in various embodiments or portions of the embodiments.

[0239] Finally, it should be noted that the above embodiments are only used to illustrate the technical solutions of the present disclosure, and are not limited thereto. Although the present disclosure has been described in detail with reference to the foregoing embodiments, those of ordinary skill in the art will understand that the technical solutions described in the foregoing embodiments can be staying static modified, or some technical features are equivalently replaced. These modifications or replacements do not make the essence of the corresponding technical solutions depart from the spirit and scope of the technical solutions in various embodiments of the present disclosure.

Claims

1. An assisting method for a cleaning device, comprising:

obtaining movement information of a cleaning device;
identifying operation intention of a user operating the cleaning device to move based on the movement information; and
controlling an assisting apparatus of the cleaning device to operate, to provide assisting for the user operating the cleaning device to move according to the operation intention and the movement information.

2. The method according to claim 1, wherein the cleaning device comprises a floor brush, the floor brush is provided with a rear wheel, and the assisting apparatus provides the assisting by driving the rear wheel; and wherein, the obtaining the movement information of the cleaning device comprises:

detecting a movement signal of the rear wheel by a sensor; and
generating movement information of the rear wheel based on the detected movement signal.

3. The method according to claim 2, wherein the generating the movement information based on the detected movement signal comprises:

determining a movement direction and a speed of the rear wheel based on the movement signal continuously detected by the sensor; and
calculating an acceleration of the rear wheel according to the speeds of the rear wheel corresponding to a plurality of consecutive moments;
wherein the movement information comprises: the movement direction, the speed, and the acceleration.

4. The method according to claim 2 or 3, wherein the identifying the operation intention of the user operating the cleaning device to move based on the movement information comprises:

analyzing a movement trend of the rear wheel according to the movement information of the rear wheel; and

identifying the operation intention of the user based on the movement trend.

5. The method according to claim 4, wherein the identifying the operation intention of the user based on the movement trend comprises at least one of the following:

when the movement trend is a tendency of forward advancing, identifying the operation intention of the user as forward pushing;
 when the movement trend is a tendency of forward stop trend, identifying the operation intention of the user as forward pushing and stopping or backward pulling;
 when the movement trend is a tendency of backward advancing, identifying the operation intention of the user as backward pulling;
 when the movement trend is a backward stop trend, identifying the operation intention of the user as backward pulling and stopping or forward pushing; and
 when the movement trend is staying static, identifying the operation intention of the user as stopping at the spot;
 wherein the tendency of forward stop trend refers to a movement trend in which a forward speed is less than a first threshold and continuously decelerated; and
 the backward stop trend refers to a movement trend in which a backward speed is less than a second threshold and continuously decelerated.

6. The method according to claim 1, wherein identifying the operation intention of the user operating the cleaning device to move based on the movement information comprises at least one of the following:

when analyzing the movement trend of the cleaning device as a tendency of forward advancing based on the movement information, identifying the operation intention of the user as forward pushing;
 when analyzing the movement trend of the cleaning device as a forward stop trend based on the movement information, identifying the operation intention of the user as forward pushing and stopping or backward pulling;
 when analyzing the movement trend of the cleaning device as a tendency of backward advancing based on the movement information, identifying the operation intention of the user as backward pulling;
 when analyzing the movement trend of the cleaning device as a tendency of backward stop trend based on the movement information, identifying the operation intention of the user as backward pulling and stopping or forward pushing; and
 when analyzing the movement trend of the cleaning device as staying static based on the movement information, identifying the operation intention of the user as stopping at the spot;
 wherein the forward stop trend refers to a movement trend in which a forward speed is less than a first threshold and continuously decelerated; and
 the tendency of backward stop trend refers to a movement trend in which a backward speed is less than a second threshold and continuously decelerated.

7. The method according to claim 5 or 6, wherein when the movement trend is the tendency of forward advancing, identifying the operation intention of the user as forward pushing comprises at least one of the following:

when the movement trend is a tendency of forward acceleration, identifying the operation intention of the user as forward pushing with an acceleration; and
 when the movement trend is a tendency of forward deceleration and keeping advancing, identifying the operation intention of the user as forward pushing with a deceleration;
 wherein the tendency of forward deceleration and keeping advancing is a movement trend in which a forward speed after a deceleration is not less than the first threshold.

8. The method according to claim 5 or 6, wherein when the movement trend is the tendency of backward advancing, identifying the operation intention of the user as backward pulling comprises at least one of the following:

when the movement trend is a tendency of backward acceleration, identifying the operation intention of the user as backward pulling with an acceleration;
 when the movement trend is a tendency of backward deceleration and keeping advancing, identifying the operation intention of the user as backward pulling with a deceleration;
 wherein the tendency of backward deceleration and keeping advancing refers to a movement trend in which the backward speed after a deceleration is not less than the second threshold.

9. The method according to claim 5 or 6, wherein the controlling the assisting apparatus of the cleaning device to operate according to the operation intention and the movement information comprises at least one of the following:

when the operation intention is forward pushing, controlling the assisting apparatus to output an adaptive forward assisting or to stop operating, based on the movement information;
 when the operation intention is forward pushing and stopping or backward pulling, if the movement information indicates that the cleaning device is in a forward pushing and advancing state, then controlling the assisting apparatus to output an adaptive backward assisting, to accelerate a forward deceleration of the cleaning device, based on the movement information;
 when the operation intention is backward pulling, if the movement information indicates that the cleaning device is in a backward pulling and advancing state, then controlling the assisting apparatus to output an adaptive backward assisting, based on the movement information;
 when the operation intention is backward pulling and stopping or forward pushing, if the movement information indicates that the cleaning device is in a backward pulling and advancing state, then controlling the assisting apparatus to output an adaptive forward assisting to accelerate a backward deceleration of the cleaning device, or controlling the assisting apparatus to stop operating to utilize a forward power of the roller brush to accelerate the backward deceleration of the cleaning device, based on the movement information; and
 when the operation intention is stopping at the spot, controlling the assisting apparatus to output a backward assisting adapted to a forward power of the roller brush, to balance the forward power of the roller brush.

10. The method according to any one of claims 1 to 6, wherein the controlling the assisting apparatus of the cleaning device to operate, according to the operation intention and the movement information, comprises:

determining an assisting direction according to the operation intention;
 dynamically determining an output power of the assisting apparatus according to the movement information; and
 controlling the assisting apparatus of the cleaning device to operate in accordance with an assisting parameter; wherein the assisting parameter comprises the assisting direction and the output power.

11. The method according to claim 10, wherein the determining the assisting direction according to the operation intention comprises at least one of the following:

when the operation intention is forward pushing, determining the assisting direction to be forward;
 when the operation intention is to forward pushing and stopping, determining the assisting direction to be backward;
 when the operation intention is backward pulling and stopping at the spot, determining the assisting direction to be forward;
 when the operation intention is backward pulling, determining the assisting direction to be backward; and
 when the operation intention is stopping at the spot, determining the assisting direction to be backward.

12. The method according to claim 10, wherein the dynamically determining the output power of the assisting apparatus according to the movement information comprises:

obtaining a calculation model; using the movement information as an input parameter of the calculation model, and executing the calculation model to obtain the output power; or
 obtaining a preconfigured correspondence table of movement information and output power, querying the output power corresponding to the movement information, or calculating the output power corresponding to the movement information by an interpolation algorithm.

13. The method according to any one of claims 1 to 6, wherein the operation intention of the user comprises various intentions; at least some intentions of the various intentions are set as requiring assisting;
 after the identifying the operation intention of the user operating the cleaning device to move, the method further comprises:

judging whether the identified operation intention of the user is one of the at least some intentions being set as requiring assisting in the various intentions;
 if so, triggering the step of determining the determining assisting parameter according to the operation intention and the movement information.

14. The method according to claim 1, wherein the controlling the assisting apparatus of the cleaning device to operate according to the operation intention and the movement information comprises:

determining a forward speed of the cleaning device according to the movement information;
when the operation intention is backward pulling, controlling the assisting apparatus to output an adaptive backward assisting, to intervene a deceleration in advance accelerating the forward speed of the cleaning device, based on the forward speed.

15. An assisting method for a cleaning device, comprising:

obtaining a current movement state of the cleaning device;
determining an assisting strategy adapted to the movement state;
obtaining movement information of the cleaning device; and
controlling an assisting apparatus of the cleaning device to operate, to provide assisting for a user operating the cleaning device, according to the movement information and the assisting strategy.

16. The method according to claim 15, wherein the cleaning device comprises a floor brush, the floor brush is provided with a rear wheel, and the assisting apparatus provides assisting by driving the rear wheel; and wherein, the obtaining the current movement state of the cleaning device comprises:

detecting a movement signal of the rear wheel by a sensor; and
determining the current movement state of the cleaning device according to the movement signal of the rear wheel;
wherein, the determining the current movement state of the cleaning device according to the movement signal of the rear wheel comprises at least one of the following:

when determining based on the detected movement signal that the rear wheel is forward advancing, the cleaning device is currently in a forward pushing and advancing state;
when determining based on the detected movement signal that the rear wheel is backward advancing, the cleaning device is currently in a backward pulling and advancing state; and
when determining based on the detected movement signal that the rear wheel is staying static, the cleaning device is currently in a stopping at the spot state.

17. The method according to claim 16, wherein the obtaining the movement information of the cleaning device comprises:

determining the movement direction and speed of the rear wheel based on the movement signal continuously detected by the sensor;
calculating an acceleration of the rear wheel according to the speeds of the rear wheel corresponding to a plurality of consecutive moments;
wherein the movement information comprises: the movement direction, the speed, and the acceleration.

18. The method according to any one of claims 15 to 17, wherein the assisting strategy is adapted to the forward pushing and advancing state, and the controlling the assisting apparatus of the cleaning device to operate according to the movement information and the assisting strategy comprises:

identifying whether the user operation causes the cleaning device to have a tendency of forward stop trend, according to the movement information;
if there is a tendency of forward stop trend, controlling the assisting apparatus to output an adaptive backward assisting, to accelerate the deceleration of the forward speed of the cleaning device, based on the movement information; and
if there is no tendency of forward stop trend, controlling the assisting apparatus to output an adaptive forward assisting or to stop operating, based on the movement information.

19. The method according to claim 18, wherein prior to the identifying whether the user operation causes the cleaning device to have a tendency of forward stop trend, according to the movement information, further comprises:

identifying whether the user operation has a tendency of backward pulling operation, according to the movement

information;

if there is a tendency of backward pulling operation, triggering the step of identifying whether the user operation causes the cleaning device to have a tendency of forward stop trend, according to the movement information;

if there is no tendency of backward pulling operation, controlling the assisting apparatus to output an adaptive forward assisting or to stop operating according to the movement information.

