(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 March 2019 (14.03.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/048030 A1

(51) International Patent Classification:
A47L 9/28 (2006.01)

(21) International Application Number:
PCT/EP2017/072267

(22) International Filing Date:
05 September 2017 (05.09.2017)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

(54) Title: METHOD OF A ROBOTIC CLEANING DEVICE

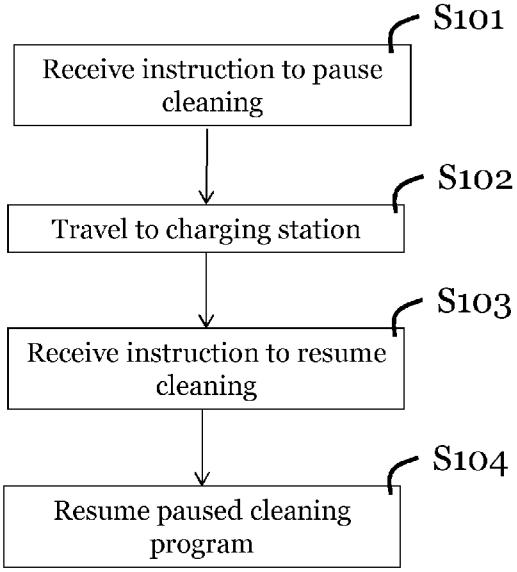

Figure 3

(57) Abstract: The invention relates to a method of a robotic cleaning device (100) of controlling operation of a cleaning program in progress, and a robotic cleaning device (100) configured to perform the method. In an aspect of the invention, a robotic cleaning device (100) configured to control operation of a cleaning program in progress is provided. The robotic cleaning device (100) comprises a propulsion system (112, 113, 115a, 115b) configured to move the robotic cleaning device (100), at least one battery (117) configured to power the robotic cleaning device (100), and a controller (116) configured to receive an instruction to pause the cleaning program in progress, control, in response to said instruction to pause, the propulsion system (112, 113, 115a, 115b) to cause the robotic cleaning device (100) to travel to a charging station to recharge the robotic cleaning device battery (117), receive a further instruction to resume the cleaning program that was in progress upon receiving the instruction to pause, and resume, in response to said further instruction, the cleaning program that was in progress upon receiving the instruction to pause.

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METHOD OF A ROBOTIC CLEANING DEVICE

TECHNICAL FIELD

The invention relates to a method of a robotic cleaning device of controlling operation of a cleaning program in progress, and a robotic cleaning device configured to perform the method.

BACKGROUND

In many fields of technology, it is desirable to use robots with an autonomous behaviour such that they freely can move around a space without colliding with possible obstacles.

Robotic vacuum cleaners are known in the art, which are equipped with drive means in the form of a motor for moving the cleaner across a surface to be cleaned. The robotic vacuum cleaners are further equipped with intelligence in the form of microprocessor(s) and navigation means for causing an autonomous behaviour such that the robotic vacuum cleaners freely can move around and clean a surface in the form of e.g. a floor. Thus, these prior art robotic vacuum cleaners have the capability of more or less autonomously vacuum clean a room in which objects such as tables and chairs and other obstacles such as walls and stairs are located.

For practical reasons, there are limitations as to how much battery power a robotic vacuum cleaner is capable of carrying. As a consequence, this sets a restriction on the size of the surface over which the robotic vacuum cleaner can be move before charging of the cleaner is required.

When the battery is close to being drained on energy but areas still remain to be cleaned, the robotic vacuum cleaner returns to its charging station for a so called *pit stop*, during which process the robotic vacuum cleaner docks with the charging station to recharge the cleaner battery.

If a user returns home during a cleaning program in progress and do not want the vacuum cleaner to proceed with the cleaning at this very instance, the user has two options:

1) abort the cleaning program and send the cleaner to the charging station, or

2) instruct the cleaner to pause on the spot and restart it later.

SUMMARY

An object of the present invention is to provide an improved method of controlling operation of a cleaning program in progress for a robotic cleaning device.

This object is attained in a first aspect of the invention by a method of a robotic cleaning device of controlling operation of a cleaning program in progress. The method comprises receiving an instruction to pause the cleaning program in progress, travelling, in response to said instruction to pause, to a charging station to recharge a robotic cleaning device battery, receiving a further instruction to resume the cleaning program that was in progress upon receiving the instruction to pause, and to resume, in response to said further instruction, the cleaning program that was in progress upon receiving the instruction to pause.

