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(54) **SYSTEM FOR CONTROLLING A MOVEMENT OF A BODY ELEMENT, A VEHICLE, A METHOD AND A COMPUTER PROGRAM ELEMENT**

(57) The disclosure relates to a system for controlling a movement of a body element (11) of a vehicle comprising:
- at least one actuator (12) configured to move the body element (11);
- at least a first sensor (13) configured to monitor the surrounding of the vehicle for an object (14) and to determine the distance of the object (14) from the body element (11);
- a processing unit (15) configured to process sensor data of at least the first sensor (13) to determine a threshold position of the body element (11);
- a control unit (16) configured to control the actuator (12) for moving the body element (11) to the threshold position.

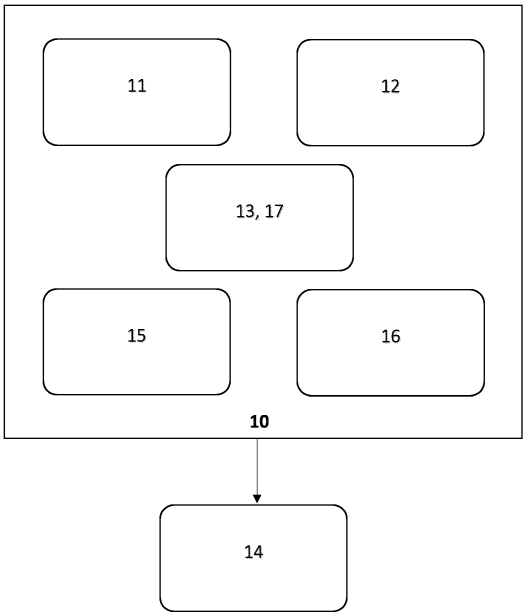

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a system for controlling a movement of a body element. The present disclosure further relates to a vehicle with such a system, a method for controlling a body element and a corresponding computer program element.

BACKGROUND ART

[0002] Many vehicles today comprise motors to move several body elements of the vehicle, for example a tailgate or a hood. In other words, the body elements are not moved manually by the user, but by the electric motor. For example, this can be triggered by pushing a button in the vehicle or on a remote. Before doing so, the user has to ensure that the body element can be opened safely. Sometimes there may be objects or obstacles that are in the way of the intended movement of said body element.

[0003] It has now become apparent, due to the wide range of applications, that there is a need to provide an improved means to control the movements of body elements of a vehicle.

[0004] In view of the above, it is an object of the present disclosure to provide an improved system for controlling the movement of a body element, which particularly allows preventing collisions of the body element with objects. It is further an object of the present disclosure to provide a vehicle with such a system, a method for controlling a body element and a corresponding computer program element.

SUMMARY

[0005] The object of the present disclosure is at least partially solved or alleviated by the subject-matter of the appended independent claims, wherein further examples are incorporated in the dependent claims.

[0006] A first aspect of the present disclosure is directed to a system for controlling a movement of a body element of a vehicle comprising: at least one actuator configured to move the body element; at least a first sensor configured to monitor the surrounding of the body element for an object and to determine the distance of the object from the body element; a processing unit configured to process sensor data of at least the first sensor to determine a threshold position of the body element; a control unit configured to control the actuator for moving the body element to the threshold position.

[0007] The actuator is configured to move the body element. The actuator may be an electric motor. For example, the actuator may be a linear drive. Alternatively, the use of other motors as an actuator is possible.

[0008] The system is configured to control the movements of the body element. The body element can be designed as any element of the vehicle. The body element may be movably arranged at least partially at the outside of the vehicle. It is conceivable that the body element may be a side mirror, a tailgate, or the engine hood. Other parts or elements may also be possible.

[0009] The system comprises at least one first sensor. The first sensor is configured to monitor the environment of the body element. More precisely, the first sensor is configured to monitor whether there is an object or an obstacle in the vicinity of the body element. The first sensor is also configured to measure or determine the distance of the object from the body element.