20. The method according to claim 19, wherein the movement information is operation information of the rear wheel of the cleaning device; and the identifying whether the user operation has a tendency of backward pulling operation or identifying whether the user operation causes the cleaning device to have a tendency of backward stop trend, according to the movement information, comprises:

analyzing the movement trend of the rear wheel according to the movement information;

when analyzing that the rear wheel has a movement trend of a backward speed being decelerated and the rear wheel after the deceleration having a speed not less than a second threshold, identifying that the user operation has a tendency of backward pulling operation; or

when analyzing that the rear wheel has a movement trend of a backward speed being less than the second threshold and being continuously decelerated toward zero or equal to zero, identifying that the user operation causes the cleaning device to have a tendency of backward stop trend.

21. The method according to any one of claims 15 to 17, wherein the assisting strategy is adapted to a backward pulling and advancing state, and the controlling the assisting apparatus of the cleaning device to operate according to the movement information and the assisting strategy comprises:

determining the assisting direction of the assisting apparatus being backward;

dynamically determining the output power of the assisting apparatus based on the movement information; and

controlling the assisting apparatus of the cleaning device to operate in accordance with the assisting parameter;

wherein the assisting parameter comprises the assisting direction and the output power.

22. The method according to any one of claims 15 to 17, wherein the assisting strategy is adapted to a stopping at the spot state, and the controlling the assisting apparatus of the cleaning device to operate according to the movement information and the assisting strategy comprises:

determining the assisting direction of the assisting apparatus being backward;

obtaining a rotation speed of the roller brush of the cleaning device;

determining the output power of the assisting apparatus according to the rotation speed of the roller brush; and

controlling the assisting apparatus of the cleaning device to operate in accordance with the assisting parameter;

wherein the assisting parameter comprises the assisting direction and the output power.

23. A cleaning device, comprising:

a machine body, on which a floor brush is provided;

a handle, provided on the machine body, through which a user operates the roller brush of the cleaning device;

an assisting apparatus, used to output assisting;

a controlling apparatus, provided on the machine body and electrically connected to the assisting apparatus, and used to obtain movement information of the cleaning device; identify operation intention of a user operating the cleaning device based on the movement information; and control the assisting apparatus to operate according to the operation intention and the movement information, to provide assisting for the user operating the cleaning device.

24. The cleaning device according to claim 23, wherein the controlling apparatus, when controlling the assisting apparatus to operate according to the operation intention and the movement information, is used to:

determine a forward speed of the cleaning device according to the movement information;

when the operation intention is backward pulling, controlling the assisting apparatus to output an adaptive backward assisting, to intervene a deceleration in advance accelerating the forward speed of the cleaning device,

based on the forward speed.

25. The cleaning device according to claim 23, further comprising a sensor;

the floor brush is provided with a rear wheel;
the assisting apparatus is connected to the rear wheel and provides assisting by driving the rear wheel;
the sensor is used to detect a movement signal of the rear wheel;
the controlling apparatus is electrically connected to the sensor and is used to determine the movement information of the rear wheel according to the movement signal detected by the sensor.

26. The cleaning device according to claim 23, wherein the controlling apparatus is used to implement the steps in the method according to any one of claims 3 to 14.

27. A cleaning device, comprising:

a machine body, on which a roller brush is provided;
a handle, provided on the body, through which a user operates the roller brush of the cleaning device;
an assisting apparatus, used to output assisting;
a controlling apparatus, provided on the machine body and electrically connected to the assisting apparatus, and used to implement the steps in the method according to any one of claims 15 to 22.

28. A cleaning device controlling method, being applied to a cleaning device, wherein the cleaning device is provided with an assisting apparatus, and the method comprises:

obtaining an operating parameter of the assisting apparatus in the cleaning device;
identifying a state of the assisting apparatus by the operating parameter; and
adjusting an output power of the assisting apparatus based on the state of the assisting apparatus.

29. The method according to claim 28, wherein the obtaining of the operating parameter of the assisting apparatus in the cleaning device comprises:

obtaining a speed and an acceleration of the assisting apparatus in the cleaning device;
the identifying the state of the assisting apparatus by the operating parameter comprises:
identifying the state of the assisting apparatus by the speed and the acceleration.

30. The method according to claim 29, wherein the identifying the state of the assisting apparatus by the speed and the acceleration comprises:

determining an acceleration dispersion degree corresponding to the acceleration according to a preset acceleration dispersion degree determination cycle;
judging whether the acceleration dispersion degree is less than a preset first dispersion degree threshold, and judging whether the speed is more than a preset speed threshold;
if the acceleration dispersion degree is less than the preset first dispersion degree threshold and the speed is more than the preset speed threshold, identifying the assisting apparatus being in a slipping or suspended state.

31. The method according to claim 30, wherein the determining the acceleration dispersion degree corresponding to the acceleration according to the preset acceleration dispersion degree determination cycle comprises:

obtaining an acceleration variance corresponding to the acceleration within the acceleration dispersion degree determination cycle according to the preset acceleration dispersion degree determination cycle; and
determining the acceleration variance as the acceleration dispersion degree of the acceleration within the acceleration dispersion degree determination cycle.

32. The method according to claim 29, wherein the identifying the state of the assisting apparatus by the speed and the acceleration comprises:

obtaining an acceleration difference between the acceleration and a preset acceleration threshold;
judging whether the acceleration difference is within a preset acceleration error range;

if the acceleration difference is within the preset acceleration error range, identifying the assisting apparatus being in a slipping or suspended state.

- 5 **33.** The method according to claim 32, wherein if the acceleration difference is within the preset acceleration error range, identifying the assisting apparatus being in a slipping or suspended state comprises:

if the acceleration difference is within the preset acceleration error range, counting a first duration during which the acceleration difference is within the preset acceleration error range;
judging whether the first duration reaches a preset first duration threshold;
10 if the first duration reaches the preset first duration threshold, identifying the assisting apparatus being in a slipping or suspended state.

- 15 **34.** The method according to claim 32 or 33, wherein the identifying the assisting apparatus being in a slipping or suspended state comprises:

judging whether the speed is more than a preset speed threshold;
if the speed is more than the preset speed threshold, identifying the assisting apparatus being in a slipping or suspended state.

- 20 **35.** The method according to claim 28, wherein the obtaining the operating parameter of the assisting apparatus in the cleaning device comprises:

obtaining an operating current of the assisting apparatus in the cleaning device;
the identifying the state of the assisting apparatus by using the operating parameter comprises:
25 identifying the state of the assisting apparatus by the operating current.

- 36.** The method according to claim 35, wherein the identifying the state of the assisting apparatus by the operating current comprises:

30 determining a current dispersion degree corresponding to the operating current according to a preset current dispersion degree determination cycle;
judging whether the current dispersion degree is less than a preset second dispersion degree threshold;
if the current dispersion degree is less than the preset second dispersion degree threshold, identifying the assisting apparatus being in a slipping or suspended state.
35

- 37.** The method according to claim 36, wherein the determining the current dispersion degree corresponding to the operating current according to a preset current dispersion degree determination cycle comprises:

40 obtaining a current variance corresponding to the operating current within the current dispersion degree determination cycle according to a preset current dispersion degree determination cycle;
determining the current variance as the current dispersion degree corresponding to the operating current within the current dispersion degree determination cycle.

- 45 **38.** The method according to claim 35, wherein the identifying the state of the assisting apparatus by the operating current comprises:

obtaining a current difference between the operating current and a preset current threshold, and judging whether the current difference is within a preset current error range;
if the current difference is within the preset current error range, identifying the assisting apparatus being in a slipping or suspended state.
50

- 39.** The method according to claim 38, wherein if the current difference is within the preset current error range, identifying the assisting apparatus being in a slipping or suspended state comprises:

55 if the current difference is within the preset current error range, counting a second duration during which the current difference is within the preset current error range;
judging whether the second duration reaches a preset second duration threshold;
if the second duration reaches the preset second duration threshold, identifying the assisting apparatus being in a

slipping or suspended state.

40. The method according to any one of claims 28 to 39, wherein the adjusting the output power of the assisting apparatus based on the state of the assisting apparatus comprises:

if the assisting apparatus being in a slipping or suspended state, adjusting the assisting apparatus to reverse, and reducing the output power of the assisting apparatus to cause the speed of the cleaning device being zero;
if the assisting apparatus is not in a slipping or suspended state, maintaining the output power of the assisting apparatus.

41. The method according to claim 40, wherein the cleaning device is provided with a roller brush, and the reducing the output power of the assisting apparatus as an output power of the assisting apparatus reduced according to a target ratio, comprises:

determining a force generated by a movement of the roller brush, and searching a ratio corresponding to the force generated by the movement of the roller brush, wherein the ratio comprises a maximum output power ratio of the assisting apparatus;
determining the ratio as a target ratio, and reducing the output power of the assisting apparatus according to the target ratio.

42. A cleaning device, comprising:

a machine body, on which a floor brush is provided;
a handle, provided on the body, through which a user operates the cleaning device to move;
an assisting apparatus, used to output assisting; and
a controlling apparatus, provided on the machine body and electrically connected to the assisting apparatus, and is used to implement the method steps according to any one of claims 28 to 41.