This object is attained in a second aspect of the invention by a robotic cleaning device configured to control operation of a cleaning program in progress. The robotic cleaning device comprises a propulsion system configured to move the robotic cleaning device, at least one battery configured to power the robotic cleaning device, and a controller. The controller is configured to receive an instruction to pause the cleaning program in progress, control, in response to said instruction to pause, the propulsion system to cause the robotic cleaning device to travel to a charging station to recharge the robotic cleaning device battery, receive a further instruction to resume the cleaning program that was in progress upon receiving the instruction to pause and resume, in response to said further

instruction, the cleaning program that was in progress upon receiving the instruction to pause.

A user wishing to temporarily pause a cleaning operation of the robotic cleaning device may for instance press a pause button on a user interface on top of the robotic cleaning device or send a pause instruction via a mobile phone app, in which case the robotic cleaning device must be capable of wireless communication such as radio or infrared communication.

Upon receiving the instruction to pause the cleaning program, the robotic cleaning device travels to a charging station to recharge a battery with which the robotic cleaning device is equipped. The robotic cleaning device will remain docked in the charging station until it is given a further instruction to resume the cleaning program that has been paused.

After some time, the user will instruct the robotic cleaning device to resume the paused cleaning program, for instance by wirelessly submitting the further instruction to the robotic cleaning device via the previously discussed mobile phone app.

In response to the further instruction to resume the paused cleaning program, the robotic cleaning device leaves the charging station and recommences the previously paused cleaning program.

Advantageously, the battery of the robotic cleaning device has been partly or fully charged during the user-initiated pause spent in the charging station, and the originally set cleaning program is resumed.

In an embodiment, the further instruction being configured to cause the robotic cleaning device to resume the paused cleaning program may stipulate that the program should be immediately resumed, or that the paused cleaning program should be resumed after a set time period has elapsed as indicated by the further instruction.

Hence, it is envisaged that the further instruction may stipulate a time period after the lapse of which the robotic cleaning device will resume the paused

cleaning program. The further instruction may be submitted to the robotic cleaning device immediately after the pause instruction has been submitted. Thus, the pause instruction is submitted followed by the further instruction that the paused cleaning program should be resumed after a given time period, such as e.g. 30 minutes.

For instance, it may be envisaged that the user comes home from work every day for a 30 minutes lunch, after which the robotic cleaning device resumes the paused cleaning program. This may be effected by a custom setting in the mobile phone app, and is advantageous since the user does not have to remember to send the further instruction to the robotic cleaning device before leaving home after lunch.

In a further embodiment, in response to the instruction to pause, a current robotic cleaning device position is recorded, wherein the resuming of the cleaning program comprises travelling to the recorded robotic cleaning device position for resuming the cleaning program that was in progress upon receiving the instruction to pause.

In still a further embodiment, in response to the instruction to pause, a next robotic cleaning device position as stipulated by the cleaning program is recorded, wherein the resuming of the cleaning program comprises travelling to the recorded next robotic cleaning device position for resuming the cleaning program that was in progress upon receiving the instruction to pause.

Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the element, apparatus, component, means, step, etc." are to be interpreted openly as referring to at least one instance of the element, apparatus, component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is now described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 illustrates a prior art scenario where a user temporarily wishes to pause a cleaning operation of a robotic cleaning device;

Figure 2 illustrates a robotic cleaning device controlling operation of a cleaning program in progress in accordance with an embodiment of the invention;

Figure 3 illustrates a flowchart of a method of a robotic cleaning device of controlling operation of a cleaning program in progress in accordance with an embodiment of the invention;

Figure 4 illustrates a further embodiment, where the robotic cleaning device does not return to the position it left off upon receiving a pause instruction, but to a different position; and

Figure 5 illustrates a robotic cleaning device according to an exemplifying embodiment.

DETAILED DESCRIPTION

The invention will now be described more fully hereinafter with reference to the accompanying drawings, in which certain embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided by way of example so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout the description.

The invention relates to robotic cleaning devices, or in other words, to automatic, self-propelled machines for cleaning a surface, e.g. a robotic vacuum cleaner, a robotic sweeper or a robotic floor washer. The robotic

cleaning device according to the invention is battery-operated and occasionally needs to be recharged by returning to its charging station.

Figure 1 illustrates a prior art scenario where a user temporarily wishes to pause a cleaning operation of a robotic cleaning device 100.

The dotted line illustrates a path 200 via which the robotic cleaning device 100 is to travel as stipulated by the current cleaning program.

Now, if the user instructs the robotic cleaning device 100 to pause its current cleaning program, for instance by pressing a pause button on a user interface on top of the cleaner or by sending a pause instruction via a mobile phone app, the robotic vacuum cleaner 100 may either:

1) abort the cleaning program in operation and return to the charging station 200 in position P2, or

2) pause in its current position P1 and resume the cleaning program as soon as the user instructs the cleaner to start cleaning again.

