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(54)

METHOD FOR IMPROVING A MOVEMENT OF A FLAP, APPARATUS, VEHICLE AND COMPUTER PROGRAM

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Embodiments relate to a method 100 for improving a movement of a flap of a vehicle. The method 100 comprises determining 110 a movement profile indicative of a movement of a user relative to the vehicle. The method 100 further comprises determining 120 a movement parameter indicative of a movement of the flap of the
- vehicle. The determination of the movement parameter is based on the movement profile. Further, the method 100 comprises controlling 130 a movement of the flap of the vehicle. The control is based on the movement parameter.

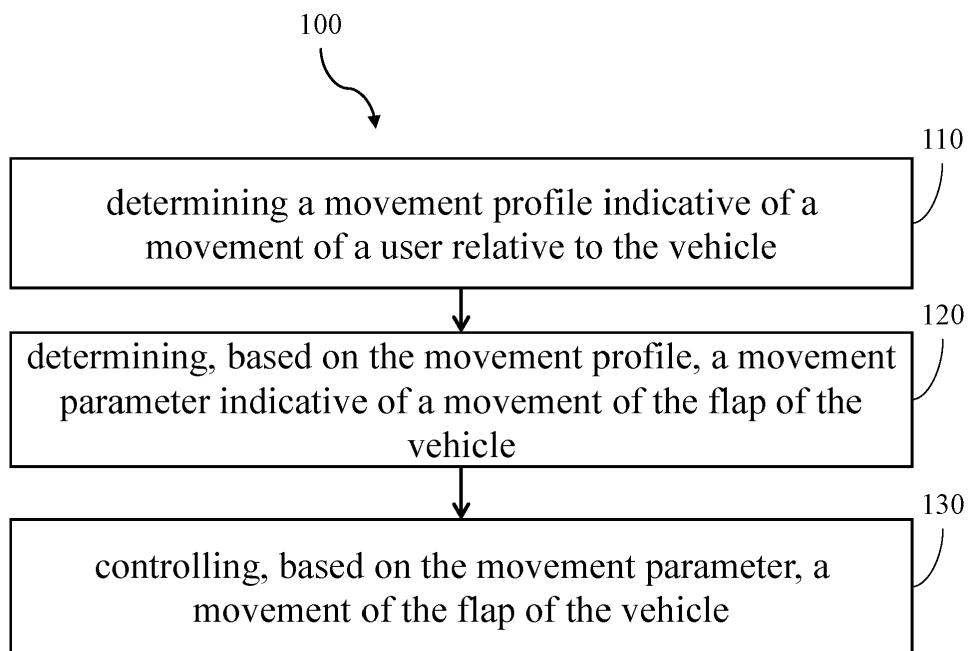


Fig. 1

Description

[0001] The present disclosure relates to the field of digital vehicle access. Embodiments relate to a method for improving a movement of flap of a vehicle, an apparatus, a vehicle and a computer program.

[0002] Existing systems for unlocking/opening a flap of a vehicle, for example a tailgate of a trunk or a front edge of a trunk, use so-called smart openers which, for example, enable opening by means of a gesture executed with a foot. In particular, this allows the flap to be opened without the use of hands. Other methods use detection of the time user equipment is in the immediate vicinity of a door that is to be opened. In this case, the door can be opened after a predefined period of time has elapsed. Both the gesture to be performed with a foot and waiting for a door to open can be perceived as unpleasant by a user. Thus, there may be a need to improve a movement of a flap of a vehicle.

[0003] It is therefore a finding that a movement of the flap, e.g., an opening, can be improved by determining an opening parameter based on a movement profile. The movement profile may be a movement profile of the user moving relative to the vehicle. The movement profile may indicate an intention of the user to use the flap, for example. Thus, the opening parameter may be indicative of an intended usage of the flap by the user. In this way, the movement of the flap can be improved by controlling the movement of the flap based on the opening parameter.