[0010] Such an object may be, for example, a lamppost, a person, or a bicycle attached to the vehicle. An object or obstacle may be understood as an element that is not part of the vehicle. However, it is possible that in certain cases, for example, a vehicle trailer mounted on a hitch of the vehicle may also be defined as such an object or obstacle. It may also be possible, that the object or obstacle is located on such a trailer mounted to the vehicle. Generally, the first sensor provides data about any object or obstacle that may interfere with the movement of the body element.

[0011] The processing unit is configured to process data from the at least first sensor. The processing unit uses the sensor data to determine a threshold position of the body element. The threshold position is a position where no collision may occur. This may also comprise the case, where the body element may be moved but stopped before it hits the object. For example, it is possible that the object and its distance from the body element were detected by the first sensor. The processing unit then uses this data to determine a threshold position that defines a range of movement of the body element within which the body element can be moved without colliding with the object.

[0012] Thus, the system allows, particularly electronically controlled, moving of the body element such that a collision with any object that might interfere with the movement of the body element, is prevented. Therefore, the system allows a user of the vehicle to initiate a movement of the body element without the need of checking beforehand, whether a collision of the body element and an object may happen. Thus, the system allows reducing damages to the vehicle caused by moving body elements hitting objects. Further, the system allows reducing injuries of passengers of the vehicle accidentally interfering with the movement of the body element.

[0013] In an example, the system may further comprise at least a second sensor configured to measure at least one force and/or torque at the body element while moving the body element. By measuring the forces and torques by means of the second sensor, it may be possible, for example, to react to an unexpected obstacle or object. The currents of the electric motor to create the forces and/or torques may also be measured.

[0014] In an example, the processing unit may be further configured to determine whether the at least

one force and/or torque exceed a threshold, and the control unit may be configured to prevent and/or stop the body element from moving, when the at least one force and/or torque are/is determined to exceed the threshold. The threshold may be a predetermined or a defined threshold. In other words, the threshold may be a set threshold with a fixed value.

[0015] In an example, the processing unit may be configured to receive data via a signal connection about an element mounted on a trailer hitch of the vehicle. This may allow the processing unit to consider the element without additional sensor data. The element may be, for example, a trailer or a caravan. For example, when the trailer or caravan is connected to the hitch of the vehicle, a signal connection to the process unit may be established. In this way, data with regard to the distance of the trailer or caravan from the body element may be transmitted to the processing unit.

[0016] In an example, the body element may be a tailgate, a door and/or a hood of the vehicle. Alternatively or additionally, other parts may be described as the body element. For example, an assisted or automated unloading mechanism for goods in the trunk, a battery replacement system for which the battery is moved out automatically and/or a movable or retractable roof rack may be described as the body element.

[0017] In an example, the first sensor may comprise a camera, an ultrasonic-sensor, a RADAR-sensor and/or a LIDAR-sensor. Other sensors or sensor arrangements that have the capacity to monitor the surrounding of the vehicle and/or body element may also be used. It may also be possible that a combination of different sensors is used to monitor the environment.

[0018] In an example, the system may be designed as an internal system of the vehicle or the system may be designed as an external system. The internal system may be integrated into the vehicle. The external system may be installed as an upgrade for the vehicle or may be designed to be retrofitted to the vehicle. In other words, the internal system may be a system that is originally built into the vehicle. Meaning the vehicle may be bought with said internal system. The external system may be available as an independent upgrade for the vehicle. For example, the external system may be sold as a separate module.

[0019] In an example, the system may comprise a communication means, in particular a monitor interface and/or a voice activation, configured to communicate with a user. This may allow sending the user a warning message and/or informing the user in case, an object is obstructing the body element. In this way, it may also be possible to for the user to give instructions to the system.

[0020] In an example, the system may be configured to use an external hardware element and/or an external software element. In other words, the system may be connected to an external device, for example a mobile phone, a tablet and/or a notebook, the external hardware element here being the external/mobile device. It may also be possible that the system may be connected to a cloud server as possible external software element. It should be clear, that the external hardware element may also comprise the external software element. The external hardware element may comprise a remote control function.

