

Control method for controlling a modular furniture system

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Reference to related documents

This document claims priority of Swiss Patent
Application No. 0197/19, filed February 15, 2019, the
10 entire contents of which are hereby incorporated by
reference.

Field of the Invention

15 The invention relates to a control method for
controlling a modular furniture system comprising at least
two furniture modules which are electrically and
independently movable in a room, and to a computer program
product according to the independent claims.

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Background

Furniture systems with movable furniture
modules are known. For example, modular rolling shelves
25 have been developed as so-called compact shelving systems
for the storage of files. Several modules are arranged one
behind the other. To access the files of a module, the
modules are moved manually until an access space is
created between the module of interest and the neighboring
30 module. This concept was later transferred to residential
units, where furniture modules are preconfigured and, by
moving the individual modules, different spaces can be
created that serve one or the other purpose, e.g. a living
room or a bedroom. For the sake of convenience, solutions
35 have been developed in which the furniture modules can be
moved electrically, with the user having to press a

corresponding button for the duration of the movement of a furniture module.

Such modular furniture systems have been developed with an eye to saving space or making optimal use of a space. Such a furniture system is e.g. known from WO 2014/108342 A1.

Description of the invention

10 The objective of the invention is to provide a better control of the modular furniture system with regard to comfort.

 The objective is reached with a control method for controlling a modular furniture system with at least two furniture modules which can be moved electrically and independently of each other in a room. The furniture system comprises a control computer with at least one control interface for the user. Each furniture module is electrically driven by means of its own motor, wherein a linear drive with a first drive element fixed along a wall of the room and a second drive element fixed to each furniture module is provided. The first drive element cooperates with the second drive element so that each furniture module is individually movable by means of the linear drive in cooperation with its own motor. Each furniture module further comprises a cable tension sensor system for position detection. A mechanical force limiter is interposed between the motor and the linear drive.

 The movement of each furniture module is controlled independently of the other furniture modules by means of the control computer and the furniture module is moved by means of its motor when the control computer has received a trigger command from the user. The relevant furniture module is controlled by the control computer without further user intervention and with the inclusion of a position signal from the cable tension sensor system until an end position is reached. The relevant furniture

module is then stopped by means of the control computer when a stop condition or an emergency stop condition is fulfilled.

Furthermore, the objective of the invention is
5 reached by means of a computer program product. When the computer program product is loaded into a control computer of a modular furniture system with at least two furniture modules which can be moved electrically and independently of each other in a room, it executes the method according
10 to the invention.

It is preferred that, especially in case of an emergency stop, no subsequent start-up of any furniture module is allowed by the control computer until the emergency stop condition has been removed by the user.

15 The present control method has the advantage that it does not require any user intervention for the duration of the movement of a furniture module. Only at the beginning a command to move has to be given. This measure increases the comfort. The user can devote himself
20 to another task during the change of a housing configuration. From this follows another advantage, namely that the furniture system is remotely configurable, since no user presence is necessary.

25 Brief description of the drawings

Further embodiments, advantages and applications of the invention result from the dependent claims and from the following description on the basis of
30 the figures. The figures show:

Fig. 1 a schematic perspective view of the furniture system, and

Fig. 2 a schematic circuit diagram of the furniture system of Fig. 1.

Ways of carrying out the invention

Fig. 1 shows a perspective view of a furniture system 1 controlled by the method according to the invention. The modular furniture system 1 has several furniture modules 2 which can be moved electrically and independently of one another in a room, of which only one module 2 is shown in the figure for reasons of clarity. Another module 2 would be arranged on the support base or substructure 16a, but it is not shown in order to make the rear arranged elements of the module visible. In the present context, the term "rear" means toward the wall 15a.

As mentioned, each furniture module 2 comprises its own motor 8 controlled by a control computer 10 of the furniture system 1. For the modular furniture system 1, an electric linear drive is provided with a first drive element 3a fixed along the wall 15a of the room and a second drive element 3b fixed to each furniture module 2. The first drive element 3a cooperates with the second drive element 3b so that each furniture module 2 can be moved individually by means of the linear drive in cooperation with its own motor 8. For controlling a speed of each furniture module 2, the control computer comprises a motor controller 12 and a first encoder 9 coupled to the motor 8 for controlling a speed of the motor 8. The motor controller 12 is electrically connected to the first encoder 9. The motor controller 12 complies with the certification for standard IEC 60335-1 as in effect on the filing date of this application.