[0004] Examples provide a method for improving a movement of a flap of a vehicle. The method comprises determining a movement profile indicative of a movement of a user relative to the vehicle. The method further comprises determining a movement parameter indicative of a movement of the flap of the vehicle. The determination of the movement parameter is based on the movement profile. Further, the method comprises controlling a movement of the flap of the vehicle. The control is based on the movement parameter. The movement profile of the user can be utilized to determine, e.g., an intention of the user, a time of usage. In this way, the movement of the flap can be controlled in an improved way. For example, the flap can be controlled such that it is already opened when a user is within a certain distance to the flap, e.g., by adjusting a movement speed of the flap.

[0005] In an example, the movement profile may comprise information about a movement speed of the user. The movement speed of the user may be combined with a position of the user relative to the flap to determine a time for the control of the movement of the flap, for example. For example, the movement speed may be indicative of a velocity of the user, an acceleration and/or a deceleration. Thus, the movement of the flap can be initiated for different distances between user and flap. In this way, a reliability that the flap is open when the user is within a certain distance to the flap, can be increased.

[0006] In an example, the method may further com-

prise determining the movement parameter based on the movement speed of the user. Based on the movement speed of the user a movement of the flap can be controlled. For example, if the user approaches the flap with a higher speed, the movement speed of the flap may be increased. In this way, the flap can be opened in a shorter time to ensure that the flap is already open when the user is within a certain distance to the flap.

[0007] In an example, the movement profile may comprise information about a direction of the movement of the user relative to the vehicle. Determining the movement parameter may be further based on the direction of the movement of the user relative to the vehicle. For example, the user may approach the vehicle from a direction which overlaps a movement path of the flap. Thus, an opening of the flap, especially an opened flap, may obstruct the user. Therefore, the movement of the flap can be controlled such that no obstruction of the user may be caused. In this way, the movement of the flap can be controlled to increase a user experience.

[0008] In an example, the method may further comprise determining stop information indicative of a stop of the user during the movement of the user. Controlling may further comprise stopping the movement of the flap. Stopping of the movement of the flap is based on the stop information. This may allow an opening process of the flap to be stopped and optionally cancelled if the user stops, e.g., to walk away from the flap. For example, the flap can be closed if the user steps away from the flap without first fully opening the flap.

[0009] In an example, the method may further comprise determining a time parameter indicative of an estimated time of arrival of the user at the flap. Determining the opening parameter may be further based on the time parameter. In this way, it can be ensured that the flap is open when the user reaches the flap.

[0010] In an example, the movement profile may be determined based on sensor data of at least one of an ultra-wide band sensor, a camera or a Bluetooth sensor. In this way, the information about the movement profile can be determined in a facilitated way. For example, a digital key can be detected by an ultra-wide band sensor to determine the movement profile.

[0011] Examples relate to an apparatus, comprising interface circuitry and processing circuitry configured to perform a method as described above. Examples relate to a vehicle, comprising an apparatus as described above.

[0012] Examples further relate to a computer program having a program code for performing the method described above, when the computer program is executed on a computer, a processor, or a programmable hardware component.

[0013] Some examples of apparatuses, methods and/or computer programs will be described in the following by way of example only, and with reference to the accompanying figures, in which

Fig. 1 shows an example of a method for improving a movement of a flap of a vehicle; and

Fig. 2 shows a block diagram of an example of an apparatus, e.g., for a vehicle.

[0014] As used herein, the term "or" refers to a non-exclusive or, unless otherwise indicated (e.g., "or else" or "or in the alternative"). Furthermore, as used herein, words used to describe a relationship between elements should be broadly construed to include a direct relationship or the presence of intervening elements unless otherwise indicated. For example, when an element is referred to as being "connected" or "coupled" to another element, the element may be directly connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being "directly connected" or "directly coupled" to another element, there are no intervening elements present. Similarly, words such as "between", "adjacent", and the like should be interpreted in a like fashion.

[0015] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of example embodiments. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises", "comprising", "includes", or "including", when used herein, specify the presence of stated features, integers, steps, operations, elements or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components or groups thereof.

[0016] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which example embodiments belong. It will be further understood that terms, e.g., those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0017] Fig. 1 shows an example of a method 100 for improving a movement of a flap of a vehicle. The method 100 comprises determining 110 a movement profile indicative of a movement of a user relative to the vehicle. For example, the movement profile of the user may be indicative of an approach of the user to and/or a depart of the user from the vehicle. The movement profile may comprise a trajectory of the user. The movement profile may be determined based on sensor data received from a sensor, e.g., a sensor of the vehicle, a sensor of an infrastructure. For example, the method 100 may further comprise receiving sensor data from a sensor as described below.

