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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 December 2023 (14.12.2023)

WIPO | PCT

(10) International Publication Number
WO 2023/237647 A1

(51) International Patent Classification:
E05F 15/74 (2015.01) *E05F 15/76* (2015.01)

(21) International Application Number:
PCT/EP2023/065331

(22) International Filing Date:
08 June 2023 (08.06.2023)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2250698-4 09 June 2022 (09.06.2022) SE

(71) Applicant: **ASSA ABLOY AB** [SE/SE]; P.O. Box 70340, 107 23 Stockholm (SE).

(72) Inventors: **SKARP, Daniel**; Gethagsvägen 22, 182 47 Enebyberg (SE). **MERKLAND, Jonas**; Polluxgränd 5, 175 57 Järfälla (SE). **VON MATERN, Johan**; Stråkvägen 49A, 187 34 Täby (SE).

(74) Agent: **KRANSELL & WENNBORG KB**; P.O. Box 27834, 115 93 STOCKHOLM (SE).

(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, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, 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, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, 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, ME, 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))*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: DETERMINING WHEN TO PROVIDE ASSISTANCE TO OPEN A DOOR

(57) Abstract: Method for determining when to provide assistance to open a door (15), the method being performed by an assistance determiner (1). The method comprises: converting (40) mechanical energy from when the door is opened without assistance to electrical energy and storing the electrical energy in an energy storage device (25); determining (42) to provide assistance in opening the door (15) for a person; and providing (44) assistance to open the door (15), when it is determined to provide assistance, by causing a motor to convert electrical energy from the energy storage device (25) to mechanical energy for providing assistance to open the door (15).

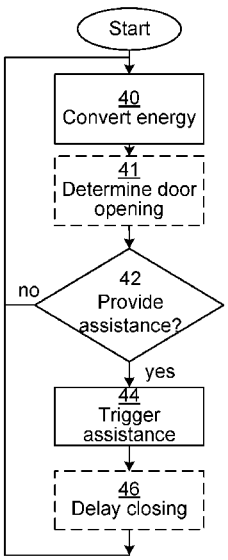


Fig. 2A

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DETERMINING WHEN TO PROVIDE ASSISTANCE TO OPEN A DOOR

TECHNICAL FIELD

[0001] The present disclosure relates to the field of determining when to provide assistance to open a door.

BACKGROUND

[0002] Door operators for opening and/or closing doors have been used for decades. Door operators use motors to open the door when a person approaches and wants to pass through. The doors can be sliding doors, swing doors or revolving doors. Door operators have the advantage that people do not need to use handles or muscle power to open the door. The user experience is convenient, and it allows people that may otherwise need human assistance to pass through, e.g. people in wheelchairs or people that carry items in both hands.

[0003] While a door operator is convenient, the installation is costly. Power cables need to be laid to allow the door operator to power the motor. Battery power is not sufficient to provide consistent door opening operation.

SUMMARY

[0004] One object is to reduce installation requirements for an installation where assistance to open a door is provided.

[0005] According to a first aspect, it is provided a method for determining when to provide assistance to open a door. The method is performed by an assistance determiner. The method comprises: converting mechanical energy from when the door is opened without assistance to electrical energy and storing the electrical energy in an energy storage device; determining to provide assistance in opening the door for a person; and providing assistance to open the door, when it is determined to provide assistance is determined, by causing a motor to convert electrical energy from the energy storage device to mechanical energy for providing assistance to open the door.

[0006] The determining to provide assistance may be based on determining that a speed of opening the door by a user is less than a threshold opening speed.

[0007] The determining to provide assistance may comprise: obtaining at least one image from an image capturing device, the image covering a space near the door; detecting a person in the image; and determining, based on the appearance of the person in the at least one image, that the person is in need of assistance in opening the door.

[0008] The appearance of the person may comprise that the person is in a wheelchair.

[0009] The appearance of the person may comprise that the person carries one or more objects with both hands.

[0010] The appearance of the person may comprise that the person carries a white cane.

[0011] The obtaining may comprise obtaining a sequence of images, in which case the appearance of the person comprises that the person is walking at a speed lower than a threshold movement speed.

[0012] The determining to provide assistance may comprise: determining an identity associated with the person; and determining that the identity is associated with a need to provide assistance in opening the door.

[0013] The determining an identity associated with the person may be based on determining a credential of an electronic key of the person.

[0014] The determining that the identity is associated with a need to provide assistance in opening the door may comprise reading a validity time window associated with the identity and determining that a need to provide assistance in opening the door only exists when a current time is within the validity time window.

[0015] The determining that the identity is associated with a need to provide assistance may also comprise determining that the person shows intent to pass through the door.

[0016] The providing assistance to open the door may comprise causing a motor to open the door.