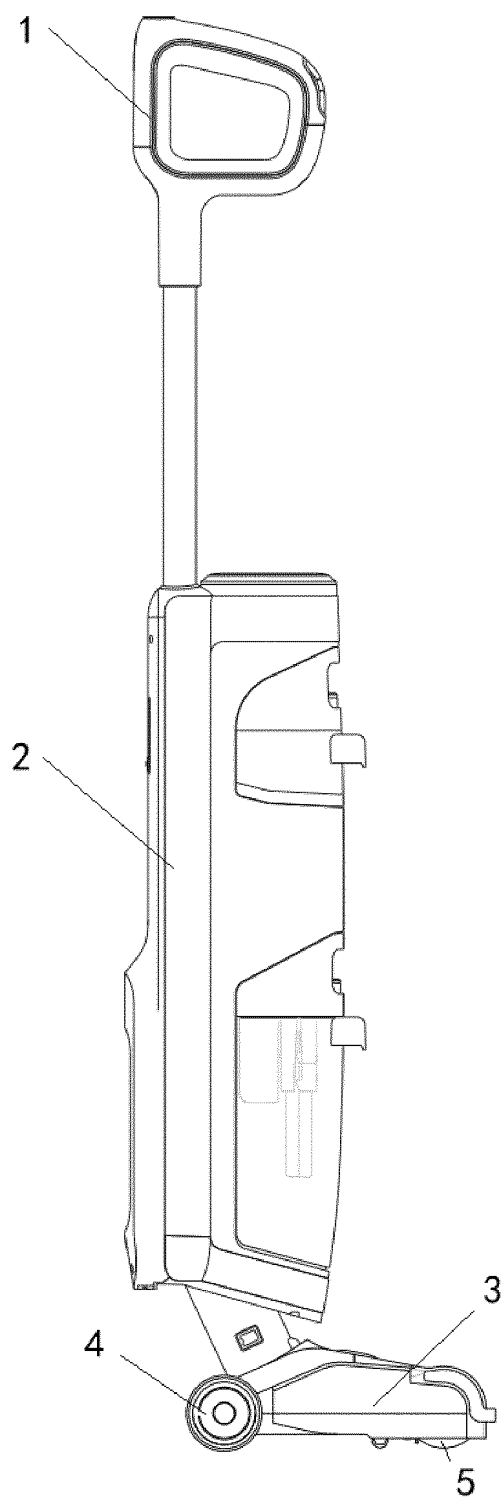


FIG. 1

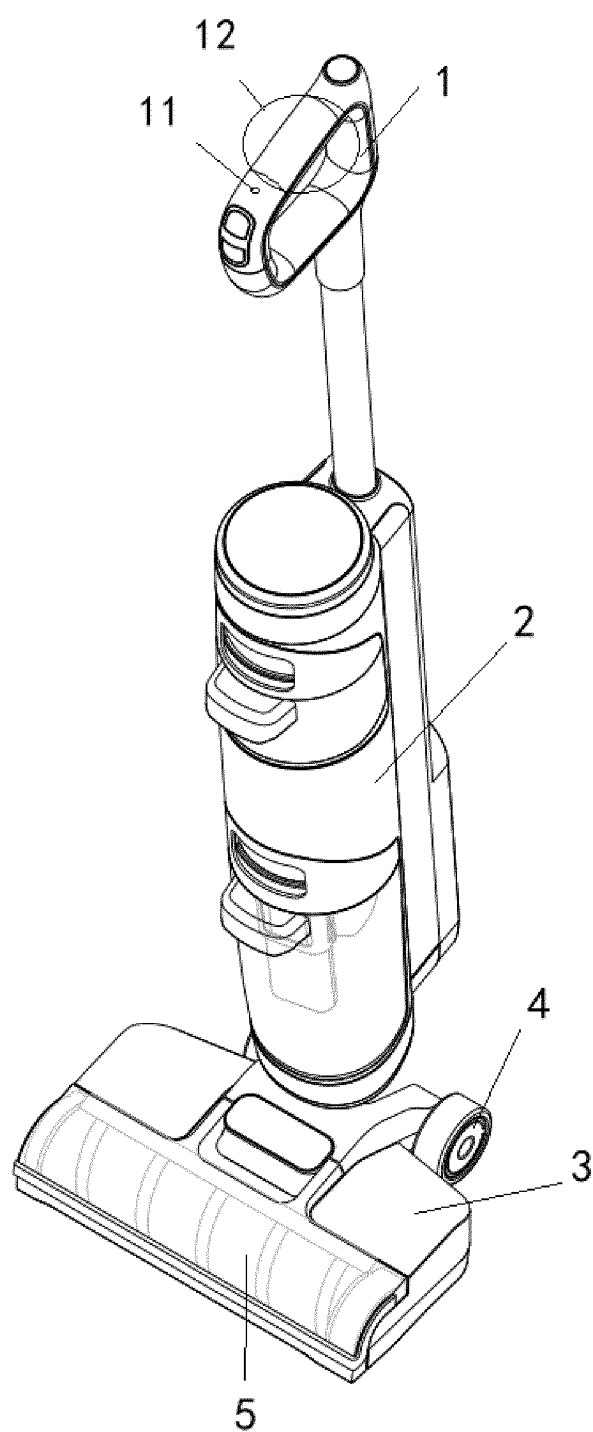


FIG. 2

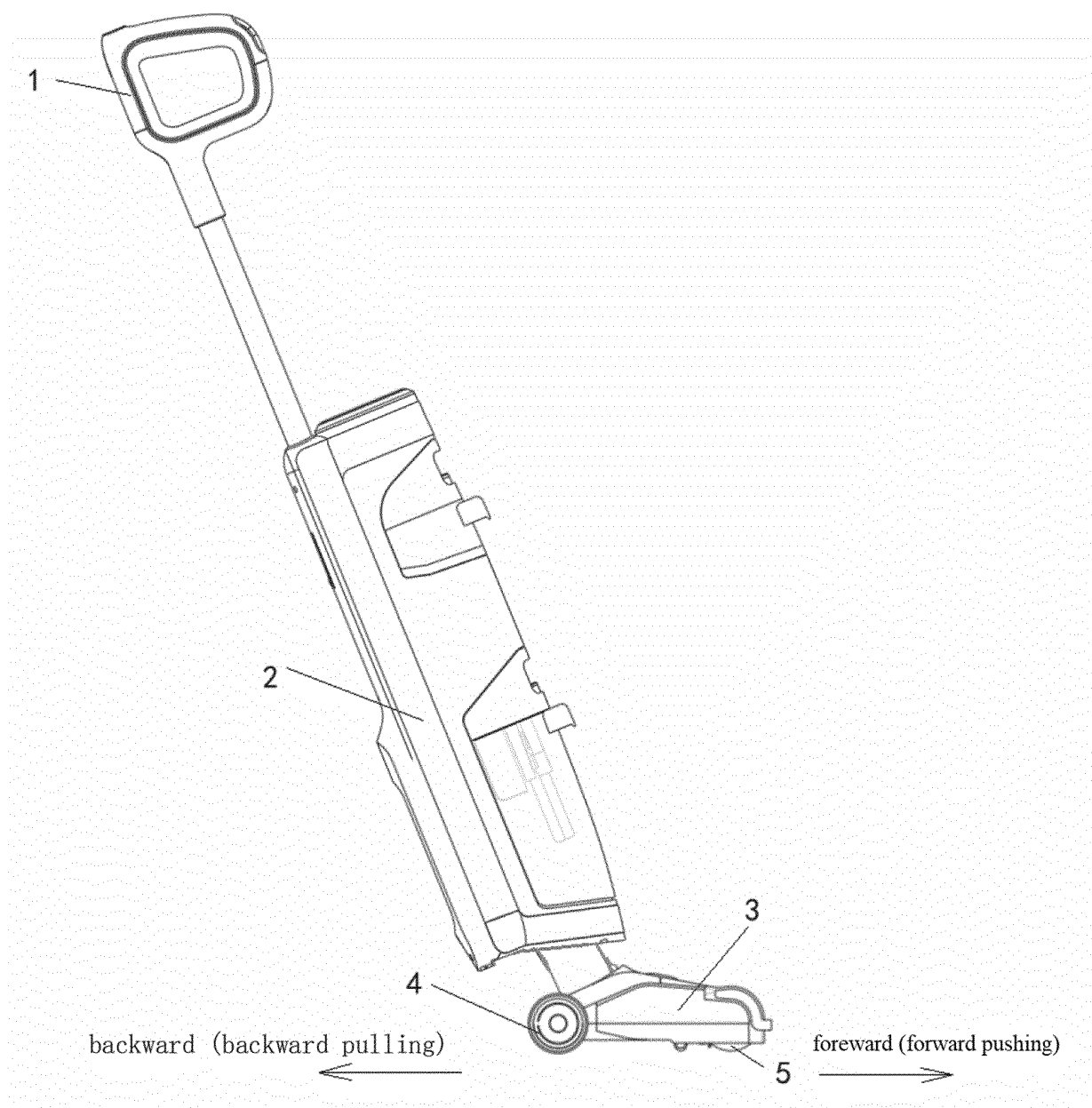


FIG. 3

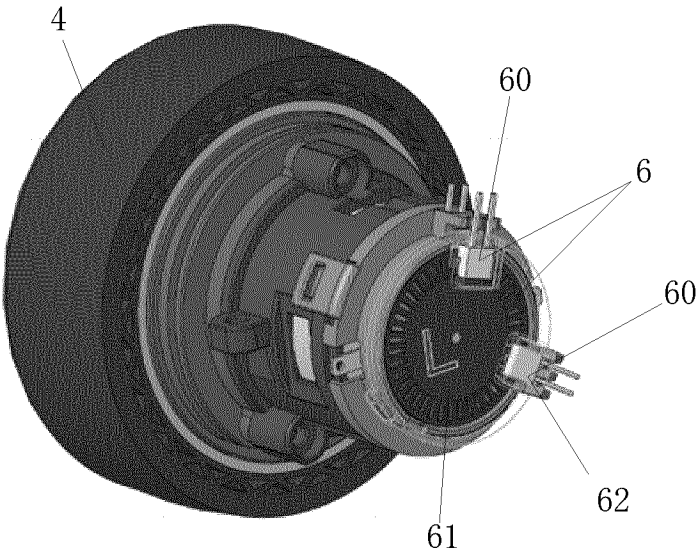


FIG. 4

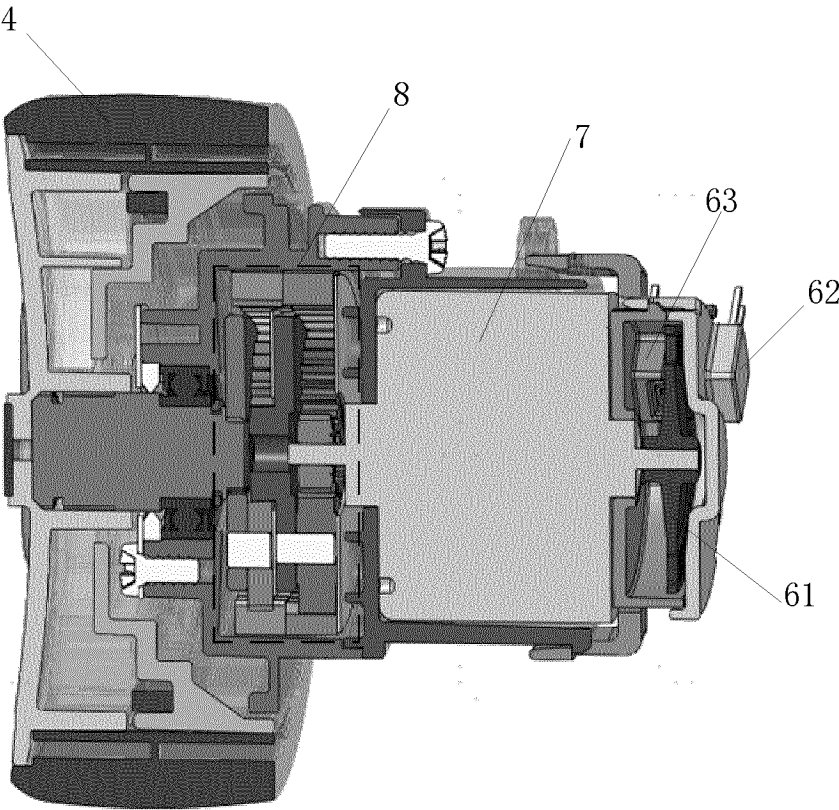


FIG. 5a

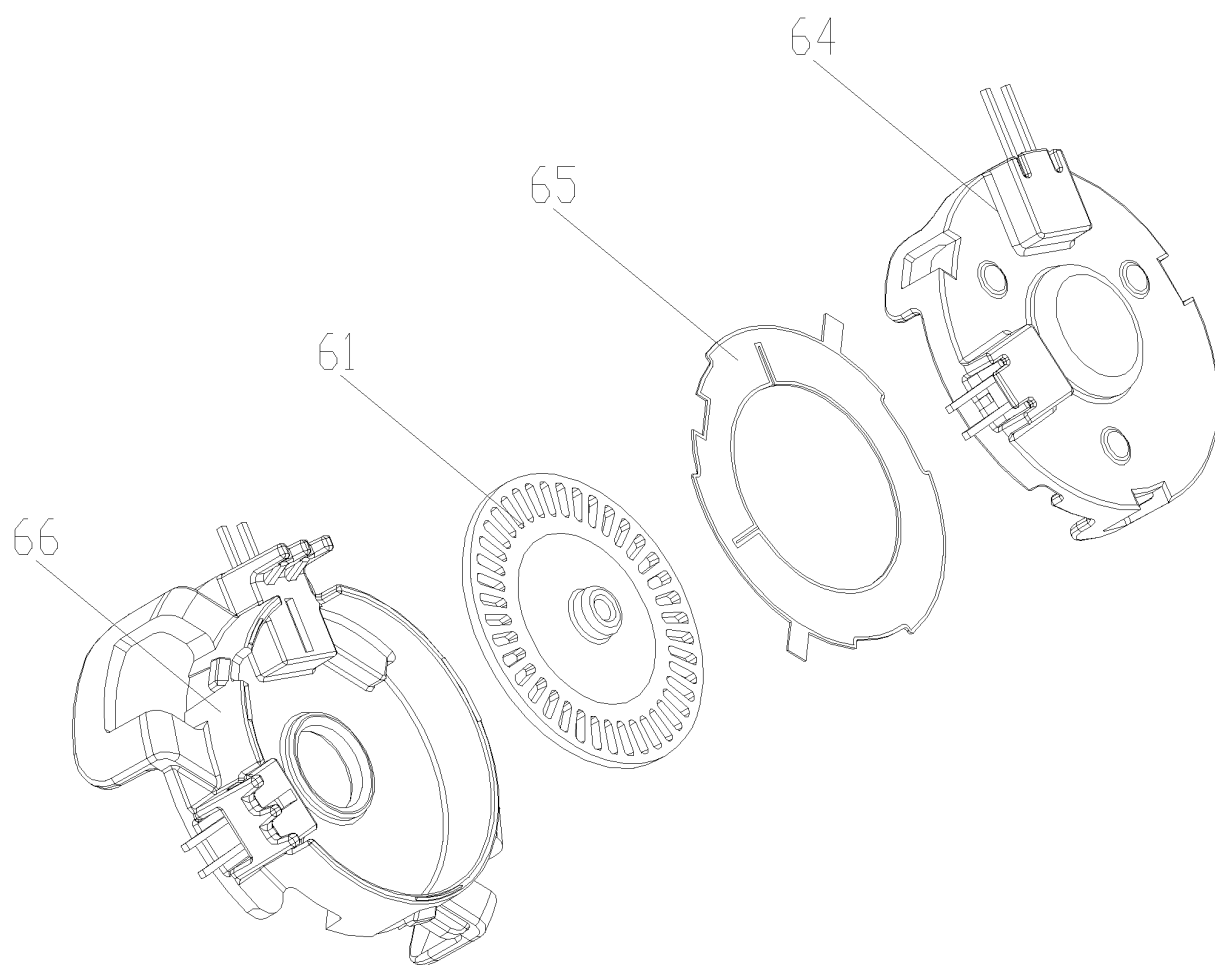


FIG. 5b

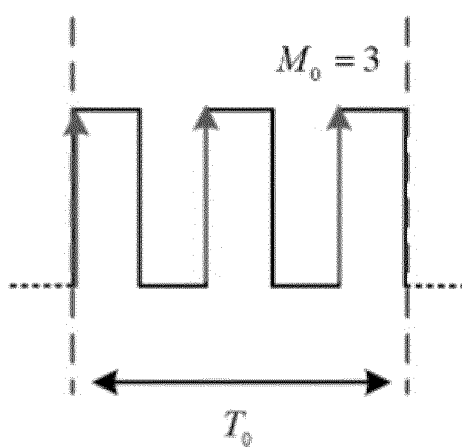


FIG. 6

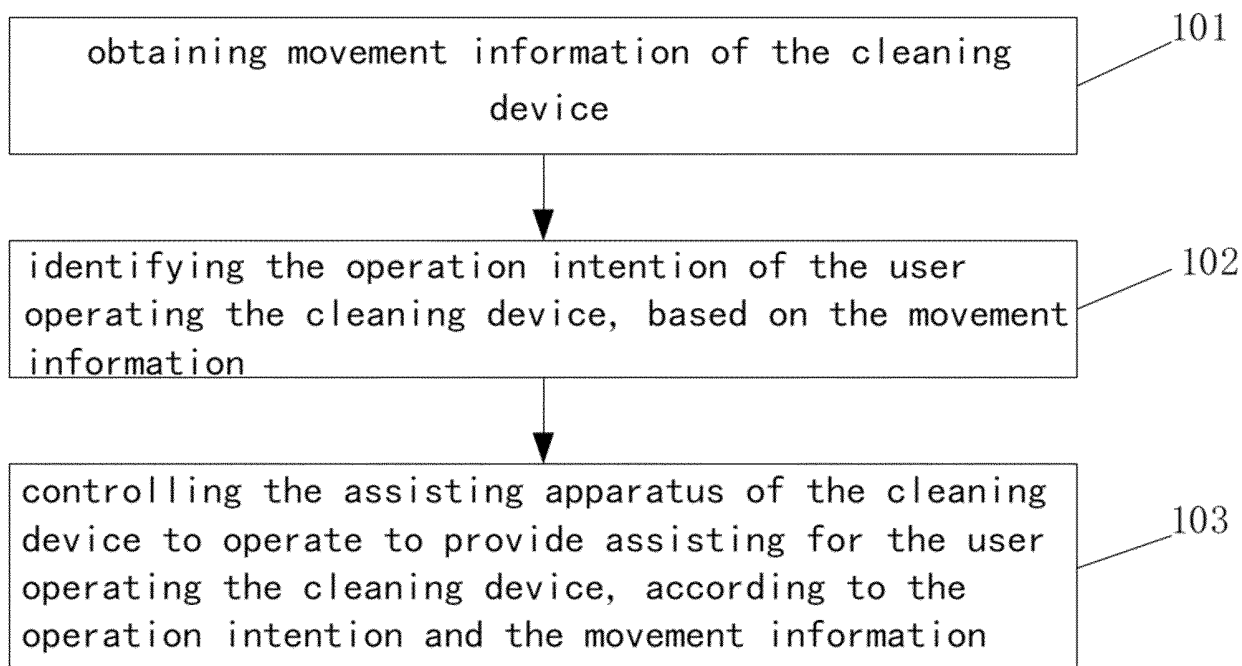


FIG. 7

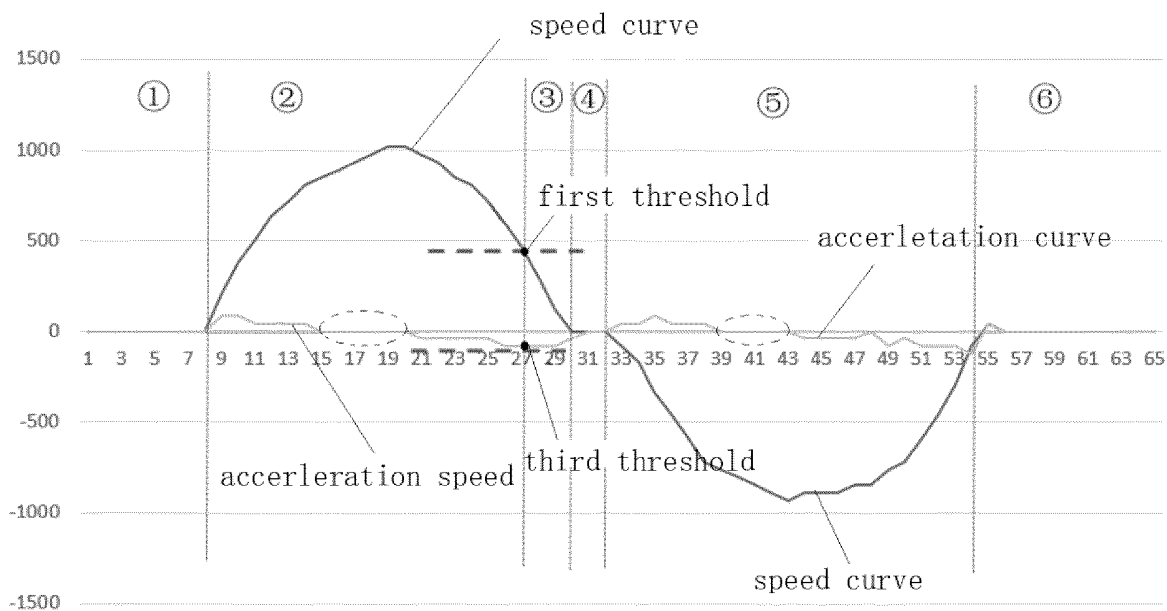


FIG. 8

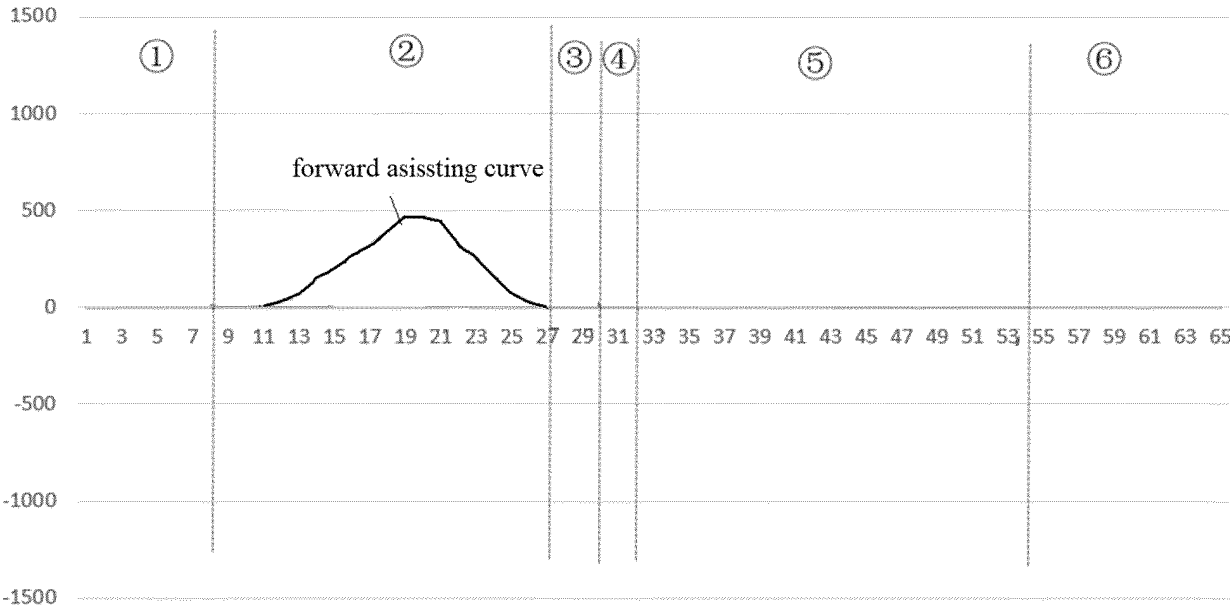


FIG. 9

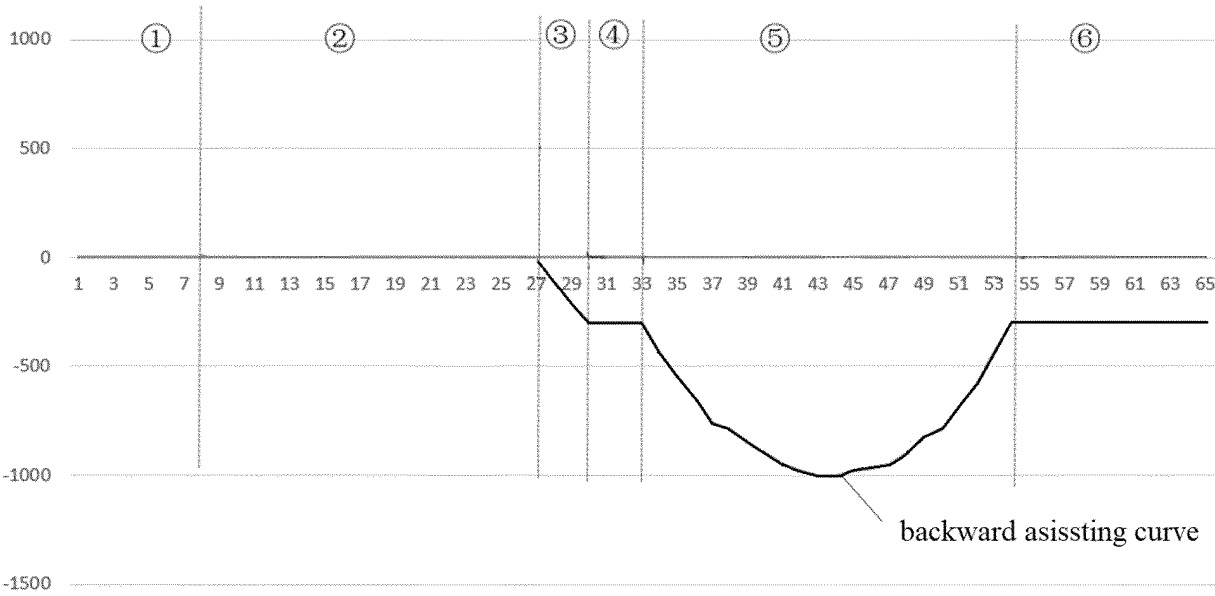


FIG. 10

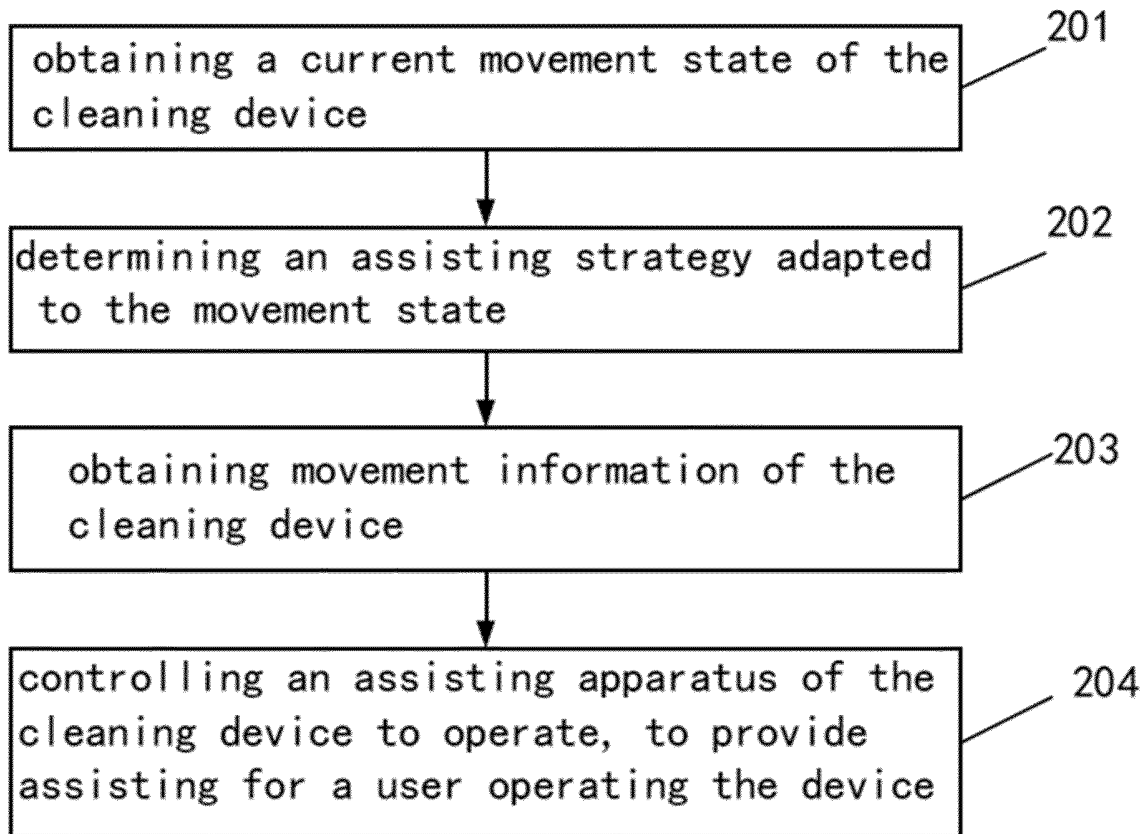


FIG. 11

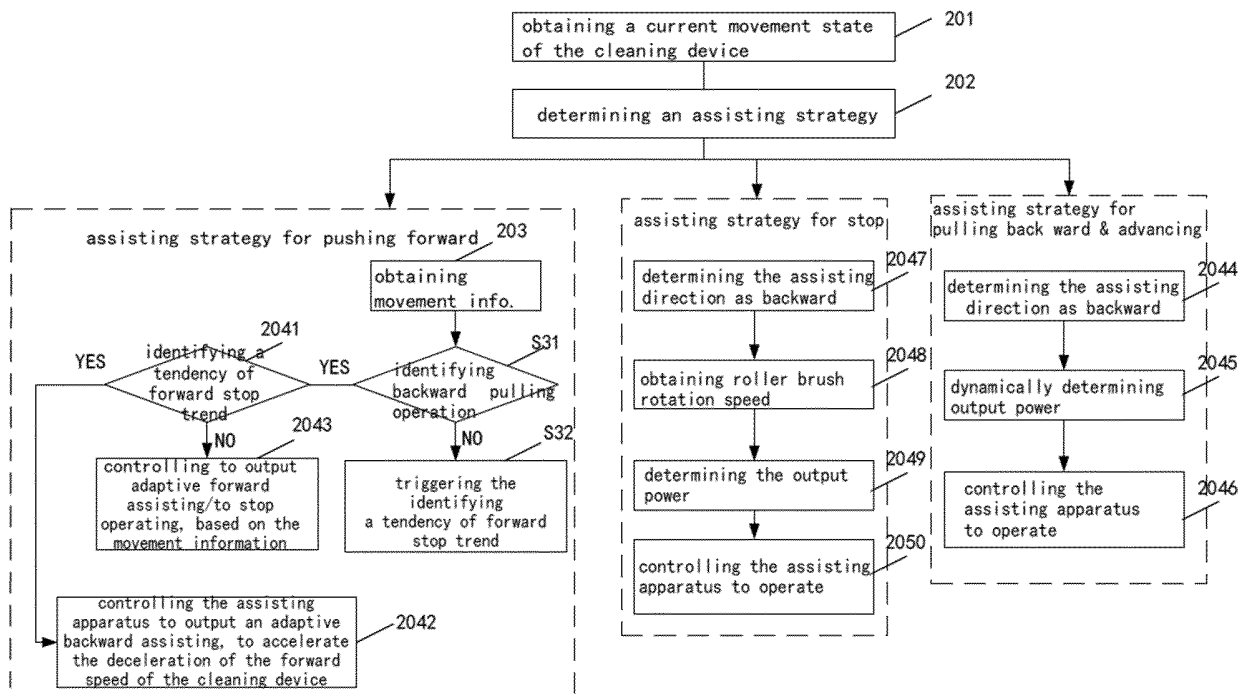


FIG. 12

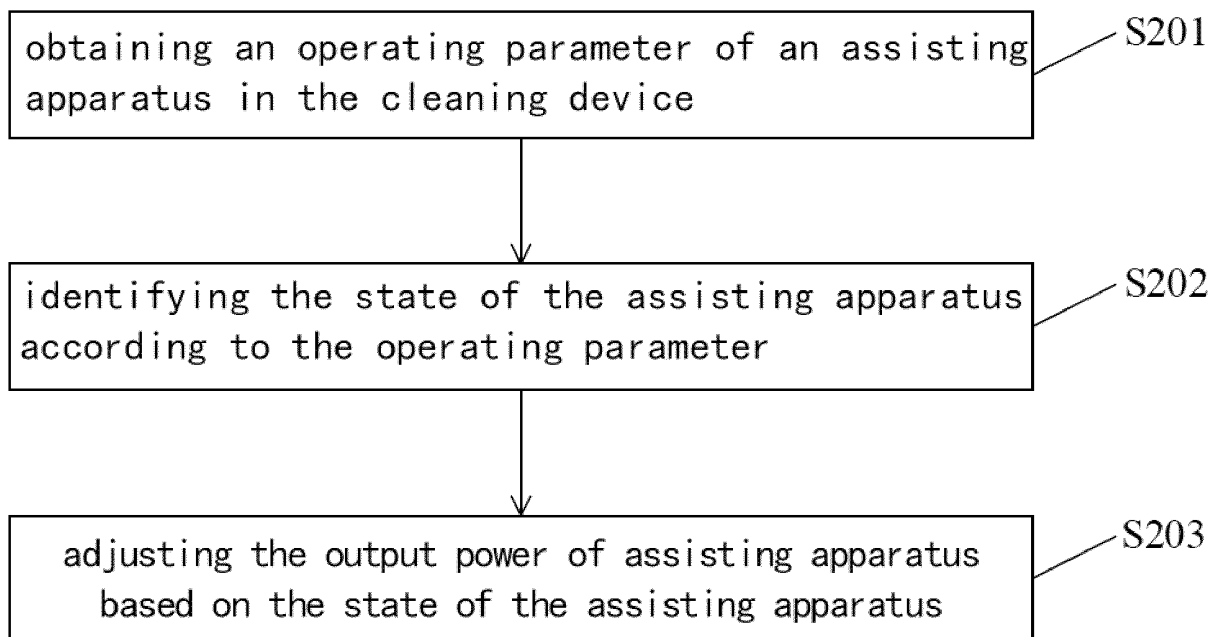


FIG. 13

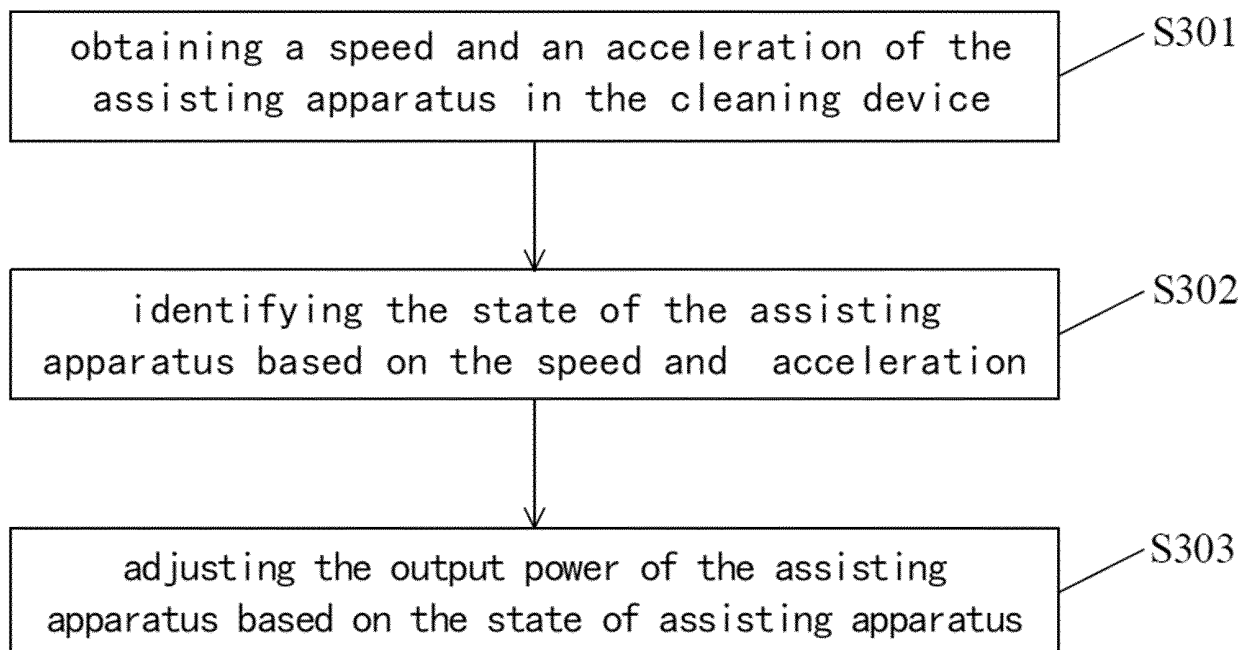


FIG. 14

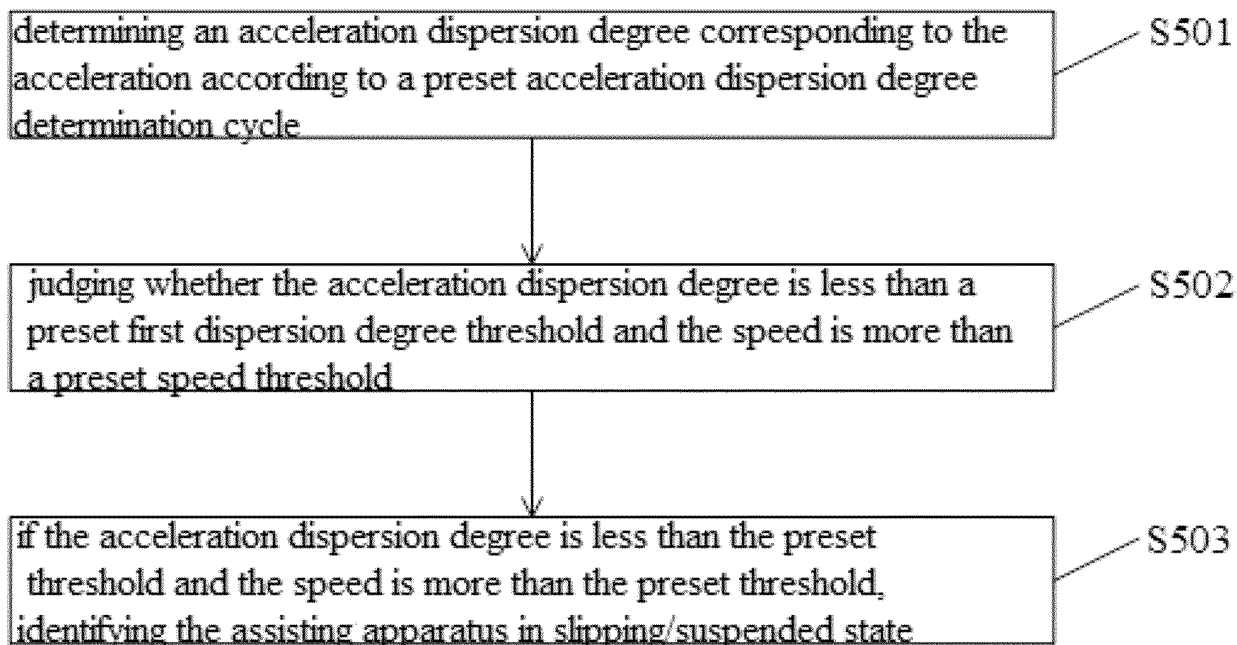


FIG. 15

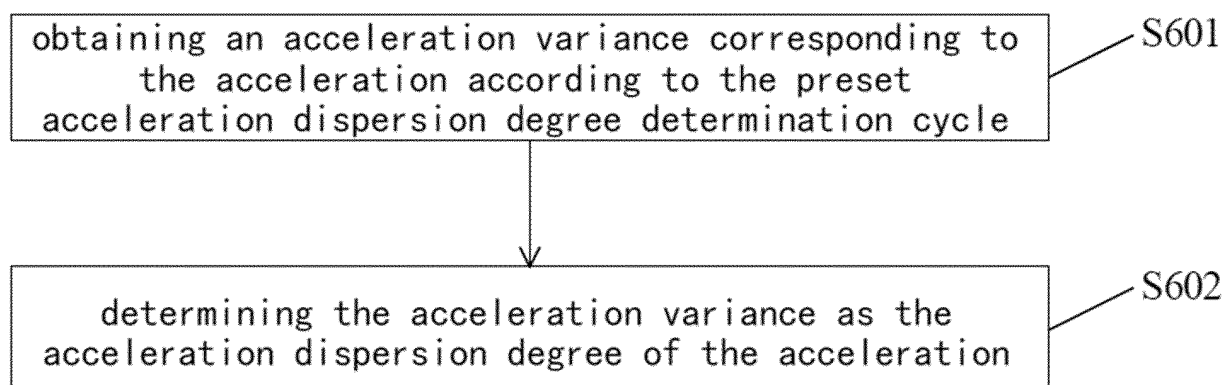


FIG. 16