[0018] The method 100 further comprises determining 120 a movement parameter indicative of a movement of

the flap of the vehicle. The determination of the movement parameter is based on the movement profile. The movement parameter may be indicative of a movement speed of, an opening/closing angle, a time to initiate an opening/closing of the flap, for example. The flap may be a door, a trunk lid, a frunk lid, for example.

[0019] Further, the method 100 comprises controlling 130 a movement of the flap of the vehicle. The control is based on the movement parameter. Using the movement parameter may allow to adjust the movement of the flap to a user behavior. For example, a scenario where the flap is opened too late can be avoided. Thus, a more intelligent flap behavior can be achieved. Thus, the movement of the flap can be more user centric. For example, a movement speed, a time an opening of the flap is initiated can be adjusted based on the movement parameter.

[0020] In an example, the movement profile may comprise information about a movement speed of the user. The movement speed of the user can be used to determine a time for initiating an opening or closing of the flap. Thus, it can be ensured that the flap is open when the user reaches the flap, the flap is closed when the user is out of view of the flap, for example. For example, the movement speed may be combined with a position of the user relative to and/or a distance of the user to the flap. Thus, an initiating of an opening/closing may be triggered for different distances between user and flap dependent on the movement speed of the user, for example. For example, a function start of the flap (imitating of opening or closing) may depend on the movement speed of the user. If the user approaches quicker, the flap may start to open earlier/at a greater distance between user and flap, e.g., 3 m instead of 2 m. If the user departs quicker, the flap may start to close earlier/at a smaller distance between user and flap, e.g., 1 m instead of 2 m.

[0021] In an example, the method 100 may further comprise determining the movement parameter based on the movement speed of the user. For example, the movement parameter may be indicative of a movement speed of the flap. Thus, a movement speed of the flap can be adapted to a movement speed of the user. For example, the movement speed of the flap may be proportional to the movement speed of the user. In this way, a time needed for an opening or closing of the flap can be adapted to the user behavior. Thus, it can be ensured that the flap is open if the user reaches flap and/or closed if the user is out of view. For example, if the user approaches quicker, the movement speed of the flap can be increased. This may allow to open the flap until the user reaches the flap.

[0022] In an example, the movement profile may comprise information about a direction of the movement of the user relative to the vehicle. Determining the movement parameter may be further based on the direction of the movement of the user relative to the vehicle. A movement of the flap may depend on a direction of a movement of the user. For example, the user may ap-

proach the flap from a direction overlapping with an area crossed by the flap during the movement of the flap. In this case, the flap may obstruct the movement of the user. Thus, the movement of the flap can be adjusted to consider a direction of approach of the user. For example, the direction of approach of the user may be determined based on a trajectory of the user.

[0023] For example, if the user approaches from the front of the vehicle, a door may open only after the user passed the door. For example, if the user approaches from the side of the vehicle, a door may open slower. For example, if the user approaches from the rear of the vehicle, a door may open directly. For example, a door closing starts earlier if the user departs from the flap towards a certain direction. In this way, the movement of the flap can be adapted to an actual use case.

[0024] In an example, the method 100 may further comprise determining stop information indicative of a stop of the user during the movement of the user. Controlling may further comprise stopping the movement of the flap. Stopping the movement of the flap is based on the stop information. This may allow an interruption of the movement of the flap based on a changed movement of the user. For example, the user may approach the flap and may decide on this approach to cancel the approach. Thus, the user may stop relative to the flap. In this case the movement of the flap could also be stopped. For example, the movement speed of the flap may reflect the movement speed of the user. In this way, an opening or closing process of the flap can be interrupted which may increase a user experience.

[0025] In an example, the method 100 may further comprise determining a time parameter indicative of an estimated time of arrival of the user at the flap. Determining the opening parameter may be further based on the time parameter. For example, a user may approach with the quick movement speed from a certain direction to the flap. By determining the time parameter the movement speed and the direction of the approach of the user can be considered. Thus, an initiating of an opening of the flap can be based on both the movement speed and the direction of approach of the user. Further, a movement speed of the flap can also be adapted to both the movement speed and the direction of approach of the user. In this way, a reliability of the control of the movement of the flap can be increased. Thus, a user experience can be improved.