[0017] The providing assistance to open the door may comprise causing a motor to provide an assisting force to open the door that is not sufficient to open the door by itself.

[0018] The converting mechanical energy to electrical energy may comprise utilizing an electromechanical machine in a generator mode; in which case the providing assistance to open the door comprises utilizing the electromechanical machine in a motor mode.

[0019] The method may further comprise, prior to providing assistance to open the door: determining that the door has begun to be opened.

[0020] The method may further comprise: delaying, after providing assistance to open the door, a closing operation of the door when it is determined to provide assistance in opening the door.

[0021] The electrical energy in the energy storage device may be used to power processing to perform the determining to provide assistance.

[0022] According to a second aspect, it is provided an assistance determiner for determining when to provide assistance to open a door. The assistance determiner comprises: a processor; and a memory storing instructions that, when executed by the processor, cause the assistance determiner to: convert mechanical energy from when the door is opened without assistance to electrical energy and storing the electrical energy in an energy storage device; determine to provide assistance in opening the door for a person; and provide assistance to open the door, when it is determined to provide assistance is determined, by causing a motor to convert electrical energy from the energy storage device to mechanical energy for providing assistance to open the door.

[0023] The instructions to determine to provide assistance may be based on determining that a speed of opening the door by a user is less than a threshold opening speed.

[0024] The determining to provide assistance may comprise instructions that, when executed by the processor, cause the assistance determiner to: obtain at least one image from an image capturing device, the image covering a space near the door; detect a person in the image; and determine, based on the appearance of the person in the at least one image, that the person is in need of assistance in opening the door.

[0025] The appearance of the person may comprise that the person is in a wheelchair.

[0026] The appearance of the person may comprise that the person carries one or more objects with both hands.

[0027] The appearance of the person may comprise that the person carries a white cane.

[0028] The instructions to obtain may comprise instructions that, when executed by the processor, cause the assistance determiner to obtain a sequence of images, in which case the appearance of the person comprises that the person is walking at a speed lower than a threshold movement speed.

[0029] The instructions to determining to provide assistance may comprise instructions that, when executed by the processor, cause the assistance determiner to: determine an identity associated with the person; and determining that the identity is associated with a need to provide assistance in opening the door.

[0030] The instructions to determine an identity associated with the person may be based on determining a credential of an electronic key of the person.

[0031] The instructions to determine that the identity is associated with a need to provide assistance in opening the door may comprise instructions that, when executed by the processor, cause the assistance determiner to read a validity time window associated with the identity and determining that a need to provide assistance in opening the door only exists when a current time is within the validity time window.

[0032] The instructions to determine that the identity is associated with a need to provide assistance may also comprise instructions that, when executed by the processor,

cause the assistance determiner to determine that the person shows intent to pass through the door.

[0033] The instructions to provide assistance to open the door may comprise instructions that, when executed by the processor, cause the assistance determiner to cause a motor to open the door.

[0034] The instructions to providing assistance to open the door may comprise instructions that, when executed by the processor, cause the assistance determiner to cause a motor to provide an assisting force to open the door that is not sufficient to open the door by itself.

[0035] The instructions to convert mechanical energy to electrical energy may comprise instructions that, when executed by the processor, cause the assistance determiner to utilise an electromechanical machine in a generator mode; in which case the instructions to provide assistance to open the door comprise instructions that, when executed by the processor, cause the assistance determiner to utilize the electromechanical machine in a motor mode.

[0036] The assistance determiner may further comprise instructions that, when executed by the processor, cause the assistance determiner to, prior to providing assistance to open the door: determine that the door has begun to be opened.

[0037] The assistance determiner may further comprise instructions that, when executed by the processor, cause the assistance determiner to: delay, after providing assistance to open the door, a closing operation of the door when it is determined to provide assistance in opening the door.

[0038] The electrical energy in the energy storage device may be used to power processing to perform the determining to provide assistance.

[0039] According to a third aspect, it is provided a computer program for determining when to provide assistance to open a door. The computer program comprises computer program code which, when executed on an assistance determiner causes the assistance determiner to: convert mechanical energy from when the door is

opened without assistance to electrical energy and storing the electrical energy in an energy storage device; determine to provide assistance in opening the door for a person; and provide assistance to open the door, when it is determined to provide assistance is determined, by causing a motor to convert electrical energy from the energy storage device to mechanical energy for providing assistance to open the door.

[0040] According to a fourth aspect, it is provided a computer program product comprising a computer program according to the third aspect and a computer readable means comprising non-transitory memory in which the computer program is stored.