In the first scenario, the vacuum cleaner will start with a new cleaning program from the charging station upon being instructed to do so, while in the second scenario, there is a risk that the battery of the cleaner will discharge before the cleaner receives an instruction to resume the paused cleaning program, thus limiting the cleaning time.

With reference to Figure 2 and further to a flowchart illustrated in Figure 3, a method of a robotic cleaning device 100 of controlling operation of a cleaning program in progress in accordance with an embodiment of the invention will be described.

Figure 3 illustrates the robotic cleaning device 100 executing a cleaning program, where a path 200 is to be travelled in order to clean a designated surface as stipulated by the cleaning program via which the robotic cleaning device 100 is to travel as stipulated by the current cleaning program.

Now, a user temporarily pause the cleaning operation of the robotic cleaning device 100 when the robot is in position P1. Hence, the robotic cleaning device 100 receives an instruction in step S101 to pause its current cleaning program, for instance by having the user press a pause button on a user interface on top of the robot or by sending a pause instruction via a mobile phone app, in which case the robotic cleaning device 100 must be capable of wireless communication such as radio or infrared communication.

It is noted that in an alternative embodiment, the controller 116 of the robotic cleaning device 100 itself takes the decision to pause, for instance by receiving an indication from the battery 117 that it is low on power in step S101.

Upon receiving the instruction to pause the cleaning program, either from the user or from the battery 117 indicating low power, the robotic cleaning device 100 travels in step S102 to the charging station 300 to recharge a battery with which the robotic cleaning device is equipped.

The robotic cleaning device 100 will remain docked in the charging station 300 until it is given a further instruction to resume the cleaning program that was paused in step S101.

After some time, the user will instruct the robotic cleaning device 100 to resume the paused cleaning program, for instance by wirelessly submitting the further instruction to the robotic cleaning device 100 accordingly in step S103.

In an embodiment, it is envisaged that said further instruction stipulates a time period after the lapse of which the robotic cleaning device 100 will resume the paused cleaning program. The further instruction may be submitted to the robotic cleaning device immediately after the pause instruction has been submitted in step S101. Hence, the pause instruction is submitted in step S101 followed by the further instruction that the paused cleaning program should be resumed after a given time period, such as e.g. 30 minutes.

For instance, it may be envisaged that the user comes home from work every day for a 30 minutes lunch, after which the robotic cleaning device 100 resumes the paused cleaning program. This may be effected by a custom setting in the mobile phone app, and is advantageous since the user does not have to remember to send the further instruction to the robotic cleaning device 100 before leaving home after lunch.

Either way, in response to the further instruction to resume the paused cleaning program, the robotic cleaning device 100 leaves the charging station in position P2 and returns to position P1 for continuing the previously paused cleaning program in step S104, thus recommencing the traveling along path 200.

Advantageously, the battery of the robotic cleaning device 100 has been partly or fully charged during the user-initiated pause spent in the charging station 300, and the originally set cleaning program is resumed.

In the embodiment of Figure 2, it is envisaged that, upon receiving the pause instruction in step S101, the robotic cleaning device records its current position such that it in step S104 can travel to the recorded robotic cleaning device position for resuming the cleaning program that was in operation upon receiving the instruction to pause.

Figure 4 illustrates a further embodiment, where the robotic cleaning device does not return to the position it left off upon receiving the pause instruction, but to a different position.

Again, the user temporarily pause the cleaning operation of the robotic cleaning device 100 when the robot is in position P1. Hence, the robotic cleaning device 100 receives an instruction in step S101 to pause its current cleaning program.

Upon receiving the instruction to pause the cleaning program, the robotic cleaning device 100 travels in step S102 to the charging station 300 to recharge a battery with which the robotic cleaning device is equipped.

In contrast to the embodiment previously described, the robotic cleaning device 100 does not record its current position but concludes that it has finished (or is very close to finishing) the cleaning of the room in which is currently resides, and will continue cleaning in an adjacent room 400; the robotic cleaning device 100 will thus record a next position where it is to resume cleaning as stipulated by the paused cleaning program.

The robotic cleaning device 100 will remain docked in the charging station 300 until it is given a further instruction to resume the cleaning program that was paused in step S101.

After the user instructs the robotic cleaning device 100 in step S103 to resume the paused cleaning program (or if a set pausing period has expired), the robotic cleaning device 100 leaves the charging station in position P2 and heads for the next room 400 to be cleaned, corresponding to the "next position" previously recorded upon receiving the pause instruction.

Again, the battery of the robotic cleaning device 100 has advantageously been partly or fully charged during the user-initiated pause spent in the charging station 300, and the originally set cleaning program is resumed.

Even though it is envisaged that the invention may be performed by a variety of appropriate robotic cleaning devices being equipped with sufficient processing intelligence, Figure 5 shows a robotic cleaning device 100 according to an embodiment of the present invention in a bottom view, i.e. the bottom side of the robotic cleaning device is shown. The arrow indicates the forward direction of the robotic cleaning device 100 being illustrated in the form of a robotic vacuum cleaner.