[0026] In an example, the movement profile may be determined based on sensor data of at least one of an ultra-wide band sensor, a camera or a Bluetooth sensor. In this way, the information about the movement profile can be determined in a facilitated way. For example, the user may carry a digital key to access the vehicle. A digital key for a vehicle is a digital authentication method that allows a user to access and operate their vehicle without using a physical key. It is a form of electronic key that may be stored and transmitted through user equipment. The position of the digital key can be determined, e.g.,

by use of at least one ultra-wide band sensor of the vehicle. Based on the position of the digital a movement profile of the user can be determined. Optionally or alternatively, the movement profile can be determined based on a camera image, e.g., acquired by a camera of the vehicle.

[0027] The method may be performed by a processing circuitry part of the vehicle. The processing circuitry may be part of a control unit, e.g., a central control unit (such as an engine control unit) of the vehicle. The processing circuitry may be communicatively coupled via an interface circuitry to a sensor, e.g., to receive the sensor data, to determine the position of a digital key.

[0028] More details and aspects are mentioned in connection with the embodiments described below. The example shown in Fig. 1 may comprise one or more optional additional features corresponding to one or more aspects mentioned in connection with the proposed concept or one or more examples described below (e.g., Fig. 2).

[0029] Fig. 2 shows a block diagram of an example of an apparatus 30, e.g., for a vehicle 40. The apparatus 30 comprises interface circuitry 32 and processing circuitry 34 configured to perform a method as described above, e.g., the method for a control unit as described with reference to Fig. 1. For example, the apparatus 30 may be part of the vehicle 40, e.g., part of a control unit of the vehicle 40.

[0030] For example, the vehicle 40 may be a land vehicle, such as a road vehicle, a car, an automobile, an off-road vehicle, a motor vehicle, a bus, a robo-taxi, a van, a truck or a lorry. Alternatively, the vehicle 40 may be any other type of vehicle, such as a train, a subway train, a boat or a ship. For example, the proposed concept may be applied to public transportation (trains, bus) and future means of mobility (e.g., robo-taxis).

[0031] As shown in Fig. 2 the respective interface circuitry 32 is coupled to the respective processing circuitry 34 at the apparatus 30. In examples the processing circuitry 34 may be implemented using one or more processing units, one or more processing devices, any means for processing, such as a processor, a computer or a programmable hardware component being operable with accordingly adapted software. Similar, the described functions of the processing circuitry 34 may as well be implemented in software, which is then executed on one or more programmable hardware components. Such hardware components may comprise a general-purpose processor, a Digital Signal Processor (DSP), a microcontroller, etc. The processing circuitry 34 is capable of controlling the interface circuitry 32, so that any data transfer that occurs over the interface circuitry 32 and/or any interaction in which the interface circuitry 32 may be involved may be controlled by the processing circuitry 34.

[0032] In an embodiment the apparatus 30 may comprise a memory and at least one processing circuitry 34 operably coupled to the memory and configured to perform the method described above.

[0033] In examples the interface circuitry 32 may cor-

respond to any means for obtaining, receiving, transmitting or providing analog or digital signals or information, e.g., any connector, contact, pin, register, input port, output port, conductor, lane, etc. which allows providing or obtaining a signal or information. The interface circuitry 32 may be wireless or wireline and it may be configured to communicate, e.g., transmit or receive signals, information with further internal or external components.

[0034] The apparatus 30 may be a computer, processor, control unit, (field) programmable logic array ((F)PLA), (field) programmable gate array ((F)PGA), graphics processor unit (GPU), application-specific integrated circuit (ASICs), integrated circuits (IC) or system-on-a-chip (SoCs) system.

[0035] More details and aspects are mentioned in connection with the embodiments described. The example shown in Fig. 2 may comprise one or more optional additional features corresponding to one or more aspects mentioned in connection with the proposed concept or one or more examples described above (e.g., Fig. 1).

[0036] The aspects and features described in relation to a particular one of the previous examples may also be combined with one or more of the further examples to replace an identical or similar feature of that further example or to additionally introduce the features into the further example.