[0041] 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

[0042] Aspects and embodiments are now described, by way of example, with reference to the accompanying drawings, in which:

[0043] Fig 1 is a schematic diagram showing an environment in which embodiments presented herein can be applied;

[0044] Figs 2A-C are flow charts illustrating methods for determining door operation of a door;

[0045] Fig 3 is a schematic diagram illustrating components of the assistance determiner of Fig 1; and

[0046] Fig 4 shows one example of a computer program product comprising computer readable means.

DETAILED DESCRIPTION

[0047] The aspects of the present disclosure will now be described more fully hereinafter with reference to the accompanying drawings, in which certain embodiments of the invention are shown. These aspects may, however, be embodied in many different forms and should not be construed as limiting; rather, these embodiments are provided by way of example so that this disclosure will be thorough and complete, and to fully convey the scope of all aspects of invention to those skilled in the art. Like numbers refer to like elements throughout the description.

[0048] According to embodiments presented herein, energy harvesting is used to convert mechanical energy from normal (non-assisted) door openings and/or closings to electrical energy. This electrical energy is not sufficient to sufficiently assist every door opening, and is thus rationed such that only when it is determined to provide assistance in opening the door is such assistance provided. In this way, assistance can be provided when it is really needed, while the system does not need to hard-wired for power. This greatly reduces the installation requirements and costs, whereby such system for assisting door opening can easily be provided both in a new installation, and also as a retrofit solution.

[0049] Fig 1 is a schematic diagram showing an environment in which embodiments presented herein can be applied. Access to a physical space 16 is controlled by a door 15, which is optionally selectively unlockable. The door 15 stands between a first physical space 14 and a second physical space 16. The door 15 can be a swivel door, sliding door (one-leaf or multiple leaves), revolving door, etc. The door is provided in a surrounding structure 17, such as a wall, fence, etc.

[0050] Optionally, in order to control access to the physical space 16, by selectively unlocking the door 15, an electronic lock 12 can be provided. When provided, the electronic lock 12 is controllable to be in a locked state or in an unlocked state. When the electronic lock 12 is in an unlocked state, the door 15 can be opened and when the electronic lock 12 is in a locked state, the door 15 cannot be opened. In this way, access to second physical space 16 can be controlled by the electronic lock 12. The electronic lock 12 can be provided in the door 15 or in the surrounding structure 17. The electronic

lock 12 can evaluate access of a person 5 by communicating with an electronic key 2 of the person 5, or using biometrics, such as face recognition, iris recognition, fingerprint recognition, etc. Alternatively or additionally, the person 5 enters a personal identification number (PIN) for access. Alternatively or additionally, access through the door 12 can be controlled with a traditional, mechanical, lock.

[0051] According to embodiments presented herein, an assistance determiner 1 is provided to determine when to provide assistance in opening the door. The assistance determiner comprises an energy harvesting device 23, an energy storage device 25 and a door opening assistance device 26. The energy harvesting device 23 converts mechanical energy from a regular (non-assistant) door opening to electrical energy. This is achieved using a generator and optionally, springs, gears and electric components to improve the performance of the energy conversion as known in the art *per se*. The energy storage device 25 can be a battery, capacitor, super-capacitor or any *other* suitable device for storing electrical energy received from the energy harvesting device 23. The door opening assistance device 26, when controlled to do so by the assistance determiner 1, assists in the opening operation of the door, e.g. using a motor or other device for converting electrical energy from the energy storage device 25 to mechanical energy. It is to be noted that the door opening assistance device 26 can physically form part of the energy harvesting device 23, e.g. a generator of the energy harvesting device 23 can also operate in reverse operation as a motor in door opening assistance device 26.

[0052] In one embodiment, the door opening assistance device 26 provides sufficient assistance to open the door 15 by itself. In this case, the assistance determiner 1 can be considered to be a door operator.

[0053] In one embodiment, the door opening assistance device 26 provides partial assistance, being part of the energy needed to open the door 15, in which case the user 5 needs to provide the remainder of energy using muscle force. In this case, the assistance determiner 1 can be considered to be a device for assisted opening.

[0054] Optionally, the door opening assistance device 26 is configurable in how much assistance is given. For instance, in one embodiment, when the amount of energy in the energy storage device 25 is greater than an energy threshold, the door opening

assistance device 26 can open the door 15 by itself. On the other hand, when the amount of energy in the energy storage device 25 is less than the energy threshold, the door opening assistance device 26 provides partial assistance. In one embodiment, the amount of assistance given depends on the type of person that is detected.

[0055] An image capturing device 11 is provided to capture images covering a space 28 near the door 15. The image capturing device 11 can be any one or more of a camera, a radar, a time-of-flight sensor, a lidar, infrared sensor, etc. While only one image capturing device 11 is shown in Fig 1 in the first physical space 14, there can also be a corresponding image capturing device in the second physical space 16. The image capturing device can form part of the assistance determiner 1, or can be external to, but connected to, the assistance determiner 1.