In this example, the first drive element 3a is a toothed rack 3a and the second drive element 3b is a pinion 3b that engages with the toothed rack 3a. To move the furniture module 2, the pinion 3b is coupled to the motor.

Further, a mechanical force limiter, in particular a torque limiter, in particular a slip clutch,

is interposed between the linear drive and the motor 8. The mechanical force limiter is designed in such a way that it disconnects the connection between motor 8 and linear drive as soon as a predefined torque is applied.

5 This safety coupling takes into account the fact that, for example, a user may find himself between two adjacent modules 2 while they are being moved towards each other. As soon as a module encounters an obstacle, the slipping clutch comes into play, separating the motor 8 from the

10 linear drive. The force limit at which the clutch is to be released is set mechanically. In any case, a value is set here at which no serious injury to the operator can occur and which complies with the applicable safety regulations. The control computer 10 is designed to detect a

15 disconnection of the connection between the linear drive and the motor 8 by means of the mechanical force limiter 6 in such a way that it compares the speed of the motor 8 with the position signal of the second encoder continuously or at predefined time intervals and checks

20 whether a deviation is above a predefined threshold value. If the position has not changed or has changed only slightly and the motor continues to rotate (at idle speed), this can be interpreted by the control computer 10 as a decoupling of the motor 8 from the linear drive. In

25 response, the control computer can switch off the motor 8 and store the standstill position provided by the position detection.

The position detection is performed with a system for absolute path measurement. For this purpose, a

30 cable tension sensor system is provided for each module in the modular furniture system 1, which comprises a cable attached to a fixed reference point. Furthermore, it comprises at each furniture module 2 a cable pull sensor interacting with the cable and having a second encoder for

35 outputting a position signal resulting from the unwinding or winding of the cable during the movement of the module 2.

The acceleration is adjustable within certain limits; the limits of the choice of the acceleration are given by the release torque of the slipping clutch 6, i.e. the acceleration torque must be below the release torque of the slipping clutch 6. If the slipping clutch 6 is triggered due to an obstacle, a deep linear acceleration is performed the next time the module is started up until a displacement of the module 2 is detected by means of the position sensor (engagement of the slipping clutch).

10 When braking a module 2, a distinction is made between a normal braking process and an emergency braking process. The control computer 10 makes this distinction based on certain signals it receives. If an emergency stop has been initiated by the user, the module 2 is braked many times faster than during a normal stop process when the module 2 is moved. In the case of this safety braking profile, braking is initiated after the emergency stop condition has been detected, wherein the module must come to a stop within a short distance. Therefore, in this case, active braking is preferred. In normal braking procedure, braking is initiated immediately after detection of a corresponding condition, with linear braking to 0 cm/s. Of course, the acceleration and braking values are adjustable and can be adapted according to the distances to be covered for the module 2 and according to the module weight.

 Preferably, each furniture module 2 comprises an optoelectronic sensor 13a, in particular a light grid 13b, for detecting an obstacle when the furniture module 2 is moving. The optoelectronic sensor 13a comprises at least one light source and at least one receiver and is designed to cover the entire width of the furniture module 2, which is illustrated in Fig. 1 by the diverging lines 13b. In this case, the light source and the receiver project away from a front or rear side of the furniture module 2 and are each held by means of a spring (not shown), so that they can be pressed into a niche provided

for this purpose against the spring force when colliding with an object or when merging with an adjacent module and no longer project out of the furniture module 2, which also triggers a detection. The niche for the optoelectronic sensor 13a is shown in Fig. 1 by the recess behind the bar marked 13a. In addition to the optoelectronic sensor, at least one pressure sensor 52 (Fig. 2) is provided for each furniture module 2. The pressure sensor 52 is arranged in the area of the one, preferably the two, front edge or edges of the support base 16a as seen in the back and forth direction of travel. In embodiments of the furniture module, several pressure sensors are distributed along the edge or edges. By means of the pressure sensor or the pressure sensors, a detection can be triggered when the furniture module 2 collides with an object close to the ground, which may not be detected by the light grid of the optoelectronic sensor. In the context of the present text, such a detection means that subsequently an emergency stop of the moving furniture module is initiated.