[0037] Examples may further be or relate to a (computer) program including a program code to execute one or more of the above methods when the program is executed on a computer, processor or other programmable hardware component. Thus, steps, operations or processes of different ones of the methods described above may also be executed by programmed computers, processors or other programmable hardware components. Examples may also cover program storage devices, such as digital data storage media, which are machine-, processor- or computer-readable and encode and/or contain machine-executable, processor-executable or computer-executable programs and instructions. Program storage devices may include or be digital storage devices, magnetic storage media such as magnetic disks and magnetic tapes, hard disk drives, or optically readable digital data storage media, for example. Other examples may also include computers, processors, control units, (field) programmable logic arrays ((F)PLAs), (field) programmable gate arrays ((F)PGAs), graphics processor units (GPU), application-specific integrated circuits (ASICs), integrated circuits (ICs) or system-on-a-chip (SoCs) systems programmed to execute the steps of the methods described above.

[0038] It is further understood that the disclosure of several steps, processes, operations or functions disclosed in the description or claims shall not be construed to imply that these operations are necessarily dependent on the order described, unless explicitly stated in the individual case or necessary for technical reasons. Therefore, the previous description does not limit the execution of several steps or functions to a certain order. Further-

more, in further examples, a single step, function, process or operation may include and/or be broken up into several sub-steps, -functions, -processes or -operations.

[0039] If some aspects have been described in relation to a device or system, these aspects should also be understood as a description of the corresponding method. For example, a block, device or functional aspect of the device or system may correspond to a feature, such as a method step, of the corresponding method. Accordingly, aspects described in relation to a method shall also be understood as a description of a corresponding block, a corresponding element, a property or a functional feature of a corresponding device or a corresponding system.

[0040] If some aspects have been described in relation to a device or system, these aspects should also be understood as a description of the corresponding method and vice versa. For example, a block, device or functional aspect of the device or system may correspond to a feature, such as a method step, of the corresponding method. Accordingly, aspects described in relation to a method shall also be understood as a description of a corresponding block, a corresponding element, a property or a functional feature of a corresponding device or a corresponding system.

[0041] The following claims are hereby incorporated in the detailed description, wherein each claim may stand on its own as a separate example. It should also be noted that although in the claims a dependent claim refers to a particular combination with one or more other claims, other examples may also include a combination of the dependent claim with the subject matter of any other dependent or independent claim. Such combinations are hereby explicitly proposed, unless it is stated in the individual case that a particular combination is not intended. Furthermore, features of a claim should also be included for any other independent claim, even if that claim is not directly defined as dependent on that other independent claim.

[0042] The aspects and features described in relation to a particular one of the previous examples may also be combined with one or more of the further examples to replace an identical or similar feature of that further example or to additionally introduce the features into the further example.

References

[0043]

- 30 apparatus
- 32 processing circuitry
- 34 interface circuitry
- 40 vehicle
- 100 method for improving a movement of a flap
- 110 determining a movement profile
- 120 determining a movement parameter
- 130 controlling a movement of the flap

Claims

1. A method (100) for improving a movement of a flap of a vehicle, comprising:

determining (110) a movement profile indicative of a movement of a user relative to the vehicle; determining (120), based on the movement profile, a movement parameter indicative of a movement of the flap of the vehicle; and controlling (130), based on the movement parameter, a movement of the flap of the vehicle.

2. The method (100) according to claim 1, wherein the movement profile comprises information about a movement speed of the user.

3. The method (100) according to claim 2, further comprising determining the movement parameter based on the movement speed of the user.

4. The method (100) according to any one of the preceding claims, wherein
the movement profile comprises information about a direction of the movement of the user relative to the vehicle; and determining the movement parameter is further based on the direction of the movement of the user relative to the vehicle.

5. The method (100) according to any one of the preceding claims, further comprising determining stop information indicative of a stop of the user during the movement of the user; and wherein controlling comprises stopping, based on the stop information, the movement of the flap.

6. The method (100) according to any one of the preceding claims, further comprising
determining a time parameter indicative of an estimated time of arrival of the user at the flap; and wherein determining the opening parameter is further based on the time parameter.

