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(54) **SYSTEM AND METHOD FOR BED HEIGHT ADJUSTMENT**

SYSTEM UND VERFAHREN ZUR BETTHÖHENEINSTELLUNG

SYSTÈME ET PROCÉDÉ DE RÉGLAGE DE LA HAUTEUR D'UN LIT

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Description

TECHNICAL FIELD OF THE INVENTION

[0001] The invention relates to a system and method for adjusting the height of a bed, and in particular to a system and method that reduces the risk of injury to a person using the bed.

BACKGROUND TO THE INVENTION

[0002] Preventing people falling at night is one of the major issues in the care of the elderly. It has been found that a substantial number of falls by the elderly occur in the bedroom, and in particular occur when getting into or out of bed.

[0003] Two ways of tackling this problem are for beds of patients that are prone to falling to be equipped with bed rails or for the patient to be restrained in the bed. However, both of these measures have significant disadvantages, namely that patients with dementia can often try to climb out of bed over the bed rails, which can lead to an even more severe fall, and restraints can lead to the patient becoming aggressive and the restraints are not tolerated by relatives of the patient. Documents US-A-2009/0044334 and US-A-2009/0044332 disclose beds that can be lowered.

[0004] A much more accepted way to reduce falls at night is to provide a bed that can be lowered when the patient is in the bed so that they sleep quite close to the floor. In this way, the distance that the patient can fall is reduced and the risk of severe injuries is thereby reduced.

[0005] Of course, a problem with these beds is that it is difficult for the patient to get out of bed when it is in a lowered position. For this reason, adjustable height beds can usually be lifted electronically using an associated control unit. These control units can be hard to handle for elderly patients who suffer from reduced sensitivity or flexibility of their hands and/or from limited vision. Furthermore, patients with dementia can often find it difficult to handle and operate electrical devices.

[0006] Thus, this means that patients can sometimes try to get up when the bed is in the lowered position, which is much more difficult and can even lead to additional falls. Moreover, patients who have adjusted their bed to an adequate height before getting up may not lower the bed back to a safer position when they get back into the bed.

[0007] Therefore, there is a need for a system and method that can overcome the difficulties with conventional height-adjustable beds.

SUMMARY OF THE INVENTION

[0008] According to a first aspect of the invention, there is provided a control system as claimed in claim 1, for an adjustable height bed, the adjustable height bed having a raised position and a lowered position, the control system comprising an input for receiving signals from a sensor located in the adjustable height bed and a processor for processing the received signals to determine the status of a user relative to the bed and for generating control signals for adjusting the bed to the raised position or to the lowered position on the basis of the determined status wherein in the event that the processor determines that the user has got into the bed and is lying in the bed, the processor generates control signals for adjusting the bed to the lowered position.

[0009] According to a second aspect, there is provided an adjustable height bed comprising a bed or mattress portion; a sensor associated with the bed or mattress portion; an adjustable height mechanism for adjusting the height of the bed or mattress portion to the raised position or to the lowered position; and a control system as described above coupled to the sensor and the adjustable height mechanism, the control system being configured to generate control signals for the adjustable height mechanism.

[0010] According to a third aspect, there is provided a method of operating an adjustable height bed, the adjustable height bed having a raised position and a lowered position, the method comprising receiving signals from a sensor located in the adjustable height bed; processing the received signals to determine the status of a user relative to the bed; and adjusting the bed to the raised position or to the lowered position on the basis of the determined status wherein, in the event that it is determined that the user has got into the bed and is lying in the bed, the bed is adjusted to the lowered position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Exemplary embodiments of the invention will now be described, by way of example only, with reference to the following drawings, in which:

Fig. 1 is a block diagram of a height adjustable bed and control system in accordance with the invention;
Fig. 2 is a block diagram of the control system;
Fig. 3 is a graph illustrating an exemplary set of signals from a pressure sensor;
Fig. 4 is a graph illustrating the variance of the exemplary set of signals in Fig. 3 and
Fig. 5 is a flow chart of the algorithm according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] Fig. 1 shows an exemplary adjustable height bed 2 and control system 4 according to the invention. The adjustable height bed 2 has a bed or mattress portion 6 that a user can sit or lie on, a base 8 and some adjustable height mechanism 10 for adjusting the height of the bed or mattress portion 6.