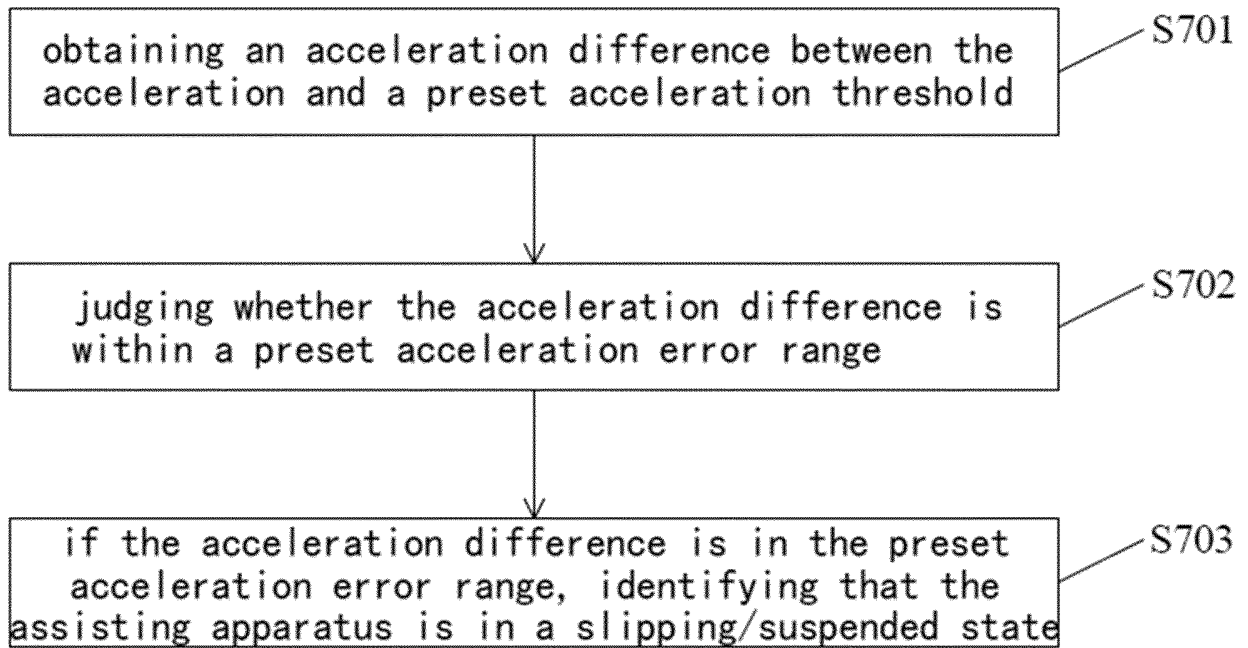


FIG. 17

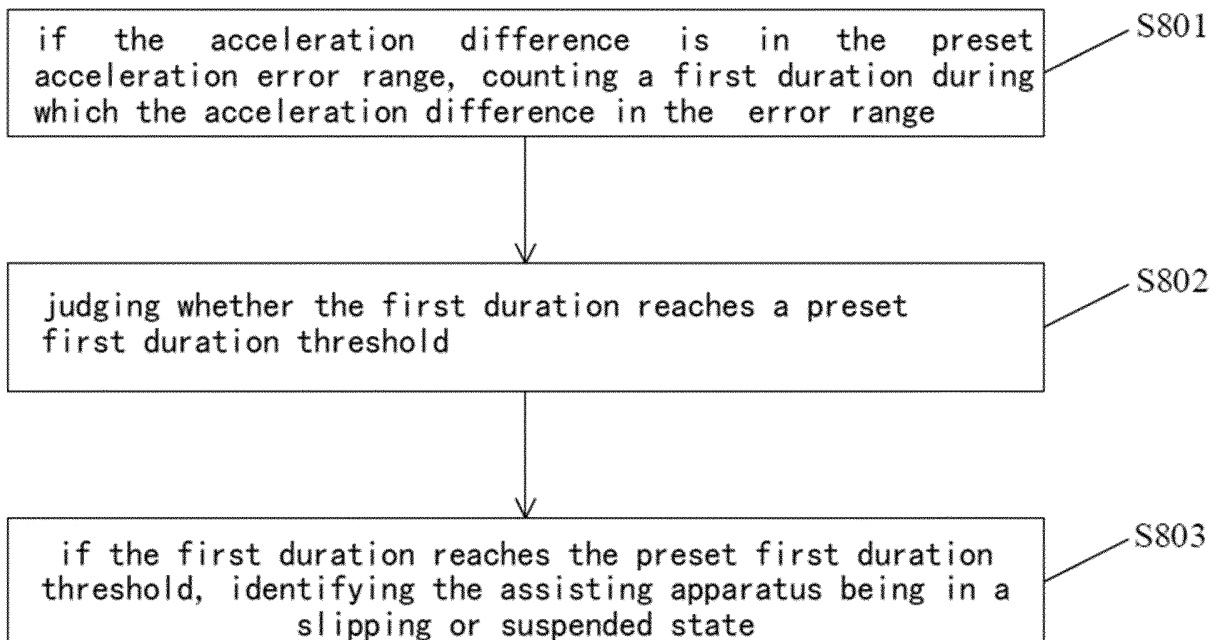


FIG. 18

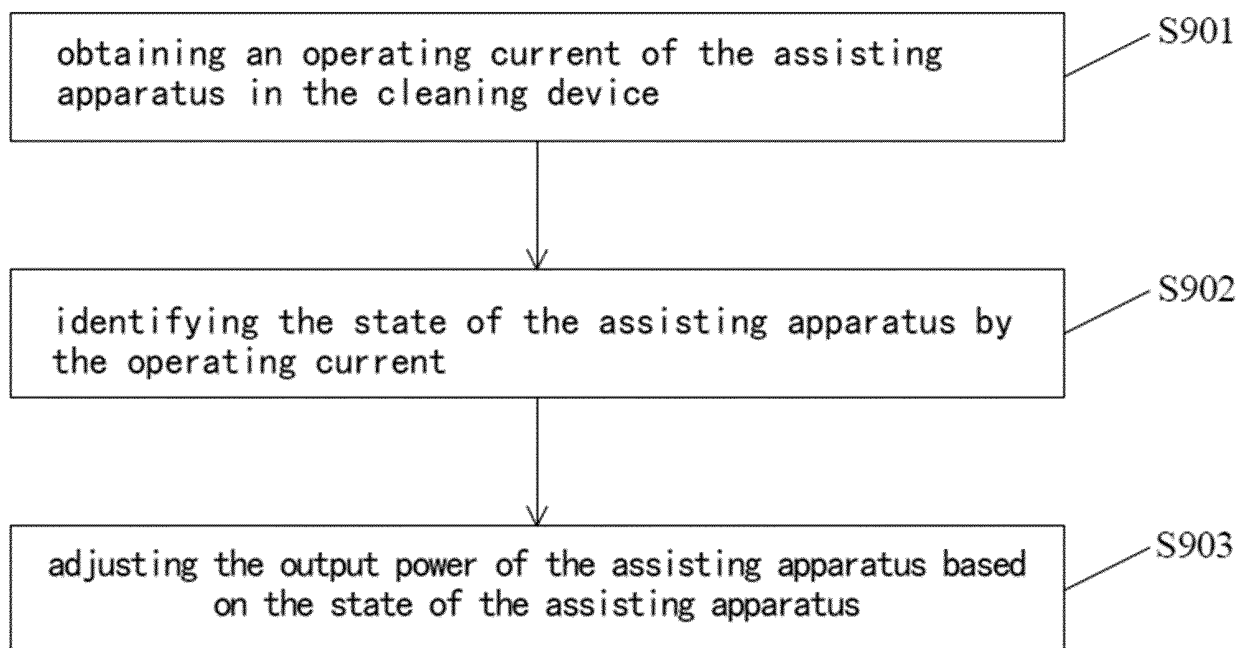


FIG. 19

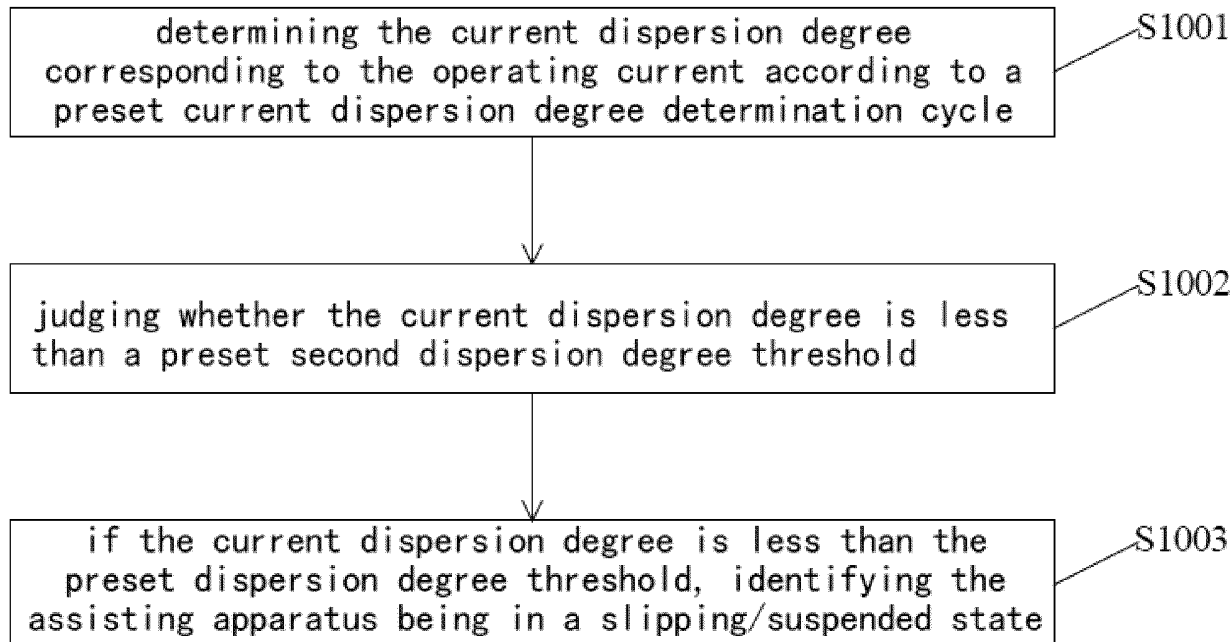


FIG. 20

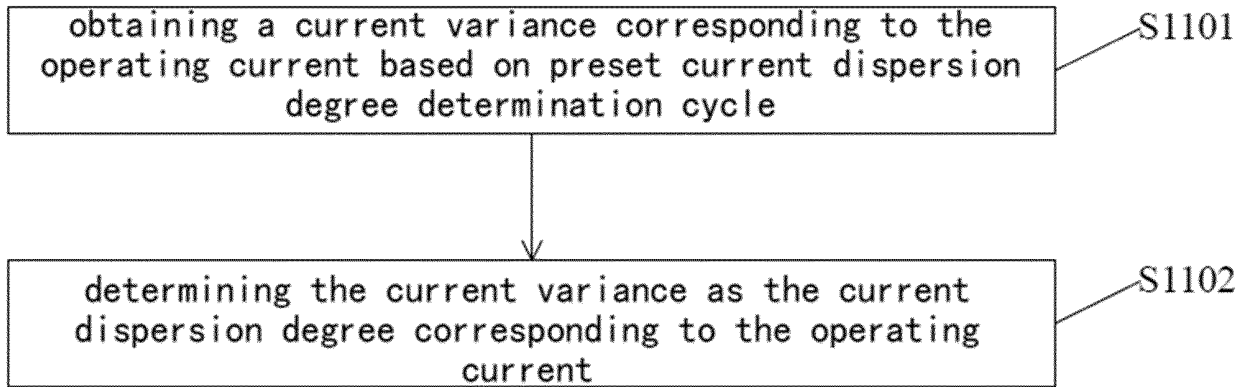


FIG. 21

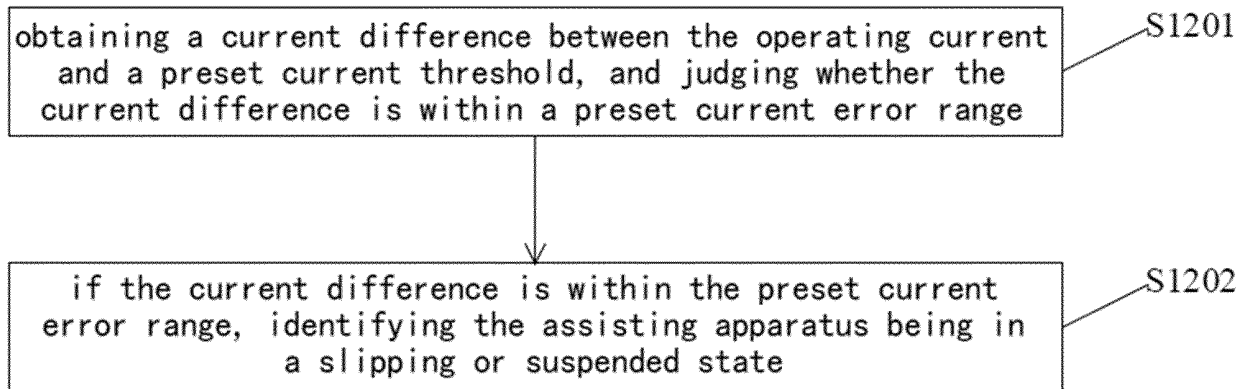


FIG. 22

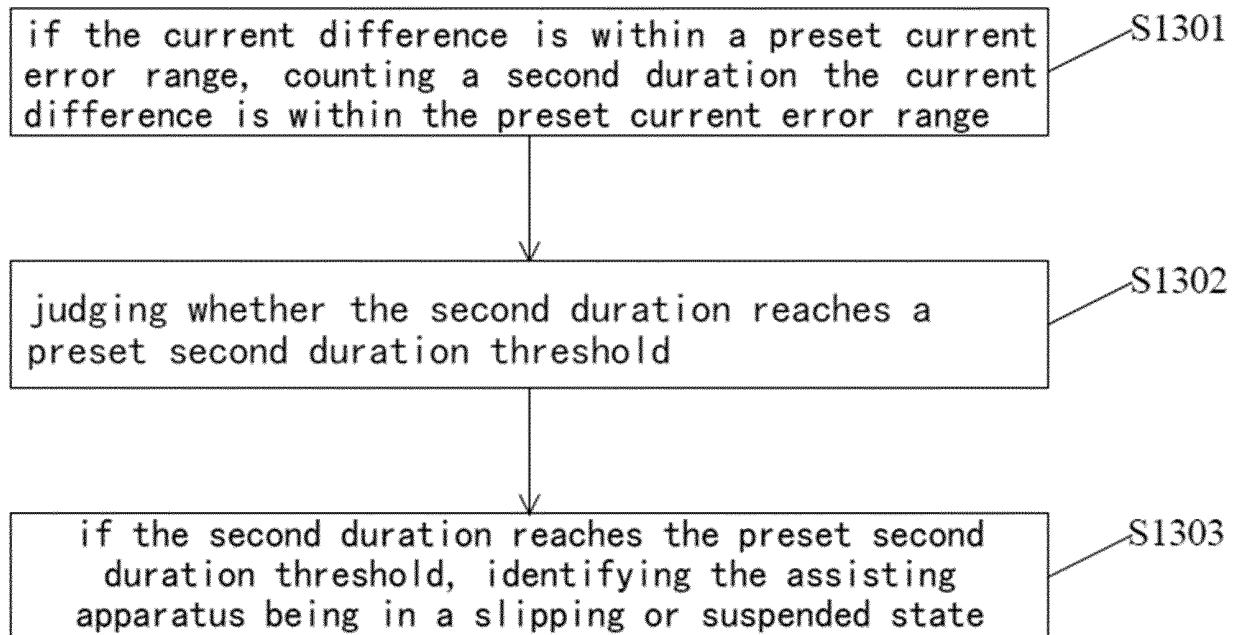


FIG. 23

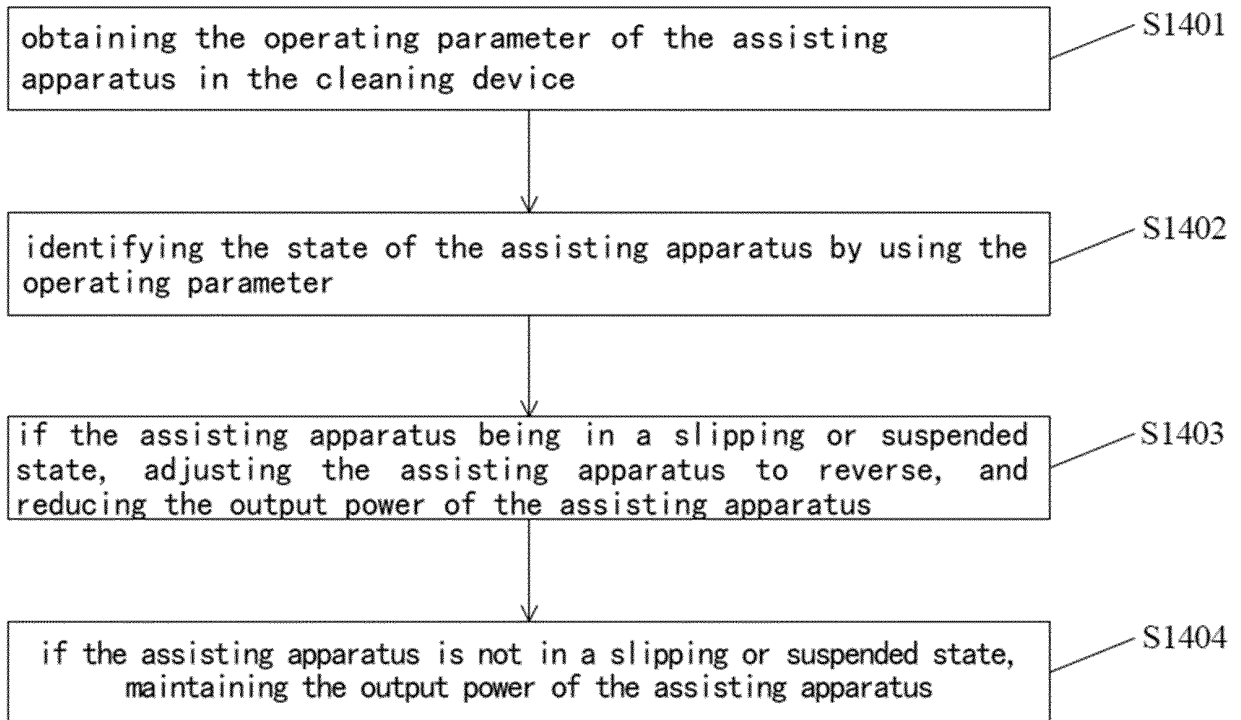


FIG. 24

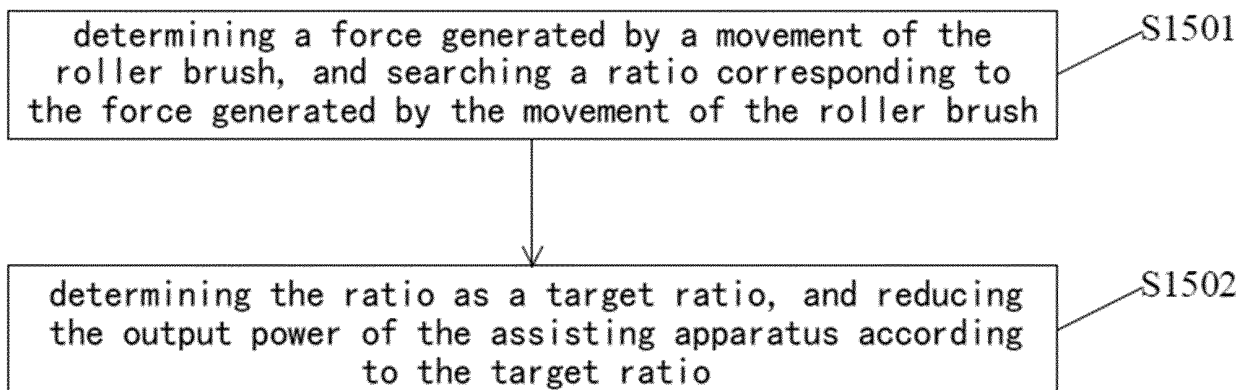


FIG. 25

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2023/078381

A. CLASSIFICATION OF SUBJECT MATTER A47L 11/28(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC																					
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC: A47L Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched																					