[0021] In an example, the movement of the body element may correspond to an openingmovement and/or the movement of the body element may correspond to a closing-movement. Other movements may also be possible. For example, the positioning of a part of the vehicle, like a side mirror or a roof rack.

[0022] In an example, the movement of the body element may correspond to a moving-in and/or moving-out movement. In this way, the body element may be a retractable element.

[0023] In an example, the object may be at least one of another vehicle, a guardrail, a lamp pole, a wall and/or a human body part. However, other elements may also be possible objects, e.g., a bicycle, that is mounted on a rack, which is attached to a hitch of the vehicle.

[0024] In an example, the threshold position may correspond to a position of the body element to which the body element may be maximally movable without causing a collision or getting into contact with the object.

[0025] A second aspect of the present disclosure is directed to a vehicle comprising a system according to the first aspect.

[0026] A third aspect of the present disclosure is directed to a method for moving a body element of a vehicle, comprising: Providing first sensor data of a first sensor monitoring the surrounding of the vehicle for an object and determining the distance of the object from the vehicle; Processing of the first sensor data and determining a threshold position of the body element by a processing unit; Providing the processed sensor data to a control unit; Controlling the actuator for moving the body element, by the control unit, to the threshold position.

[0027] Thus, the method allows moving the body element, particularly electronically, such that a collision with any object that might interfere with the movement of the body element, is prevented. Therefore, the method allows a user of the vehicle to initiate a movement of the body element without the need of checking beforehand, whether a collision of the body element and an object may happen. Thus, the method allows reducing damages to the vehicle caused by moving body elements hitting objects. Further, the method allows reducing injuries of passengers of the vehicle accidentally interfering with the movement of the body element.

[0028] The method may be at least partly computer-implemented, and may be implemented in software or in hardware, or in software and hardware. Further, the method may be carried out by computer program instructions running on means that provide data processing functions. The data processing means may be a suitable computing means, such as an electronic control module etc., which may also be a distributed computer system.

The data processing means or the computer, respectively, may comprise one or more of a processor, a memory, a data interface, or the like.

[0029] In an example, the method may further comprise: Providing second sensor data of a second sensor comprising forces and/or torques while moving the body element; and combining the first sensor data and the second sensor data in the processing step to control the movement of the body element.

[0030] In an example, the method may further comprise: Informing the user if an object is blocking the movement of the body element and/or if the movement of the body element is stopped.

[0031] In an example, the method may further comprise: Reversing the position of the body element, if the body element is stopped during a movement.

[0032] A fourth aspect of the present disclosure is directed to a computer program element for moving a body element of a vehicle according to the second aspect, which, when being executed by a processing element, being adapted to perform the method according to the third aspect.

[0033] It should be noted that the above examples may be combined with each other irrespective of the aspect involved. Accordingly, the method may be combined with structural features and, likewise, the system may be combined with features described above with regard to the method.

[0034] These and other aspects of the present disclosure will become apparent from and elucidated with reference to the examples described hereinafter.

BRIEF DESCRIPTION OF DRAWINGS

[0035] Exemplary examples of the disclosure will be described in the following with reference to the following drawings.

Fig. 1 shows a schematic illustration of a system according to the present disclosure; and

Fig. 2 shows a flow diagram of a method according to the present disclosure.

[0036] The figures are merely schematic representations and serve only to illustrate examples of the disclosure. Identical or equivalent elements are in principle provided with the same reference signs.

DESCRIPTION OF EXAMPLES

[0037] Figure 1 shows a schematic view of a system 10. The system 10 comprises a body element 11. The body element 11 is a part of a vehicle (not illustrated). The body element 11 is configured to be moved in one or more directions.

[0038] The system 10 further comprises an actuator 12. The system 10 may comprise more than one actuator 12. The actuator 12 may be an electric motor, for example an electric linear drive. Other types of actuators may be possible. The actuator 12 is configured to move the body element 11.