[0013] The adjustable height mechanism 10 adjusts

the height of the bed or mattress portion 6 between at least a raised position, at which it is easier for the user to get off of the bed 2, and a lowered position, at which the risk of the user injuring themselves if they roll out of the bed 2 is reduced. The difference in height between the raised and lowered positions can be of the order of 0.5m - 1m.

[0014] In a preferred embodiment, the bed 2 can be configured for use by a specific user. In particular, the specific height of the bed or mattress portion 6 above the floor in each of the raised and lowered positions can be adjusted for different users. For example, the raised position could be set higher for a tall person than for a short person. This configuration for a specific user can be achieved through suitable control of the adjustable height mechanism.

[0015] The control system 4 is coupled to, and controls the operation of, the adjustable height mechanism 10.

[0016] A sensor 12 is provided in or on the bed or mattress portion 6 for sensing force or pressure exerted on the bed or mattress portion 6 by the user. Signals from the sensor 12 are provided to the control system 4. Preferably, the sensor 12 is placed in or on the bed or mattress portion 6 such that it will be located under the thorax of the user when they are lying appropriately on the bed or mattress portion 6.

[0017] The sensor 12 can be a force sensor for measuring the forces exerted on the bed or mattress portion 6 by the user, a pressure sensor for measuring the pressure exerted on the bed or mattress portion 6 by the user, or a strain gauge for measuring the strain on the bed or mattress portion 6 caused by the user. In this latter embodiment, the measurements from the strain gauge are used to determine the pressure being exerted on the bed or mattress portion 6 by the user. In preferred embodiments, the sensor 12 is selected from a piezoelectric switch, a piezoelectric foil, an electret foil or a strain gauge. Those skilled in the art will appreciate that alternative types of sensors can be used to perform the method in accordance with the invention.

[0018] In accordance with the invention, the control system 4 processes the signals from the sensor 12 to determine the status of the user relative to the bed (i.e. the user is lying down asleep, sat of the edge of the bed 2, getting into or out of the bed 2 or is out of the bed 2) and adjusts the height of the bed 2 to reduce the risk of the user falling and/or the risk of the user injuring themselves during a fall.

[0019] In particular, if it is determined that the user has got into the bed 2 and is lying in the bed 2 (whether asleep or awake), the height of the bed 2 is lowered so that the risk of the user injuring themselves if they roll out of the bed 2 is reduced. Furthermore, if it is determined that the user is sat on the edge of the bed (which can be seen as a reliable predictor of the user getting out of the bed 2), the user is getting out of the bed 2, the height of the bed 2 is raised so that it is easier for the user to stand up, thereby reducing the risk of the user falling.

[0020] The control system 4 preferably predicts or detects that the user is going to get out of the bed 2 early enough so that the bed 2 can be raised to a safe height before the user actually gets out of the bed 2. In addition, the control system 4 preferably determines that the user is lying down safely before lowering the bed 2, in order to reduce the risk that the user will fall out of the bed 2 while it is lowered.

[0021] It will be appreciated that the height adjustments of the bed 2 are performed automatically under the control of the control system 4, and no user or care provider interaction is required.

[0022] Fig. 2 shows the control system 4 in more detail. The control system 4 has an input 14 for receiving signals from the sensor 12, a processor 16 that is coupled to the input 14 and which processes the received signals to determine the status of a user relative to the bed 2.

[0023] The processor 16 is coupled to an output 18 through which signals for controlling the adjustable height mechanism 10 are transmitted.

[0024] The control system 4 further comprises a memory 20 for storing instructions for the algorithm used to process the signals from the sensor 12 and for generating the control signals for the adjustable height mechanism 10.

[0025] In some embodiments, the control system 4 can also include a user-operable height control 22. This control 22 allows the user or a care provider to manually control the adjustment of the height of the bed or mattress portion 6 (or to override the bed height set by the algorithm according to the invention).

[0026] Although the control system 4 is shown as being co-located with the adjustable height bed 2, it will be appreciated that the control system 4 can be located remotely from the bed 2, which means that the signals from the sensor 12 will be transmitted to the control system 4 for processing, and the signals for controlling the height of the bed 2 will be transmitted back to the adjustable height mechanism 10.

[0027] The algorithm executed by the processor 16 will now be described in more detail.

[0028] Fig. 3 shows an exemplary set of signals received from a pressure sensor 12. The exemplary set of signals represents various different states of the user and the bed 2. Fig. 4 is a graph showing the variance of the signals shown in Fig. 3.