The robotic cleaning device 100 comprises a main body 111 housing components such as a propulsion system comprising driving means in the form of two electric wheel motors 115a, 115b for enabling movement of the driving wheels 112, 113 such that the cleaning device can be moved over a surface to be cleaned. Each wheel motor 115a, 115b is capable of controlling the respective driving wheel 112, 113 to rotate independently of each other in

order to move the robotic cleaning device 100 across the surface to be cleaned. A number of different driving wheel arrangements, as well as various wheel motor arrangements, can be envisaged. It should be noted that the robotic cleaning device may have any appropriate shape, such as a device having a more traditional circular-shaped main body, or a triangular-shaped main body. As an alternative, a track propulsion system may be used or even a hovercraft propulsion system. The propulsion system may further be arranged to cause the robotic cleaning device 100 to perform any one or more of a yaw, pitch, translation or roll movement.

A controller 116 such as a microprocessor controls the wheel motors 115a, 115b to rotate the driving wheels 112, 113 as required in view of information received from an obstacle detecting device (not shown in Figure 5) for detecting obstacles in the form of walls, floor lamps, table legs, around which the robotic cleaning device must navigate. The obstacle detecting device may be embodied in the form of a 3D sensor system registering its surroundings, implemented by means of e.g. a 3D camera, a camera in combination with lasers, a laser scanner, etc. for detecting obstacles and communicating information about any detected obstacle to the microprocessor 116. The microprocessor 116 communicates with the wheel motors 115a, 115b to control movement of the wheels 112, 113 in accordance with information provided by the obstacle detecting device such that the robotic cleaning device 100 can move as desired across the surface to be cleaned.

Further, the robotic cleaning device 100 is equipped one or more batteries 117 for powering the different components included in the cleaning device 100. The one or more batteries 117 are charged via a charging station into which the robotic cleaning device 100 docks. The one or more batteries 117 are further in communicative connection with the controller 116 for signalling if they are low on power (or if they are fully charged).

Moreover, the main body 111 of the robotic cleaner 100 comprises a suction fan 120 creating an air flow for transporting debris to a dust bag or cyclone arrangement (not shown) housed in the main body via the opening 118 in the

bottom side of the main body 111. The suction fan 120 is driven by a fan motor 121 communicatively connected to the controller 116 from which the fan motor 121 receives instructions for controlling the suction fan 120. The main body 111 may further be arranged with one or more rotating side brushes 114 adjacent to the opening 118.

With further reference to Figure 5, the controller/processing unit 116 embodied in the form of one or more microprocessors is arranged to execute a computer program 125 downloaded to a suitable storage medium 126 associated with the microprocessor, such as a Random Access Memory (RAM), a Flash memory or a hard disk drive. The controller 116 is arranged to carry out a method according to embodiments of the present invention when the appropriate computer program 125 comprising computer-executable instructions is downloaded to the storage medium 126 and executed by the controller 116. The storage medium 126 may also be a computer program product comprising the computer program 125. Alternatively, the computer program 125 may be transferred to the storage medium 126 by means of a suitable computer program product, such as a digital versatile disc (DVD), compact disc (CD) or a memory stick. As a further alternative, the computer program 125 may be downloaded to the storage medium 126 over a wired or wireless network. The controller 116 may alternatively be embodied in the form of a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field-programmable gate array (FPGA), a complex programmable logic device (CPLD), etc.

The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

CLAIMS

1. A method of a robotic cleaning device (100) of controlling operation of a cleaning program in progress, comprising:

receiving (S101) an instruction to pause the cleaning program in progress;

travelling (S102), in response to said instruction to pause, to a charging station (300) to recharge a robotic cleaning device battery (117);

receiving (S103) a further instruction to resume the cleaning program that was in progress upon receiving the instruction to pause; and

resuming (S104), in response to said further instruction, the cleaning program that was in progress upon receiving the instruction to pause.

2. The method of claim 1, wherein the instruction to pause is received from the battery (117) indicating low power.

3. The method of claims 1 or 2, wherein the instruction to pause is received from a user.

4. The method of any one of claims 1-3, further comprising:

recording, in response to said instruction to pause, a current robotic cleaning device position; wherein the resuming (S104) of the cleaning program comprises:

travelling to the recorded robotic cleaning device position for resuming the cleaning program that was in progress upon receiving the instruction to pause.

5. The method of any one of claims 1-4, further comprising:

recording, in response to said instruction to pause, a next robotic cleaning device position as stipulated by the cleaning program; wherein the resuming of the cleaning program comprises:

travelling to the recorded next robotic cleaning device position for resuming the cleaning program that was in progress upon receiving the instruction to pause.