[0056] Figs 2A-C are flow charts illustrating embodiments of methods for determining when to provide assistance to open a door 15. The method is performed by an assistance determiner 1. First, embodiments illustrated by Fig 2A will be described.

[0057] In a *convert energy* step 40, the assistance determiner 1 converts mechanical energy from when the door is opened (in the opening of the door and/or in the closing of the door) without assistance to electrical energy and storing the electrical energy in an energy storage device 25. The energy conversion occurs using the door opening assistance device 26. Specifically, when a person opens the door without assistance, mechanical energy from the opening is stored in a spring. When the person releases the door, the mechanical energy in the (tensioned) spring causes the door to close. During the door closing, (at least part of) the mechanical energy from the spring is converted to electrical energy. In one embodiment, the conversion of mechanical energy to electrical energy comprises utilizing an electromechanical machine 21 (of the door opening assistance device 26) in a generator mode.

[0058] In an optional *determine door opening* step 41, the assistance determiner 1 determines that the door 15 has begun to be opened. This can be assumed to be that a person is trying to open the door. This can be a trigger to perform the rest of the method. In this way, there is no need for an electric striking plate since the door is no longer engaged with the striking plate if the door has started to be opened.

[0059] In a conditional *determine to provide assistance* step 42, the assistance determiner 1 determines whether to provide assistance in opening the door 15 for a person or not. When it is determined to provide assistance, the method proceeds to a *trigger assistance* step 44. Otherwise, the method returns to the convert energy step 40.

[0060] The determining to provide assistance can be based on determining that a speed of opening the door by a user is less than a threshold opening speed. In other words, if someone opens the door slowly, this can be a sign that the person opening does not have enough muscle power to easily open the door and would benefit from assistance.

[0061] Optionally, the electrical energy in the energy storage device 25 is used to power the processing for performing this step. In this way, the assistance determiner 1 requires no additional energy source.

[0062] In the *trigger assistance* step 44, the assistance determiner 1 provides assistance to open the door 15, when it is determined to provide assistance The assistance is provided by causing a motor to convert electrical energy from the energy storage device 25 to mechanical energy for providing assistance to open the door 15.

[0063] The providing assistance to open the door 15 can comprises causing a motor to open the door. Alternatively, the providing assistance to open the door 15 comprises causing a motor to provide an assisting force to open the door that is not sufficient to open the door 15 by itself.

[0064] In one embodiment, the providing assistance to open the door 15 comprises utilizing the electromechanical machine 21 in a motor mode. In other words, the electromechanical machine 21 is in this case reversible between a generator mode used by the door opening assistance device 26 and a motor mode when providing assistance.

[0065] In an optional *delay closing* step 46, the assistance determiner 1 delays 46, after the triggering of assistance to open the door 15, a closing operation of the door 15 when it is determined to provide assistance in opening the door 15. The delay can be that the door closing is completely delayed, i.e. that the door remains open for a longer period of time, or that the speed of door closing is reduced.

[0066] Optionally, the image capturing device 11 can be used to detect when there are people and/or objects in the way of closing the door. When the door closing can be controlled, the closing operation can be thereby be controlled to prevent closing the door on the person/object.

[0067] Looking now to Fig 2B, optional sub-steps of the determine to *provide assistance* step 42 are shown.

[0068] In an optional *obtain image* sub-step 42a, the assistance determiner 1 obtains at least one image from an image capturing device 11. The image covers a space near the door 15. Optionally, the obtaining comprises obtaining a sequence of images, i.e. a video sequence.

[0069] In an optional *detect person* sub-step 42b, the assistance determiner 1 detects a person in the image.

[0070] In an optional *determine person need of assistance* sub-step 42c, the assistance determiner 1 determines, based on the appearance of the person in the at least one image, that the person is in need of assistance in opening the door 15.

[0071] In one embodiment, the appearance of the person indicates that the person is in a wheelchair, whereby assistance to open the door is of great help. In one embodiment, the appearance of the person indicates that the person carries one or more objects with both hands, in which case the person can pass through the door without putting down the objects if assistance is provided. In one embodiment, the appearance of the person indicates that the person carries a white cane, indicating that the person is blind and would greatly benefit from assistance for opening the door. In one embodiment, when step 42a obtains a sequence of images, the appearance of the person indicates that the person is walking at a speed lower than a threshold movement speed. This can indicate reduced physical strength, whereby it can be beneficial to provide door opening assistance.

[0072] Looking now to Fig 2C, optional sub-steps of the determine to *provide assistance* step 42 are shown.

[0073] In an optional *determine identity* sub-step 42d, the assistance determiner 1 determines an identity associated with the person. The determining an identity associated with the person can e.g. be based on determining a credential of an electronic key of the person, and/or using biometrics (such as face recognition, iris recognition or fingerprint recognition).