[0039] The system 10 further comprises a first sensor 13. Additional sensors of the same type as the first sensor 13 and/or other types of sensors are possible. The first sensor 13 is configured to monitor the surrounding of the vehicle or the body element 11 for objects 14. The first sensor 13 further allows determining a distance of the object 14 to the body element 11 or the vehicle. The first sensor 13 may be a camera, an ultra-sonic sensor, and a RADAR- or LIDAR-sensor. A combination of more than one sensor may also be possible.

[0040] The system 10 may comprise a second sensor 17 to measure the force and/or torque of the actuator. This allows, for example, determining whether the movement of the body element 11 is manually influenced by a user. In this way, it may also be possible to stop the body element 11 from moving, when it hits an object 14, which it did not detect.

[0041] The system 10 may further comprise a processing unit 15. The processing unit 15 is configured to receive sensor data. The sensor data originates from the at least first sensor 13. The processing unit 15 determines based on the sensor data if a collision may be possible. Then, the processing unit 15 determines a threshold position. The threshold position corresponds to a position to which the body element 11 can be moved without causing a collision or getting into contact with the object 14.

[0042] The system 10 further comprises a control unit 16. The control unit 16 receives commands from the processing unit 15. The control unit 16 controls the actuator 12 that moves the body element 11. More precisely, the control unit 16 is configured to control the actuator 12 to move the body element 11 to the threshold position.

[0043] In this way, it is possible to move the body element 11 at least partially without a collision occurring or even though an object 14 is in the path of movement of the body element 11. For example, the object 14 may be placed in a way that a tailgate cannot be fully opened. However, a partial opening of the tailgate would be enough for a user to get the content in and/or out of the tailgate. In this case, the system 10 enables automatic opening of the tailgate without damaging the vehicle, with the tailgate opening wide enough for the user to reach the contents.

[0044] In another possible example, the system 10 may be able to detect a trailer hitched to the vehicle. In this case, the first sensor 13 may determine the trailer as the object 14. Alternatively, by connecting the trailer to the vehicle, the processing unit 15 may receive a signal, that the trailer is connected to the vehicle and the processing unit 15 may consider this information, when determining the threshold position of the body element 11.

[0045] In another possible example, a bike rack is mounted to the vehicle. The bike rack may then be

determined as the object 14 and a threshold position can be determined accordingly.

[0046] Figure 2 is a flow diagram of an example of a method 20 according to the present disclosure, wherein the steps are not necessarily performed in the presented order. A step S1 comprises providing first sensor data of a first sensor 13 monitoring the surrounding of the body element for an object 14 and determining the distance of the object 14 from the body element.

[0047] A step S2 comprises processing of the first sensor data and determining a threshold position of the body element 11 by a processing unit 15; and providing the processed sensor data to a control unit 16.

[0048] A step S3 comprises controlling the actuator 12 for moving the body element 11, by the control unit 16, to the threshold position.

[0049] In step S4, the method 20 further comprises providing second sensor data of a second sensor 17 comprising forces and/or torques while moving the body element 11.

[0050] In a step S5, the method 20 comprises combining the first sensor data and the second sensor data in the processing step to control the movement of the body element 11.

[0051] In a step S6, the method 20 further comprises informing the user if an object 14 is blocking the movement of the body element 11 and/or if the movement of the body element 11 is stopped.

[0052] Further, the method may comprise reversing the position of the body element 11, if the body element 11 is stopped during a movement (not illustrated).

[0053] Other variations to the disclosed examples can be understood and effected by those skilled in the art in practicing the claimed disclosure, from the study of the drawings, the disclosure, and the appended claims. In the claims the word "comprising" does not exclude other elements or steps and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfill the functions of several items or steps recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. A computer program may be stored/distributed on a suitable medium such as an optical storage medium or a solid-state medium supplied together with or as part of other hardware, but may also be distributed in other forms, such as via the Internet or other wired or wireless telecommunication systems. Any reference signs in the claims should not be construed as limiting the scope of the claims.