6. The method of any one of claims 1-5, said further instruction being configured to cause the robotic cleaning device (100) to immediately resume the paused cleaning program upon being received, or to resume the paused cleaning program after a set time period has elapsed as indicated by said further instruction.

7. Robotic cleaning device (100) configured to control operation of a cleaning program in progress, comprising:

a propulsion system (112, 113, 115a, 115b) configured to move the robotic cleaning device (100);

at least one battery (117) configured to power the robotic cleaning device (100); and

a controller (116) configured to:

receive an instruction to pause the cleaning program in progress;

control, in response to said instruction to pause, the propulsion system (112, 113, 115a, 115b) to cause the robotic cleaning device (100) to travel to a charging station to recharge the robotic cleaning device battery (117);

receive a further instruction to resume the cleaning program that was in progress upon receiving the instruction to pause; and

resume, in response to said further instruction, the cleaning program that was in progress upon receiving the instruction to pause.

8. The robotic cleaning device (100) of claim 7, wherein the instruction to pause is received from the battery (117) indicating low power.

9. The method of claims 1 or 2, wherein the instruction to pause is received from a user via a robotic cleaning device user interface.

10. The robotic cleaning device (100) of any one of claims 7-9, the controller (116) further being configured to:

record, in response to said instruction to pause, a current robotic cleaning device position; and further being configured to, upon resuming the cleaning program:

control the propulsion system (112, 113, 115a, 115b) to cause the robotic

cleaning device (100) to travel to the recorded robotic cleaning device position for resuming the cleaning program that was in progress upon receiving the instruction to pause.

11. The robotic cleaning device (100) of any one of claims 7-10, the controller (116) further being configured to:

record, in response to said instruction to pause, a next robotic cleaning device position as stipulated by the cleaning program; and further being configured to, upon resuming the cleaning program:

control the propulsion system (112, 113, 115a, 115b) to cause the robotic cleaning device (100) to travel to the recorded next robotic cleaning device position for resuming the cleaning program that was in progress upon receiving the instruction to pause.

12. The robotic cleaning device (100) of any one of claims 7-11, said further instruction being configured to cause the robotic cleaning device (100) to immediately resume the paused cleaning program upon being received, or to resume the paused cleaning program after a set time period has elapsed as indicated by said further instruction.

13. A computer program (125) comprising computer-executable instructions for causing a robotic cleaning device (100) to perform the steps recited in any one of claims 1-6 when the computer-executable instructions are executed on a controller (116) included in the robotic cleaning device (100).

14. A computer program product comprising a computer readable medium (126), the computer readable medium having the computer program (125) according to claim 13 embodied thereon.