[0074] In an optional *determine identity assistance need* sub-step 42e, the assistance determiner 1 determines that the determined identity is associated with a need to provide assistance in opening the door 15. This need can be determined in communication with a server or by looking up in a local database within the assistance determiner. In one embodiment, the need to provide assistance is provided by the electronic key, optionally cryptographically signed by a trusted third party to prevent than anyone can request door opening assistance.

[0075] In one embodiment, a validity time window is also applied. Hence, the determining that the identity is associated with a need to provide assistance in opening the door 15 comprises reading a validity time window associated with the identity, and determining that a need to provide assistance in opening the door only exists when a current time is within the validity time window. For instance, consider the case with a janitor that works to clean rooms in the building between 9 a.m. and 3 p.m. A validity time window is then applied for the time between 9 a.m. and 3 p.m., during which the janitor is likely to have a cleaning cart. At other times, the janitor may be arriving or leaving work, at which point assistance is not needed. Another example is when a person with multiple responsibilities is responsible for receiving deliveries, and these deliveries only arrive between 7 a.m. and 9 a.m. The validity time window can then be set to 7 a.m. and 9 a.m. for that person.

[0076] Optionally, the step of determining that the identity is associated with a need to provide assistance also comprises determining that the person shows intent to pass through the door. The determination of intent can e.g. be based on a movement trajectory derived from a sequence of images from the image capturing device. By conditioning the determination of providing assistance on intent, the number of inadvertent openings is reduced, saving significant amounts of energy.

[0077] Using embodiments presented herein, door opening assistance is restricted and energy harvesting is used to collect energy when door opening assistance is not provided. In this way, the assistance determiner 1 does not need to be hard-wired with power and can rely on a local energy storage device (e.g. battery) that is charged using the energy harvesting and that is used to power the door opening assistance operation.

[0078] Fig 3 is a schematic diagram illustrating components of the assistance determiner 1 of Fig 1. The assistance determiner comprises an energy harvesting device 23, an energy storage device 25 and a door opening assistance device 26, as described above with reference to Fig 1.

[0079] A processor 60 is provided using any combination of one or more of a suitable central processing unit (CPU), graphics processing unit (GPU), multiprocessor, microcontroller, digital signal processor (DSP), etc., capable of executing software instructions 67 stored in a memory 64, which can thus be a computer program product. The processor 60 could alternatively be implemented using an application specific integrated circuit (ASIC), field programmable gate array (FPGA), etc. The processor 60 can be configured to execute the method described with reference to Figs 2A-C above.

[0080] The memory 64 can be any combination of random-access memory (RAM) and/or read-only memory (ROM). The memory 64 also comprises non-transitory persistent storage, which, for example, can be any single one or combination of magnetic memory, optical memory, solid-state memory or even remotely mounted memory.

[0081] A data memory 66 is also provided for reading and/or storing data during execution of software instructions in the processor 60. The data memory 66 can be any combination of RAM and/or ROM.

[0082] An I/O interface 62 is provided for communicating with external and/or internal entities using wired communication, e.g. based on Ethernet or Universal Serial Bus (USB), and/or wireless communication, e.g. Wi-Fi, and/or a cellular network, complying with any one or a combination of next generation mobile networks (fifth generation, 5G), LTE (Long Term Evolution), UMTS (Universal Mobile

Telecommunications System) utilising W-CDMA (Wideband Code Division Multiplex), or any other current or future wireless network, as long as the principles described hereinafter are applicable.

[0083] Other components of the assistance determiner 1 are omitted in order not to obscure the concepts presented herein.

[0084] Fig 4 shows one example of a computer program product 90 comprising computer readable means. On this computer readable means, a computer program 91 can be stored in a non-transitory memory. The computer program can cause a processor to execute a method according to embodiments described herein. In this example, the computer program product is in the form of a removable solid-state memory, e.g. a Universal Serial Bus (USB) drive. As explained above, the computer program product could also be embodied in a memory of a device, such as the computer program product 64 of Fig 4. While the computer program 91 is here schematically shown as a section of the removable solid-state memory, the computer program can be stored in any way which is suitable for the computer program product, such as another type of removable solid-state memory, or an optical disc, such as a CD (compact disc), a DVD (digital versatile disc) or a Blu-Ray disc.

[0085] The aspects of the present disclosure have 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. Thus, while various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

CLAIMS

1. A method for determining when to provide assistance to open a door (15), the method being performed by an assistance determiner (1), the method comprising:

converting (40) mechanical energy from when the door is opened without assistance to electrical energy and storing the electrical energy in an energy storage device (25);

determining (42) to provide assistance in opening the door (15) for a person; and

providing (44) assistance to open the door (15), when it is determined to provide assistance is determined, by causing a motor to convert electrical energy from the energy storage device (25) to mechanical energy for providing assistance to open the door (15).