As already mentioned, the furniture system 1 is electrically driven. In the event of an interruption of the power supply or in the event of a fault, each furniture module 2 can also be controlled manually individually. For this purpose, a mechanical crank can be coupled to each furniture module 2, by means of which the furniture module 2 can be moved manually by turning the crank (not shown).

In summary, the interruption of the power supply is provided when the stop condition is fulfilled, i.e. when

- a. a stop command from the user, or
 - b. a signal of reaching the end position is received from the control computer 10,
- or when the emergency stop condition is fulfilled, i.e. when

c. a signal that an obstacle in the path of one of the furniture modules 2 occurs as a counterforce to the driving force of the furniture module 2 and the mechanical force limiter performs an interruption of the connection between the motor 8 and the linear drive, is received by the control computer 10,

d. a signal that an obstacle has entered the light grid of the optoelectronic sensor of one of the furniture modules 2 without counterforce is received by the control computer 10, or

e. a signal that an obstacle collides with the push button or pressure switch is received by the control computer 10.

Fig. 2 shows a schematic circuit diagram of the furniture system 1 according to the invention of Fig. 1 in a typical configuration, integrated in an apartment. The furniture system 1 comprises a plurality of furniture modules, illustrated in the figure by their respective associated motor controllers 12. Each furniture module has a relay 52 which interrupts the power supply to the furniture module when the stop condition or the emergency stop condition is met.

Also shown in the figure are the control computer 10, the linear drive, the position sensor 11 and the motor 8 with the motor controller 12. Furthermore, the electrical connections with the control computer and the power supply are shown. These are connections for signals for positioning the furniture modules and for safety-relevant signals, which are associated, for example, with any obstacles when moving the modules 2. A 230 V power supply network 56 is provided for the connection of devices, e.g. a work table or reading lamp, a TV set, etc. of the furniture modules 2. Further, a second 230 V power supply network 55 is provided for the components of the furniture system 1, for example for the power supply 54 of the control computer 10, for the motors 68, etc. The

system further comprises power sockets 20 and a network connection 21 for the user. The network connection 21 is intended on the one hand to provide the user with Internet access. On the other hand, the furniture system can be
5 controlled remotely by the user.

For example, the user can set a certain furniture configuration with his smartphone before he comes home and send it to the furniture system 1, which then moves the modules independently. For this purpose,
10 the control computer 10 further comprises a communication interface for the exchange of data with the user, regardless of whether this data originates from a remote device or by direct operation of the communication interface. The control computer 10 sends status
15 information to the mobile communication device via the communication interface in response. The predefined configurations of the furniture modules 2 can be triggered by means of the communication interface, in particular with a single configuration command assigned to a specific
20 configuration. In embodiments, the configuration command comprises a number of sub-commands that move multiple furniture modules 2 in a predetermined order. The preset configurations may be, for example, cooking, sleeping, working, where the user can switch between these by
25 pressing a button once and the furniture modules 2 are moved accordingly. Not only can the individual modules be moved independently by pressing a single button, but it is also possible to control intermediate positions of a module 2 by holding down a corresponding "left" or "right"
30 button until the desired position is reached. The buttons can also be released and the furniture moves to the next stop (furniture or wall) and switches off automatically.

A user interface 51 is integrated into each furniture module for added convenience. Preferably, each
35 user interface 51 comprises a screen, preferably a touch screen or a membrane keyboard with control buttons. The user interface is used for direct interaction with the

user while said communication interface is used for remote communication. For example, in embodiments, the user interface may include means for voice recognition and may be operated by voice command using an audio module for
5 audio reception and voice recognition software of the control computer 10, wherein voice commands from the user are assigned to and executed by the control computer 10 as machine commands. Alternatively or additionally, in
10 embodiments, the user interface may include means for gesture control and may be moved by gesture control using a video module for video reception, wherein gesture commands from the user are associated with and executed by machine commands from the control computer 10. In
15 embodiments, the control computer may be configured to also control individual controllable elements of the furniture system 1 by means of the voice or gesture recognition, e.g. switching on and off a work table or reading lamp, a TV, etc. For example, a voice command can mean "reading lamp on", whereupon the control computer
20 switches on the reading lamp.