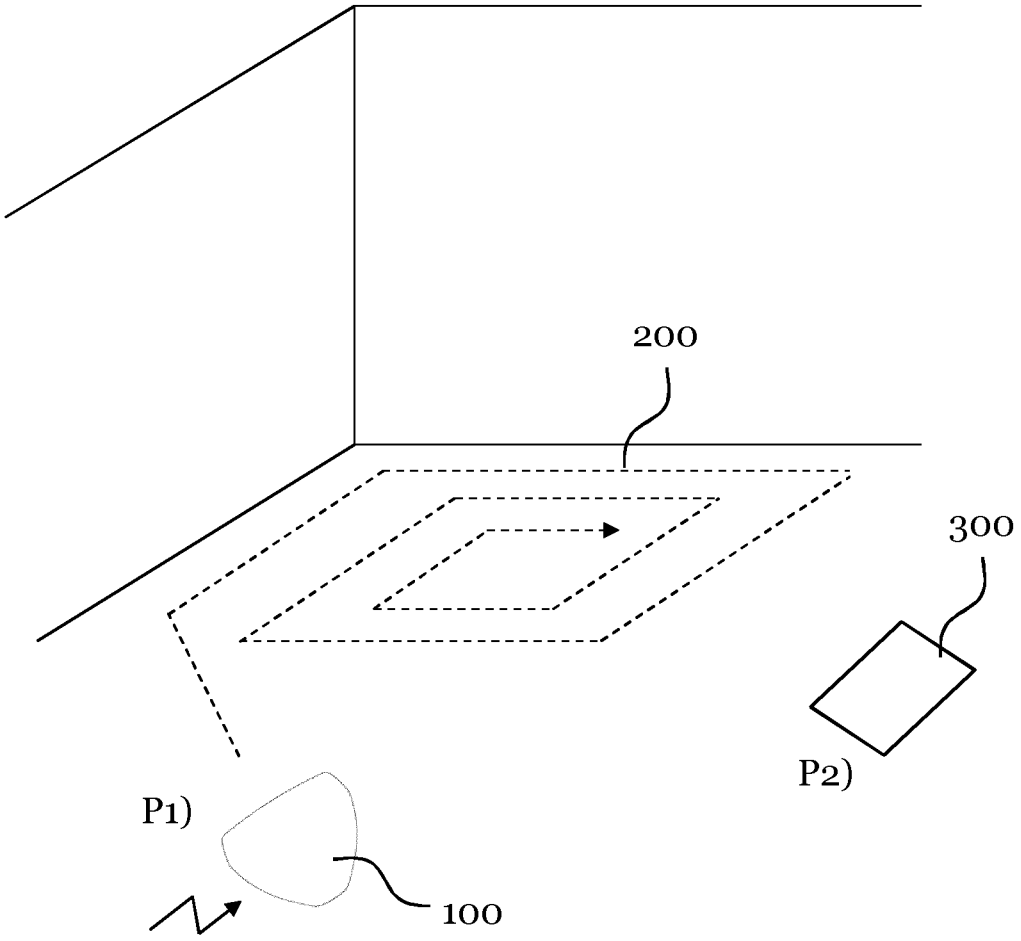

Figure 1

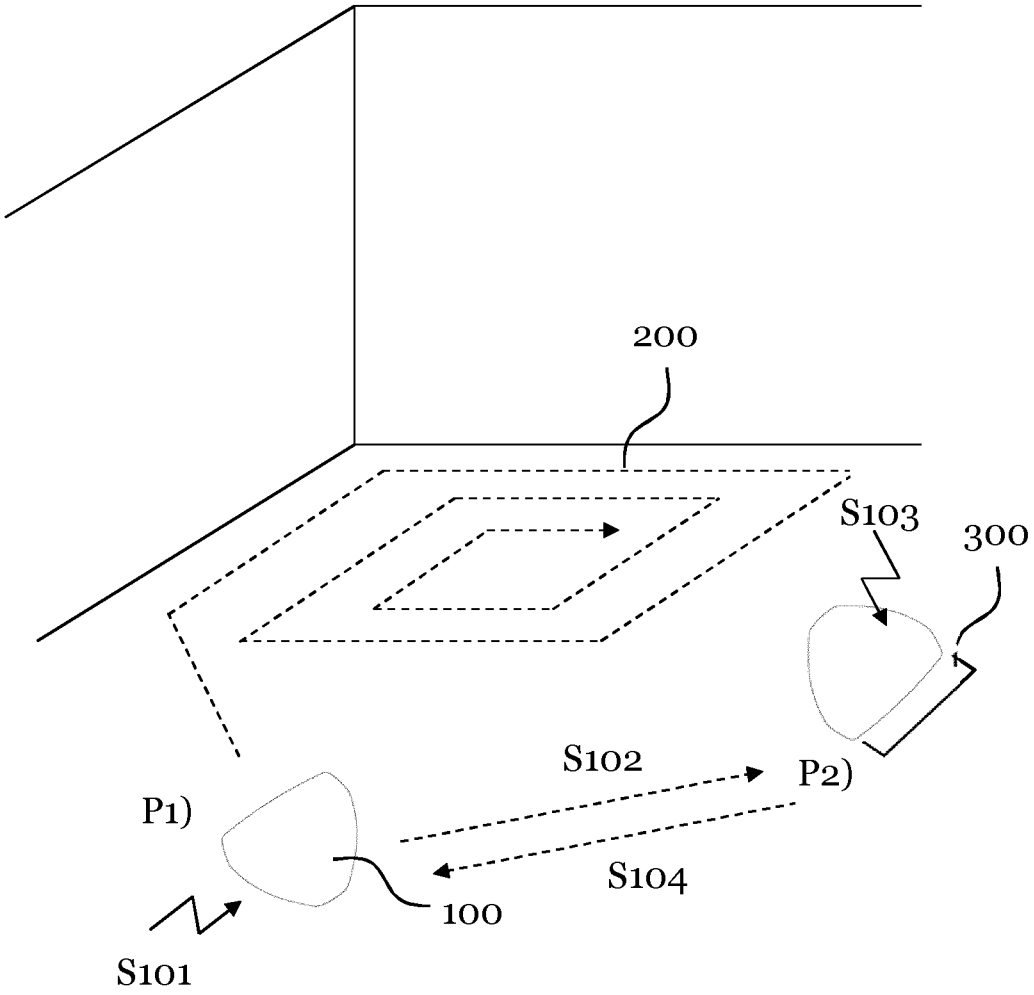

Figure 2

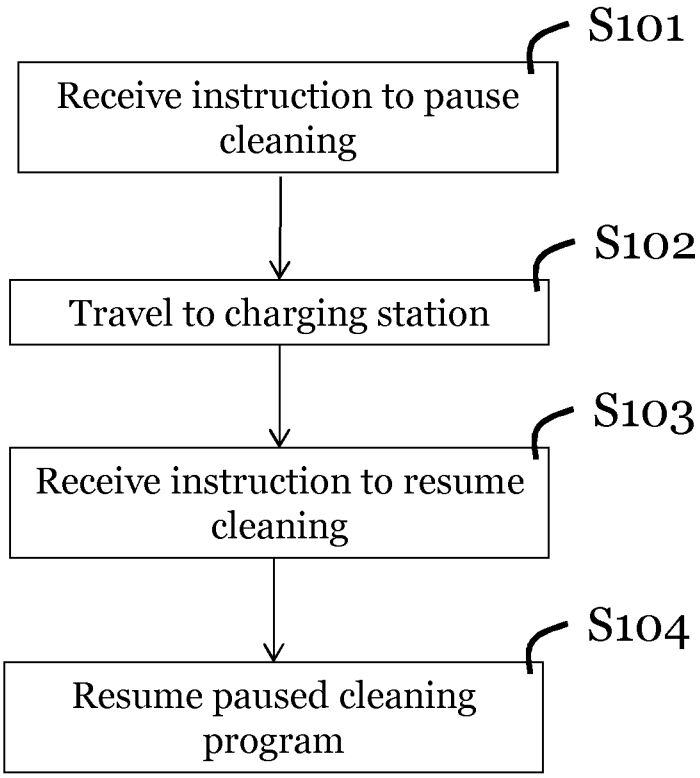
S101
Receive instruction to pause cleaning
S102
Travel to charging station
S103
Receive instruction to resume cleaning
S104
Resume paused cleaning program