2. The method according to claim 1, wherein the determining (42) to provide assistance is based on determining that a speed of opening the door by a user is less than a threshold opening speed.

3. The method according to claim 1, wherein the determining (42) to provide assistance comprises:

obtaining (42a) at least one image from an image capturing device (11), the image covering a space near the door (15);

detecting (42b) a person in the image; and

determining (42c), based on the appearance of the person in the at least one image, that the person is in need of assistance in opening the door (15).

4. The method according to claim 3, wherein the appearance of the person comprises that the person is in a wheelchair.

5. The method according to claim 3 or 4, wherein the appearance of the person comprises that the person carries one or more objects with both hands.

6. The method according to any one of claims 3 to 5, wherein the appearance of the person comprises that the person carries a white cane.

7. The method according to any one of claims 3 to 5, wherein the obtaining (42a) comprises obtaining a sequence of images, and wherein the appearance of the person comprises that the person is walking at a speed lower than a threshold movement speed.

8. The method according to claim 1, wherein the determining (42) to provide assistance comprises:

determining (42d) an identity associated with the person; and

determining (42e) that the identity is associated with a need to provide assistance in opening the door (15).

9. The method according to claim 8, wherein the determining (42d) an identity associated with the person is based on determining a credential of an electronic key of the person.

10. The method according to claim 8 or 9, wherein the determining (42e) that the identity is associated with a need to provide assistance in opening the door (15) comprises reading a validity time window associated with the identity and determining that a need to provide assistance in opening the door only exists when a current time is within the validity time window.

11. The method according to any one of claims 8 to 10, wherein the determining (42e) that the identity is associated with a need to provide assistance also comprises determining that the person shows intent to pass through the door.

12. The method according to any one of the preceding claims, wherein the providing (44) assistance to open the door (15) comprises causing a motor to open the door.

13. The method according to any one of the preceding claims, wherein the providing (44) assistance to open the door (15) comprises causing a motor to provide an assisting force to open the door that is not sufficient to open the door (15) by itself.

14. The method according to any one of the preceding claims, wherein the converting (40) mechanical energy to electrical energy comprises utilizing an electromechanical machine (21) in a generator mode; and

the providing (44) assistance to open the door (15), comprises utilizing the electromechanical machine (21) in a motor mode.

15. The method according to any one of the preceding claims, further comprising, prior to providing (44) assistance to open the door (15):

determining (41) that the door has begun to be opened.

16. The method according to any one of the preceding claims, further comprising:

delaying (46), after providing (44) assistance to open the door (15), a closing operation of the door (15) when it is determined to provide assistance in opening the door (15).

17. The method according to any one of the preceding claims, wherein the electrical energy in the energy storage device (25) is used to power processing to perform the determining (42) to provide assistance.

18. An assistance determiner (1) for determining when to provide assistance to open a door (15), the assistance determiner (1) comprising:

a processor (60); and

a memory (64) storing instructions (67) that, when executed by the processor, cause the assistance determiner (1) to:

convert mechanical energy from when the door is opened without assistance to electrical energy and storing the electrical energy in an energy storage device (25);

determine to provide assistance in opening the door (15) for a person; and

provide assistance to open the door (15), when it is determined to provide assistance is determined, by causing a motor to convert electrical energy from the energy storage device (25) to mechanical energy for providing assistance to open the door (15).

19. A computer program (67, 91) for determining when to provide assistance to open a door (15), the computer program comprising computer program code which, when executed on an assistance determiner (1) causes the assistance determiner (1) to:

convert mechanical energy from when the door is opened without assistance to electrical energy and storing the electrical energy in an energy storage device (25);

determine to provide assistance in opening the door (15) for a person; and

provide assistance to open the door (15), when it is determined to provide assistance is determined, by causing a motor to convert electrical energy from the energy storage device (25) to mechanical energy for providing assistance to open the door (15).

20. A computer program product (64, 90) comprising a computer program according to claim 19 and a computer readable means comprising non-transitory memory in which the computer program is stored.