LIST OF REFERENCE SIGNS

[0054]

10 system
11 body element
12 actuator
13 first sensor
14 object
15 processing unit
16 control unit
17 second sensor

Claims

1. A system (10) for controlling a movement of a body element (11) of a vehicle comprising:

   - at least one actuator (12) configured to move the body element (11);
   - at least a first sensor (13) configured to monitor the surrounding of the vehicle for an object (14) and to determine the distance of the object (14) from the body element (11);
   - a processing unit (15) configured to process sensor data of at least the first sensor (13) to determine a threshold position of the body element (11);
   - a control unit (16) configured to control the actuator (12) for moving the body element (11) to the threshold position.

2. The system (10) according to claim 1, wherein the system further comprises at least a second sensor (17) configured to measure at least one force and/or torque at the body element (11) while moving the body element (11).

3. The system (10) according to claim 2, wherein the processing unit is further configured to determine whether the at least one force and/or torque exceed a threshold, and the control unit is configured to prevent and/or stop the body element from moving, when the forces and/or torques are/is determined to exceed the threshold.

4. The system (10) according to any of the preceding claims, wherein the processing unit (15) is configured to receive data via a signal connection about an element mounted on a trailer hitch of the vehicle.

5. The system (10) according to any of the preceding claims, wherein the body element (11) is a tailgate, a door and/or a hood of the vehicle.

6. The system (10) according to any of the preceding claims, wherein the first sensor (13) comprises a camera, an ultrasonic-sensor, a RADAR-sensor and/or a LIDAR-sensor.

7. The system (10) according to any of the preceding claims, wherein the system (10) is designed as an internal system of the vehicle or wherein the system is designed as an external system.

8. The system (10) according to any of the preceding claims, wherein the system (10) comprises a communication means, in particular a monitor interface and/or a voice activation, configured to communicate with a user.

9. The system (10) according to any of the preceding claims, wherein the system (10) is configured to use an external hardware element and/or an external software element.

10. The system (10) according to any of the preceding claims, wherein the threshold position corresponds to a position of the body element (11) to which the body element (11) is maximally moveable without causing a collision or getting into contact with the object (14).

11. A vehicle comprising a system according to any of the preceding claims.

12. A method for moving a body element (11) of a vehicle, comprising:

- Providing first sensor data of a first sensor (13) monitoring the surrounding of the vehicle for an object (14) and determining the distance of the object (14) from the body element (11) ;
- Processing of the first sensor data and determining a threshold position of the body element (11) by a processing unit (15);
- Providing the processed sensor data to a control unit (16);
- Controlling an actuator (12) for moving the body element (11), by the control unit (16), to the threshold position.

13. The method according to claim 12, further comprising:

- Providing second sensor data of a second sensor (17) comprising forces and/or torques while moving the body element; and
- Combining the first sensor data and the second sensor data in the processing step to control the movement of the body element (11).

14. The method according to claim 12 or 13, further comprising:

- Informing the user if an object is blocking the movement of the body element (11) and/or if the movement of the body element (11) is stopped.

15. The method according to any of claims 12 to 14, further comprising:

- Reversing the position of the body element (11), if the body element is stopped during a movement.

16. A computer program element for moving a body element of a vehicle according to claim 11, which, when being executed by a processing element, being adapted to perform the method according to any of claims 12 to 15.

Amended claims in accordance with Rule 137(2) EPC.

1. A system (10) for controlling a movement of a body element (11) of a vehicle comprising:

- at least one actuator (12) configured to move the body element (11);
- at least a first sensor (13) configured to monitor the surrounding of the vehicle for an object (14) and to determine the distance of the object (14) from the body element (11);
- a processing unit (15) configured to process sensor data of at least the first sensor (13) to determine a threshold position of the body element (11);
- a control unit (16) configured to control the actuator (12) for moving the body element (11) to the threshold position;

characterized by

- at least a second sensor (17) configured to measure at least one force and/or torque at the body element (11) while moving the body element (11).