[0029] In segment I, the bed 2 is unoccupied, i.e. the user is out of the bed 2, and this is represented by the signal amplitude being small (< -1500), as the sensor 12 is comparatively relaxed and measures only the pressure exerted from the weight of the mattress.

[0030] During segment II, the user sits on the edge of the bed 2 and gets ready to lie down. The centre of gravity of the user is away from the sensor 12 (which is located in the middle of the bed or mattress portion 6 around the point at which the thorax of the user will be located when they are lying down), which means that almost no additional pressure is detected.

[0031] Segment III shows the signal recorded when the user is lying down. Lying down leads to signals with a high amplitude and a comparatively large variance (as shown in Fig. 4).

[0032] In segment IV, the user is lying calmly on the bed 2. In this segment, the thorax of the user is exerting considerable additional pressure onto the sensor 12, which leads to high amplitude signals being recorded. The variance of these signals is small, however, as the user is not moving.

[0033] In segment V, the user sits up. A large, high variance signal appears first which decays rapidly once the user has lifted their upper body from the region of the bed 2 in which the sensor 12 is located. An amplitude smaller than a threshold value a_{in} indicates that the process of sitting up is almost finished.

[0034] During segment VI the user is sitting on the edge of the bed 2. In segment VII the user has got off of the bed 2, and the signal indicates that the bed 2 is empty.

[0035] Fig. 5 shows the steps in the algorithm executed by the processor 16.

[0036] The algorithm starts in step 101 at a time $t = t_{start}$.

[0037] In step 103, the height status of the bed 2 is determined (i.e. whether the bed 2 is in the raised or lowered positions). This determination can be made by examining the status of the adjustable height mechanism 10, or by reading a status of the bed 2 from the memory 20.

[0038] At step 105, the next sample or signal a from the sensor 12 is read.

[0039] At step 107, the sample a is compared to the amplitude threshold, a_{in}. If a is less than the threshold value a_{in} the process moves to step 109.

[0040] As the amplitude of the signal a is below the threshold, this indicates that the bed is empty or that the user is sat on the edge of the bed, and the bed should be in the raised position. Therefore, at step 109, if the status of the bed 2 is "high", the bed 2 is left in the raised position and the method returns to step 105 in which the next sample a is read. However, if, at step 109, the status of the bed 2 is "low" (i.e. it is in the lowered position), the process moves to step 111 in which the bed 2 is raised, and the status of the bed is set to "high".

[0041] The method then returns to step 105 in which the next sample or signal a is read from the sensor 12.

[0042] Returning to step 107, if the amplitude of the signal a is greater than the threshold value a_{in}, the method passes to step 113 in which the variance, var, of the signal is compared to the variance threshold, var_{in}.

[0043] If the variance is greater than the variance threshold, the method returns to step 105 and the next sample a is read. In this case, the user is on the bed, but either in the process of lying down, sitting up or rolling over (as shown in segments III and VI of Fig. 3). Therefore, adjustments of the bed height should be avoided, as this could increase the risk of the user suffering a fall.

[0044] If the variance is less than the variance threshold, the method passes to step 115 in which the height status of the bed 2 is examined.

[0045] As the amplitude of the signal a is above the threshold and the variance is below the variance threshold, this indicates that the user is lying on the bed calmly, and the bed should be in the lowered position. Therefore, if the bed status is "high", the bed is lowered and the status of the bed is set to "low". The method then returns to step 105 and the next sample a is read. If, at step 115, the bed status is "low", then the method returns to step 105 and the next sample a is read.

[0046] As described above, the control system 4 can be integrated into the bed 2 or can be separate from the bed 2. In some embodiments, the control system 4 can be integrated into existing electronics in a bed 2 (for example the electronics for controlling the adjustment of the height of the bed 2).

[0047] Furthermore, it will be appreciated that some height adjustable beds 2 can also be electronically adjusted into a chair-like configuration. In this case, it is possible for the algorithm according to the invention to be adapted so that when the bed 2 is moved into the raised position the bed 2 is also adapted to change into the chair-like configuration, and vice versa.

[0048] In addition, although the exemplary embodiments described above only make use of a single sensor 12, it will be appreciated that it is possible to use more than one sensor 12.

[0049] Therefore, there is provided a control system for a height adjustable bed that automatically adjusts the height of the bed according to the status of the user relative to the bed. The bed can be adjusted into a raised position if it is determined that the user is getting into or out of the bed, or adjusted into a lowered position if it is determined that the user is lying on the bed. In this way, the risk of falls, and the risk of injury sustained during a fall, can be reduced.