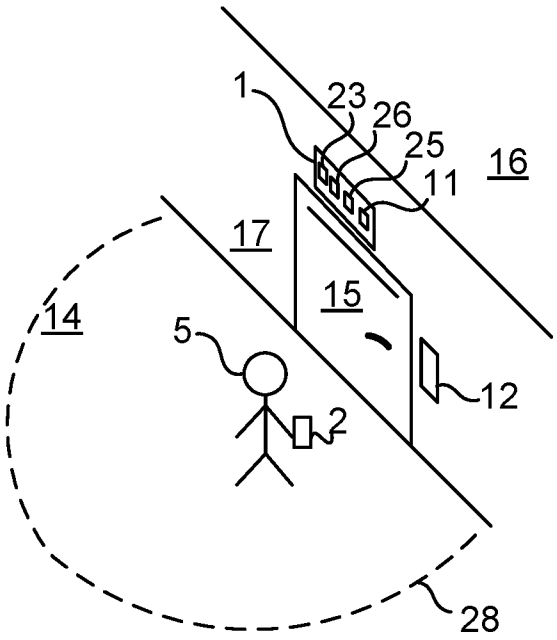


Fig. 1

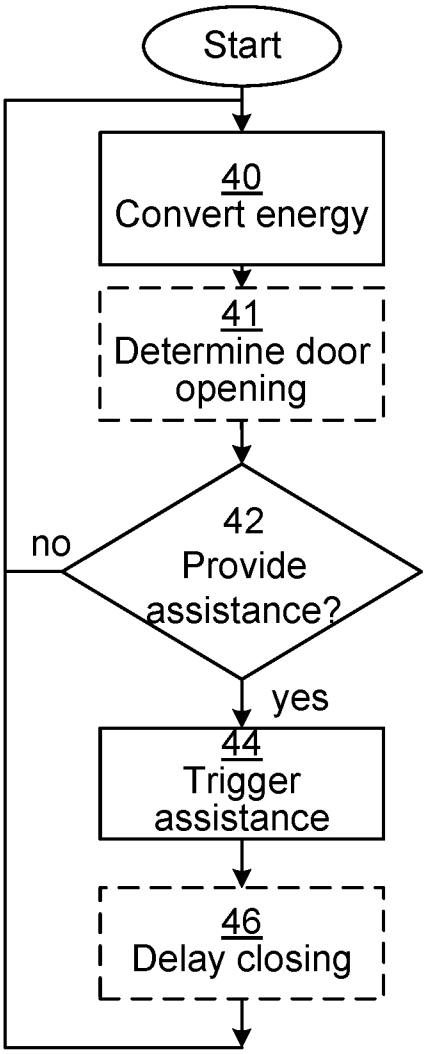


Fig. 2A

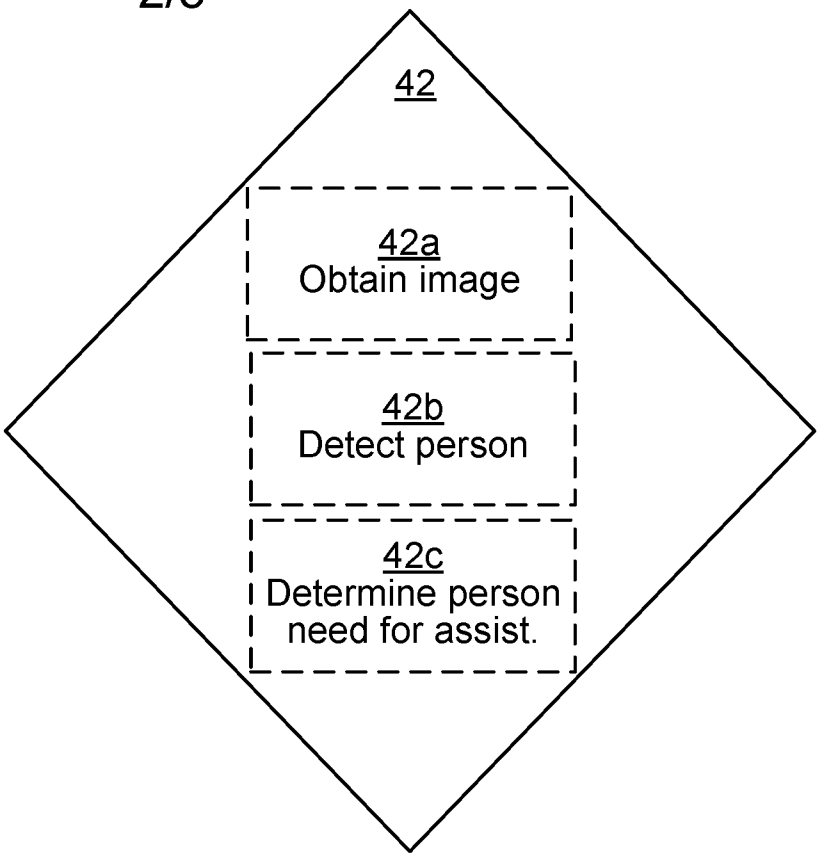


Fig. 2B

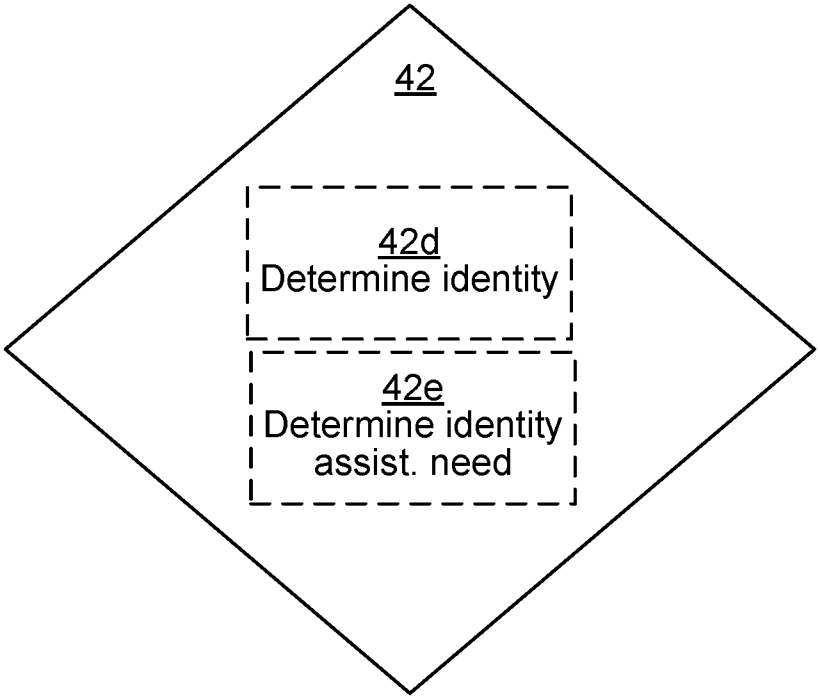


Fig. 2C

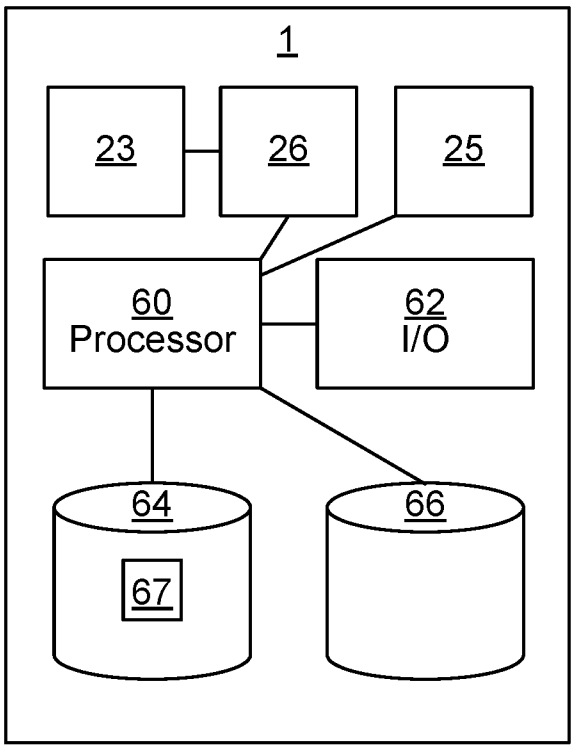


Fig. 3

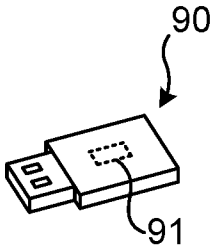


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2023/065331

A. CLASSIFICATION OF SUBJECT MATTER
INV. E05F15/74 E05F15/76
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)
E05F

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/012350 A1 (SIEMENS AG [DE]) 24 January 2013 (2013-01-24)	1,2, 8-15, 17-20
Y	page 2, lines 7-37 claims 1, 3	3-7,16

Y	WO 2021/049636 A1 (NEC SOLUTION INNOVATORS LTD [JP]; FULLTECH INC [JP]) 18 March 2021 (2021-03-18)	3-7
A	paragraphs [0020], [0021] paragraphs [0028], [0029] paragraph [0033] paragraph [0035] paragraph [0044]	1,18-20

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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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
19 September 2023	29/09/2023

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	Mund, André

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2023/065331

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 11 085 219 B2 (GEZE GMBH [DE]) 10 August 2021 (2021-08-10)	16
A	column 3, lines 10-33	1,2,4,5, 11

A	US 7 719 213 B2 (HERMAN S A [US] ET AL) 18 May 2010 (2010-05-18) figures column 5, lines 8-25 column 7, lines 21-36 claim 1	1,8,9, 11,12, 18-20

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2023/065331

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		JP 7311175 B2	19-07-2023
		JP WO2021049636 A1	18-03-2021
		US 2022341247 A1	27-10-2022
		WO 2021049636 A1	18-03-2021
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		EP 3361030 A1	15-08-2018
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US 7719213 B2	18-05-2010	NONE	