2. The system (10) according to claim 1, wherein the processing unit is further configured to determine whether the at least one force and/or torque exceed a threshold, and the control unit is configured to prevent and/or stop the body element from moving, when the forces and/or torques are/is determined to exceed the threshold.

3. The system (10) according to any of the preceding claims, wherein the processing unit (15) is configured to receive data via a signal connection about an element mounted on a trailer hitch of the vehicle.

4. The system (10) according to any of the preceding claims, wherein the body element (11) is a tailgate, a door and/or a hood of the vehicle.

5. The system (10) according to any of the preceding claims, wherein the first sensor (13) comprises a camera, an ultrasonic-sensor, a RADAR-sensor and/or a LIDAR-sensor.

6. The system (10) according to any of the preceding claims, wherein the system (10) is designed as an

internal system of the vehicle or wherein the system is designed as an external system.

7. The system (10) according to any of the preceding claims, wherein the system (10) comprises a communication means, in particular a monitor interface and/or a voice activation, configured to communicate with a user.

8. The system (10) according to any of the preceding claims, wherein the system (10) is configured to use an external hardware element and/or an external software element.

9. The system (10) according to any of the preceding claims, wherein the threshold position corresponds to a position of the body element (11) to which the body element (11) is maximally moveable without causing a collision or getting into contact with the object (14).

10. A vehicle comprising a system according to any of the preceding claims.

11. A method for moving a body element (11) of a vehicle, comprising:

- Providing first sensor data of a first sensor (13) monitoring the surrounding of the vehicle for an object (14) and determining the distance of the object (14) from the body element (11) ;
- Processing of the first sensor data and determining a threshold position of the body element (11) by a processing unit (15);
- Providing the processed sensor data to a control unit (16);
- Controlling an actuator (12) for moving the body element (11), by the control unit (16), to the threshold position;

characterized by

- Providing second sensor data of a second sensor (17) comprising forces and/or torques while moving the body element.

12. The method according to claim 11, further comprising:

- Combining the first sensor data and the second sensor data in the processing step to control the movement of the body element (11).

13. The method according to claim 11 or 12, further comprising:

- Informing the user if an object is blocking the movement of the body element (11) and/or if the movement of the body element (11) is stopped.

14. The method according to any of claims 11 to 13, further comprising:

- Reversing the position of the body element (11), if the body element is stopped during a movement.

15. A computer program element for moving a body element of a vehicle according to claim 10, which, when being executed by a processing element, being adapted to perform the method according to any of claims 11 to 14.