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNABS, CNTXT, 百度, BAIDU, CNKI, 万方, WANFANG: 清洁, 清扫, 扫地, 意图, 助力, 电机, 速度, 加速度, 电流, 打滑, 空转, 悬空, 功率 DWPI, WPABS, USTXT, EPTXT, IEEE, ELSEVIER SCIENCE: sweep, clean, intention, help, motor, speed, acceleration, electric current, slip, power																					
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>PX</td> <td>CN 114794996 A (TINECO INTELLIGENT TECHNOLOGY CO., LTD.) 29 July 2022 (2022-07-29) claims 1-27, description, paragraphs 39-220, and figures 1-12</td> <td>1-27</td> </tr> <tr> <td>PX</td> <td>CN 114795005 A (TINECO INTELLIGENT TECHNOLOGY CO., LTD.) 29 July 2022 (2022-07-29) claims 1-15, description, paragraphs 56-198, and figures 1-15</td> <td>28-42</td> </tr> <tr> <td>X</td> <td>US 2018213990 A1 (LG ELECTRONICS INC.) 02 August 2018 (2018-08-02) description, paragraphs 38-149, and figures 1-7</td> <td>1-27</td> </tr> <tr> <td>Y</td> <td>US 2018213990 A1 (LG ELECTRONICS INC.) 02 August 2018 (2018-08-02) description, paragraphs 