Figure 3

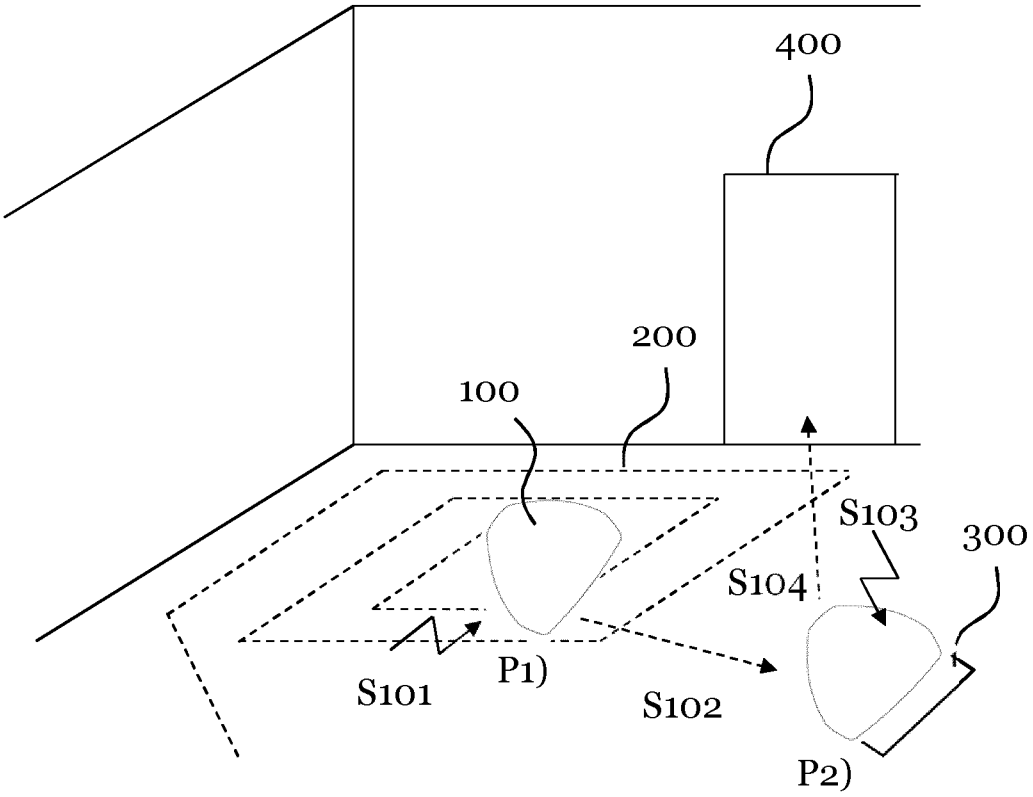

Figure 4

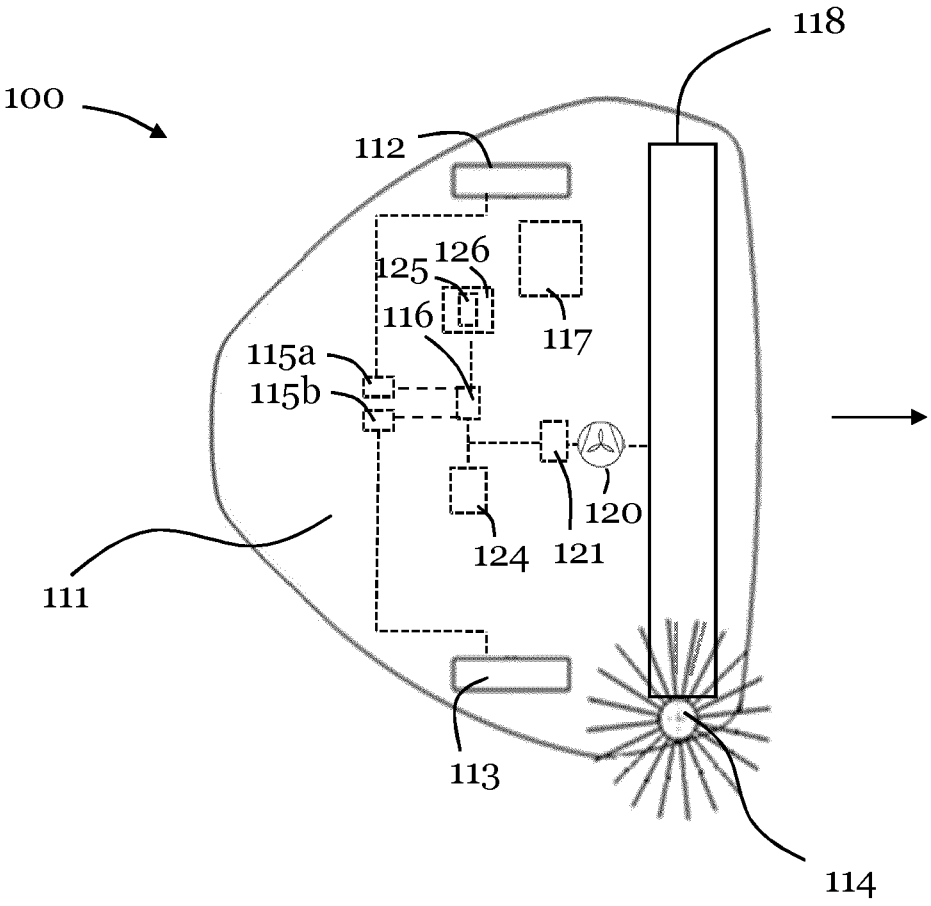

Figure 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/072267

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L9/28
ADD.

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)
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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015/000068 A1 (TSUBOI MASANORI [JP] ET AL) 1 January 2015 (2015-01-01) paragraph [0076] - paragraph [0079] paragraph [0173]; figures 1-8	1-14
A	US 2014/207280 A1 (DUFFLEY SAMUEL [US] ET AL) 24 July 2014 (2014-07-24) paragraph [0155]; figures 1-4	1-14
A	DE 20 2017 000833 U1 (LG ELECTRONICS INC [KR]) 8 March 2017 (2017-03-08) paragraph [0060] - paragraph [0067]; figures	1-14

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 May 2018	06/06/2018

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Masset, Markus

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2017/072267

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015000068 A1	01-01-2015	CN 104125792 A	29-10-2014
		JP 5968627 B2	10-08-2016
		JP 2013146309 A	01-08-2013
		KR 20140106751 A	03-09-2014
		TW 201336464 A	16-09-2013
		US 2015000068 A1	01-01-2015
		WO 2013108709 A1	25-07-2013
US 2014207280 A1	24-07-2014	AU 2013374347 A1	09-04-2015
		AU 2014207323 A1	09-04-2015
		AU 2017200992 A1	02-03-2017
		CA 2886106 A1	24-07-2014
		CA 2886451 A1	24-07-2014
		CN 104470685 A	25-03-2015
		CN 104769962 A	08-07-2015
		CN 107411639 A	01-12-2017
		CN 107518826 A	29-12-2017
		EP 2945783 A1	25-11-2015
		EP 2946567 A1	25-11-2015
		JP 2016513981 A	19-05-2016
		JP 2016515311 A	26-05-2016
		JP 2018033977 A	08-03-2018
		US 2014207280 A1	24-07-2014
		US 2016282862 A1	29-09-2016
		WO 2014113091 A1	24-07-2014
		WO 2014113713 A1	24-07-2014
		WO 2014113806 A1	24-07-2014
DE 202017000833 U1	08-03-2017	DE 202017000833 U1	08-03-2017
		EP 3207847 A2	23-08-2017
		EP 3300647 A1	04-04-2018
		US 2017238778 A1	24-08-2017