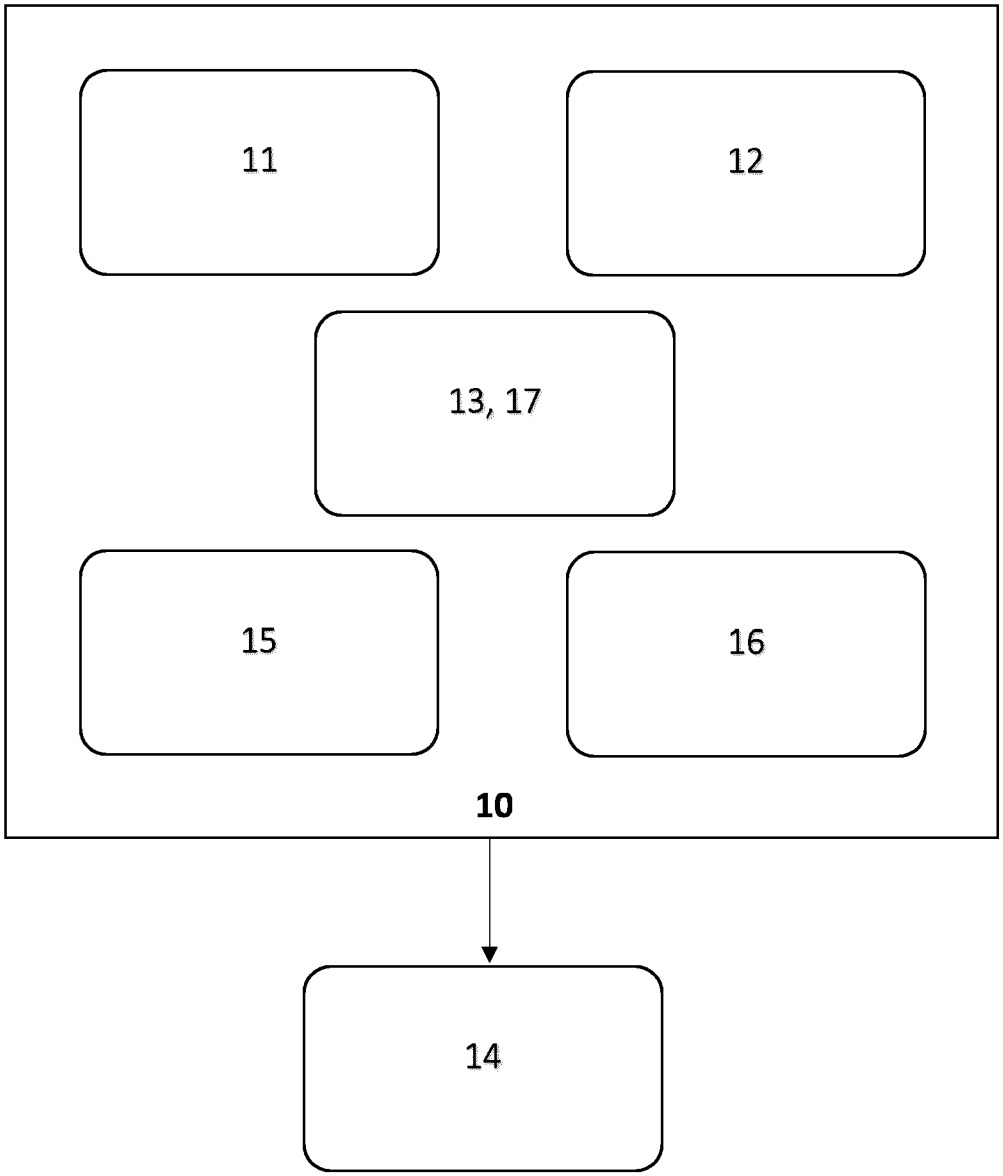

Fig. 1

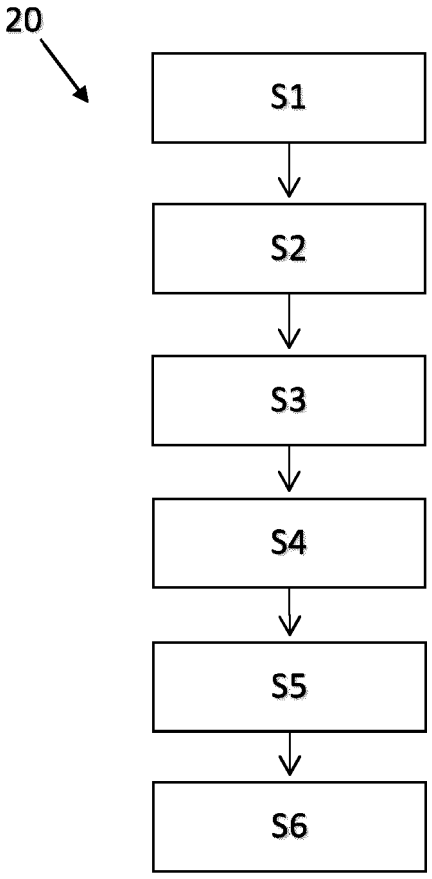

Fig. 2

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 23 17 4946

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

E05F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 November 2023	Klemke, Beate

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 17 4946

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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07-11-2023

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