Further, each furniture module may have a proximity sensor so that the user interface is activated when he approaches and is deactivated automatically after an inactive period of time. This also increases
25 convenience and saves power. Preferably, a proximity sensor is chosen for the close range of the screen so that it only triggers when the user's hand is very close to the sensor. This prevents the screen from being switched on unintentionally, for example when passing by.

30 In addition to software for controlling the furniture module configuration, the control computer also includes software for changing parameters and setting various variables, which is explained below. These are system parameters which normally cannot be changed by the
35 user and can only be changed by technical personnel, e.g. as part of a firmware update.

For the movement of a furniture module 2, a linear acceleration is set by means of the control computer 10. Preferably, a maximum acceleration value up to a fixed final speed is specified, which is below a trigger threshold of the mechanical force limitation.

The braking of the furniture module 2 is controlled by the control computer 10 in such a way that the furniture module 2 comes to a standstill after a predefined distance. Depending on the cause of braking, a safety braking program is executed in which the furniture module 2 is actively braked within a certain distance, or a comfort braking program is executed in which the furniture module 2 comes to a standstill linearly in a predefined time. Typically, the comfort braking program comes into play when a furniture module has been moved as part of a configuration change. On the other hand, the control computer executes the safety brake program if an emergency stop has been triggered or an obstacle has been detected during movement. All movements of the furniture system are stopped by the control computer 10 when a corresponding button in the control interface is pressed, and/or when an obstacle in the path of one of the furniture modules 2 occurs as a counterforce to the driving force of the furniture module 2 and the mechanical force limiter responds, or without force effect when an obstacle in the path of a furniture module 2 is detected by means of a light barrier of the furniture module 2. In other words, the control computer uses a plurality of different sensors of the furniture system for moving and positioning the furniture modules and for safety aspects.

The furniture system 1 can preferably also be integrated into home automation systems, with appropriate interfaces being provided on the control computer 10 for this purpose. This means that, for example, remote diagnostics can be conveniently called up in the event of a fault in order to determine the fault.

In contrast to conventional solutions, in which a piece of furniture or furniture system is moved manually or motor-assisted manually (by holding down the button until it comes to a standstill), the control method
5 according to the invention has, among other things, the essential advantage that it allows the furniture modules to be moved independently of the user. This increases the comfort for the user, since he does not have to be present when changing the configuration of the furniture modules
10 or only has to be active at the beginning. Besides the remote control possibility, this advantage is also noticeable at home; since the furniture system includes fixed, non-movable spaces (kitchen, bathroom), the user can, for example, take a shower while the furniture system
15 changes the configuration independently.

Although preferred embodiments of the invention have been described, it is pointed out that the invention can be carried out in other ways within the
20 scope of the following claims. In this context, terms used in the description such as "preferred", "in particular", "advantageous", etc. refer only to optional and exemplary embodiments.

Claims

1. Control method for controlling a modular furniture system (1) with at least two furniture modules (2) which can be moved electrically and independently of one another in a room, the furniture system (1) comprising a control computer (10) with at least one control interface for the user, wherein each furniture module (2) is driven electrically by means of its own motor (8),
10 wherein a linear drive is provided, by means of which each furniture module (2) can be moved individually in cooperation with its own motor (8), wherein each furniture module (2) further comprises a cable tension sensor system for position detection, wherein a mechanical force limiter (6) is interposed between the motor (8) and the linear drive,

wherein the movement of each furniture module (2) is controlled independently of other furniture modules (2) by means of the control computer (10) and the furniture module (2) is moved by means of its motor (8) when the control computer (10) has received a trigger command from the user side, wherein the relevant furniture module (2) is controlled by the control computer (10) without further influence on the user side and by
25 including a position signal from the cable tension sensor system until an end position is reached, and

wherein the relevant furniture module (2) is stopped when a stop condition or emergency stop condition is fulfilled.