7. The method (100) according to any one of the preceding claims, wherein the movement profile is determined based on sensor data of at least one of an ultra-wide band sensor, a camera or a Bluetooth sensor.

8. An apparatus (30), comprising:

interface circuitry (32); and

processing circuitry (34) configured to perform a method according to any of the preceding claims.

9. A vehicle (40) comprising the apparatus (30) according to claim 8.

10. A computer program having a program code for performing the method (100) according to claim 1 - 7, when the computer program is executed on a computer, a processor, or a programmable hardware component.

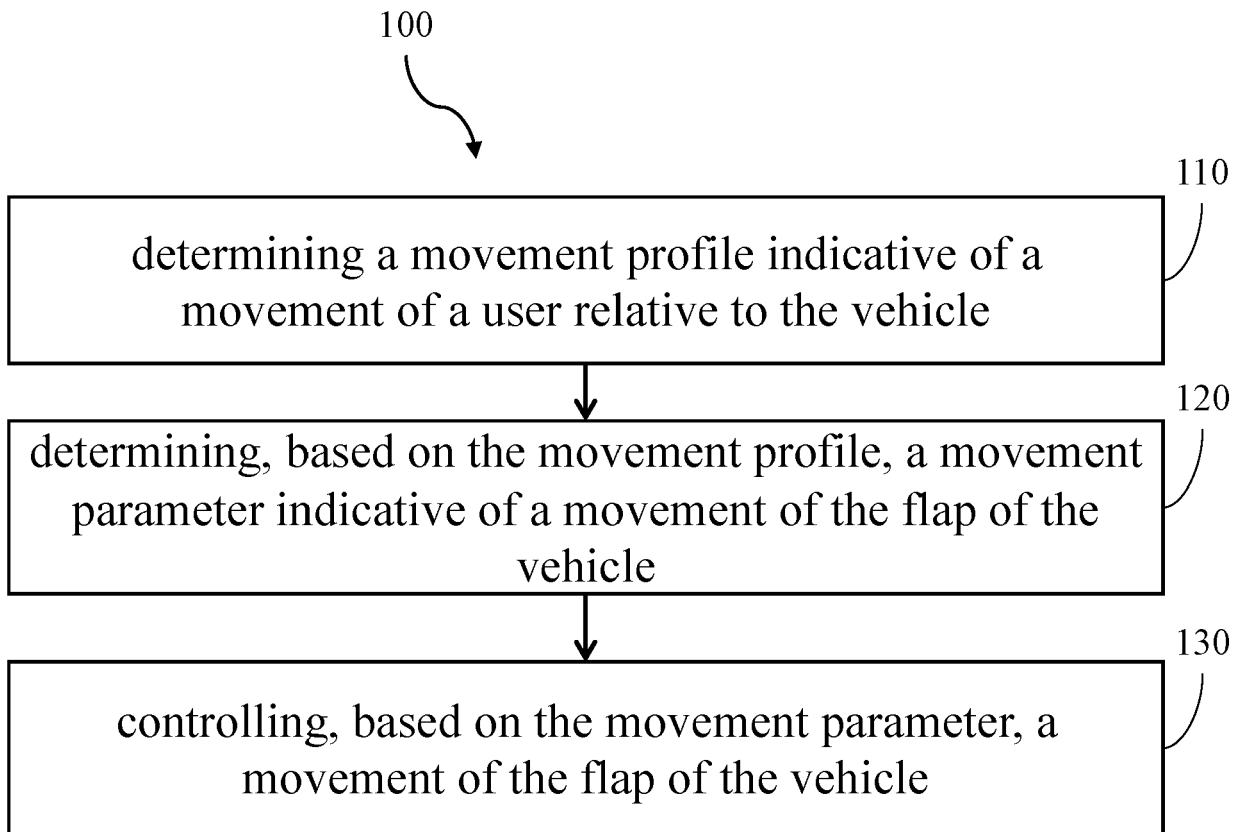


Fig. 1

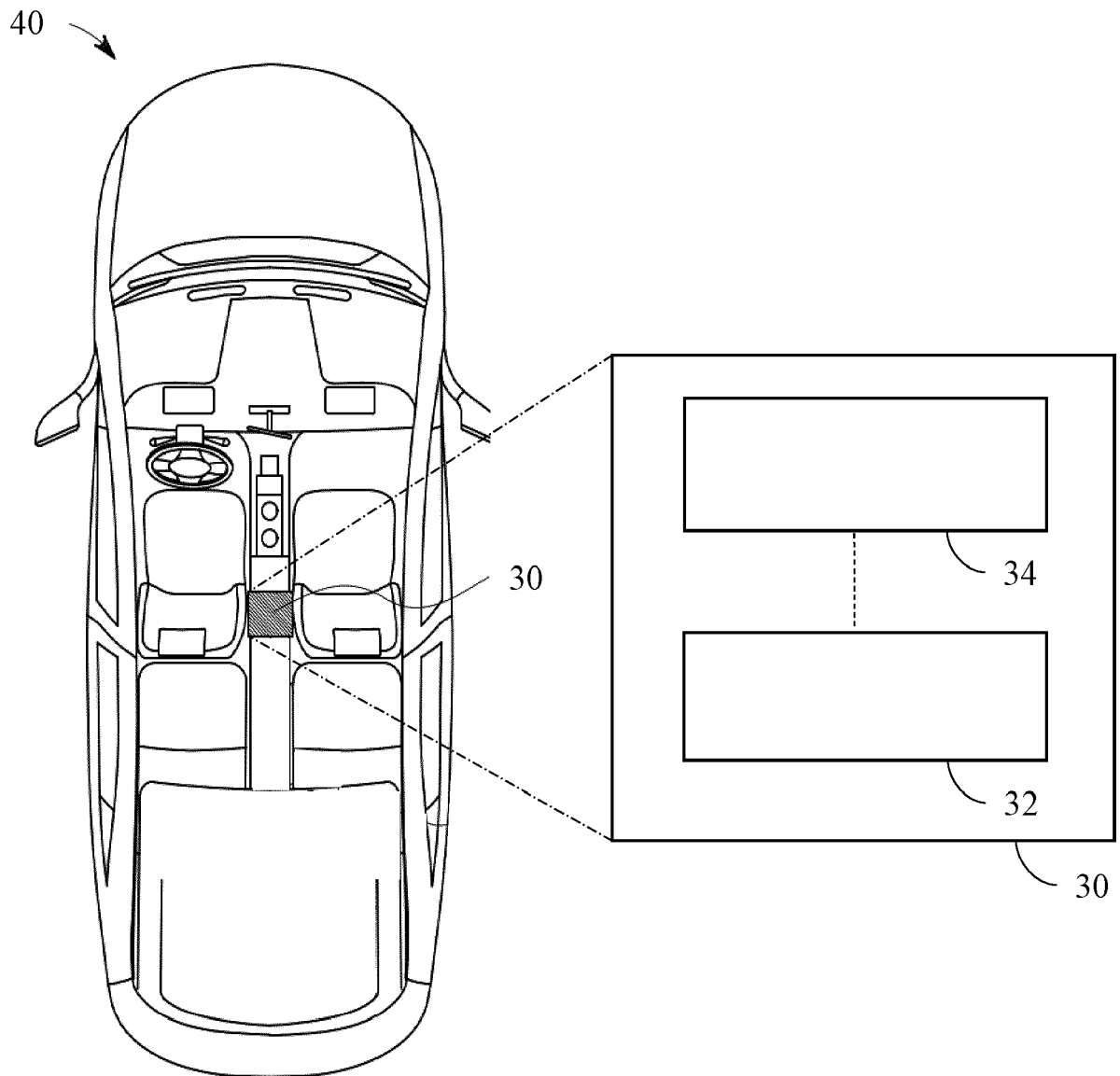


Fig. 2



EUROPEAN SEARCH REPORT

Application Number

EP 23 16 2585

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2022/290484 A1 (SALTER STUART C [US] ET AL) 15 September 2022 (2022-09-15) * paragraph [0052] * * paragraph [0055] * * paragraph [0074] * * figure 6 *	1-10	INV. E05F15/73
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			TECHNICAL FIELDS SEARCHED (IPC)
			E05F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 8 August 2023	Examiner Prieto, Daniel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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