38-149, and figures 1-7</td> <td>28-42</td> </tr> <tr> <td>Y</td> <td>CN 109414145 A (GUANGZHOU AIRUOBO ROBOT TECHNOLOGY CO., LTD.) 01 March 2019 (2019-03-01) description, paragraphs 55-179</td> <td>28-42</td> </tr> <tr> <td>X</td> <td>KR 20100053095 A (LG ELECTRONICS INC.) 20 May 2010 (2010-05-20) description, paragraphs 5-58, and figures 1-6</td> <td>1-27</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	PX	CN 114794996 A (TINECO INTELLIGENT TECHNOLOGY CO., LTD.) 29 July 2022 (2022-07-29) claims 1-27, description, paragraphs 39-220, and figures 1-12	1-27	PX	CN 114795005 A (TINECO INTELLIGENT TECHNOLOGY CO., LTD.) 29 July 2022 (2022-07-29) claims 1-15, description, paragraphs 56-198, and figures 1-15	28-42	X	US 2018213990 A1 (LG ELECTRONICS INC.) 02 August 2018 (2018-08-02) description, paragraphs 38-149, and figures 1-7	1-27	Y	US 2018213990 A1 (LG ELECTRONICS INC.) 02 August 2018 (2018-08-02) description, paragraphs 38-149, and figures 1-7	28-42	Y	CN 109414145 A (GUANGZHOU AIRUOBO ROBOT TECHNOLOGY CO., LTD.) 01 March 2019 (2019-03-01) description, paragraphs 55-179	28-42	X	KR 20100053095 A (LG ELECTRONICS INC.) 20 May 2010 (2010-05-20) description, paragraphs 5-58, and figures 1-6	1-27
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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.																					
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INTERNATIONAL SEARCH REPORT

International application No. PCT/CN2023/078381

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 110000813 A (SHENZHEN TOPBAND CO., LTD.) 12 July 2019 (2019-07-12) entire document	1-42
A	CN 110123208 A (SHENZHEN INMOTION TECHNOLOGIES CO., LTD.) 16 August 2019 (2019-08-16) entire document	1-42
A	CN 111700543 A (BEIJING QIHOO TECHNOLOGY CO., LTD.) 25 September 2020 (2020-09-25) entire document	1-42
A	JP 2014212960 A (TOSHIBA CORP. et al.) 17 November 2014 (2014-11-17) entire document	1-42

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2023/078381

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 114794996 A	29 July 2022	None	
CN 114795005 A	29 July 2022	None	
US 2018213990 A1	02 August 2018	US 10932637 B2	02 March 2021
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		AU 2016291036 B2	17 January 2019
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		TWI 632889 B	21 August 2018
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		CN 109414145 B	15 March 2022
KR 20100053095 A	20 May 2010	KR 101035165 B1	17 May 2011
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JP 2014212960 A	17 November 2014	JP 6345912 B2	20 June 2018

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