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2. Control method according to claim 1, wherein the stop condition is fulfilled when
a. a user stop command, or
b. an end position reach signal is received
35 from the control computer (10), and the emergency stop condition is met when

c. a signal indicating that an obstacle in the path of one of the furniture modules (2) occurs as a counterforce to the driving force of the furniture module (2) and the mechanical force limiter effects an interruption of the connection between the motor (8) and the linear drive, is received by the control computer (10).

3. Control method according to claim 1 or 2, wherein, in order to detect disconnection of the connection between the motor (8) and the linear drive, the control computer (10) compares a rotational speed of the motor (8) with the position signal continuously or at predefined time intervals and detects a disconnection of the connection if the position of the furniture module (2) remains unchanged when the motor (8) is running.

4. Control method according to claim 1 or 2, wherein a communication interface for the control computer (10) is provided for remotely controlling the movement of one or more furniture modules (2), wherein user commands sent by a mobile communication device of a user are received by the communication interface, and wherein status information is sent from the communication interface to the mobile communication device in response.

5. Control method according to one of the preceding claims, wherein one or more furniture modules (2) are moved by voice command by means of an audio module for audio reception and voice recognition of the control computer (10), in which voice commands of the user are assigned to machine commands by the control computer (10) and these are executed and/or wherein one or more furniture modules (2) are moved by means of a video module for video reception by means of gesture commands, in which gesture commands of the user are assigned to machine

commands by the control computer (10) and these are executed.

6. Control method according to one of the
5 preceding claims, wherein predefined configurations of the furniture modules (2) are triggered by means of the control interface for the user, in particular with a single configuration command associated with a specific configuration, in particular wherein the configuration
10 command comprises a number of sub-commands which move a plurality of furniture modules (2) in a specific order.

7. Control method according to one of the preceding claims, wherein a linear acceleration of a
15 furniture module (2) is set by means of the control computer (10) during start-up, in particular wherein a maximum acceleration value is preset up to a fixed final speed which lies below a trigger threshold of the mechanical force limiter.

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8. Control method according to one of the preceding claims, wherein the braking of the furniture module (2) is controlled by means of the control computer (10) in such a way that the furniture module (2) comes to
25 a standstill after a predefined distance, wherein, depending on the cause of the braking, a safety braking program is executed, in which the furniture module (2) is actively braked over a predefined distance, or a comfort braking program is executed, in which the furniture module
30 (2) comes to a linear standstill within a predefined time.

9. Control method according to one of the preceding claims, wherein a manual movement of a furniture module (2) by means of a crank of the furniture module (2)
35 is detected by the control computer (10) and all electrical movements are then stopped by the control computer (10).

10. Control method according to one of the preceding claims, wherein a signal is sent to the control computer (10) by means of one or more pressure sensors
5 (52) of each furniture module (2), in particular a push button or a pressure switch, when the furniture module (2) collides with an object close to the ground, which fulfils the emergency stop condition, wherein the at least one pressure sensor (13c) is arranged in the region of one, in
10 particular both, front edges of the support base (16a), seen in the direction of forward and return travel, in particular wherein several pressure sensors (52) are distributed along the edge or edges.

15 11. Control method according to one of the preceding claims, wherein, during the movement of the furniture module (2), an obstacle is detected by means of an optoelectronic sensor (13a), in particular for generating a light grid (13b), without the action of a
20 force, when the obstacle enters the light grid, wherein a signal is sent to the control computer (10) which satisfies the emergency stop condition.

12. Control method according to one of the
25 preceding claims, wherein, in the event of an emergency stop, no subsequent start-up of a furniture module (2) is permitted by the control computer (10) until the emergency stop condition has been removed by the user.

30 13. Computer program product which, when loaded into a control computer (10) of a modular furniture system with at least one furniture module (2) which can move electrically and independently of one another in a room, executes the method according to one of the
35 preceding claims.