[0050] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments.

[0051] Variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a 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 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 measured 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.

Claims

1. A control system (4) for an adjustable height bed (2), the adjustable height bed having a raised position and a lowered position, the control system comprising:

   an input (14) for receiving signals from a sensor (12) located in the adjustable height bed; and
   a processor (16) for processing the received signals to determine the status of a user relative to the bed and for generating control signals for adjusting the bed to the raised position or to the lowered position on the basis of the determined status,
   characterized in that in the event that the processor determines the status to be that the user has got into the bed and is lying in the bed, the processor is configured to generate control signals for adjusting the bed to the lowered position.

2. A control system (4) as claimed in claim 1, wherein, in the event that the processor determines the status to be that the user has got or is getting out of the bed (2), or is sat on the edge of the bed, the processor (16) is configured to generate control signals for adjusting the bed to the raised position, or for maintaining the bed in the raised position, if the bed is already in the raised position.

3. A control system (4) as claimed in claim 2, wherein the processor (16) is configured to determine that the user has got or is getting out of the bed (2), or is sat on the edge of the bed, in the event that the amplitude of the received signals is below an amplitude threshold.

4. A control system (4) as claimed in claim 1, 2 or 3, wherein, in the event that the processor (16) determines the status to be that the user is on the bed (2) lying down, the processor is configured to generate control signals for maintaining the bed in the lowered position, if the bed is already in the lowered position.

5. A control system (4) as claimed in any one of claims 1 to 4, wherein the processor (16) is configured to determine that the user is in bed lying down in the event that the amplitude of the received signals is above an or the amplitude threshold and a variance of the received signals is below a variance threshold.

6. A control system (4) as claimed in any preceding claim, further comprising a user-operable control (22) that is configured to cause the processor (16) to generate control signals for adjusting the bed to the raised position or to the lowered position in response to a user input.

7. An adjustable height bed (2), comprising:

   a bed or mattress portion (6);
   a sensor (12) associated with the bed or mattress portion;
   an adjustable height mechanism (10) for adjusting the height of the bed or mattress portion to the raised position or to the lowered position; and
   a control system (4) as claimed in any preceding claim coupled to the sensor and the adjustable height mechanism, the control system being configured to generate control signals for the adjustable height mechanism.

8. An adjustable height bed (2) according to claim 7 wherein the sensor (12) is selected from a group comprising a piezoelectric switch, a piezoelectric foil, an electrets foil and a strain gauge.

9. A method of operating an adjustable height bed (2), the adjustable height bed having a raised position and a lowered position, the method comprising:

   receiving signals from a sensor (12) located in the adjustable height bed;
   processing the received signals to determine the status of a user relative to the bed;
   adjusting the bed to the raised position or to the lowered position on the basis of the determined status;
   wherein, in the event that it is determined that the status is that the user has got into the bed and is lying in the bed, the step of adjusting comprises:

      adjusting the bed to the lowered position.

10. A method as claimed in claim 9, wherein, in the event that it is determined that the status is that the user has got or is getting out of the bed (2), or is sat on the edge of the bed, the step of adjusting comprises:

    adjusting the bed to the raised position or maintaining the bed in the raised position if the bed is already in the raised position.

11. A method as claimed in claim 10, wherein the step of processing determines that the user has got or is getting out of the bed (2), or is sat on the edge of the bed, in the event that the amplitude of the received signals is below an amplitude threshold.

12. A method as claimed in claim 9, 10 or 11, wherein,

in the event that it is determined that the status is that the user is on the bed lying down, the step of adjusting comprises:

maintaining the bed (2) in the lowered position if the bed is already in the lowered position.

13. A method as claimed in claim 12, wherein the step of processing determines that the user is in bed lying down in the event that the amplitude of the received signals is above an or the amplitude threshold and a variance of the received signals is below a variance threshold.

Patentansprüche

1. Kontrollsystem (4) für ein höhenverstellbares Bett (2), wobei das höhenverstellbare Bett eine erhöhte Position und eine abgesenkte Position hat, das Kontrollsystem besteht aus:

- einem Eingang (14) für den Signalempfang von einem Sensor (12), welcher im höhenverstellbaren Bett platziert ist; und
- einem Prozessor (16) für das verarbeiten des empfangenen Signals, um den Status eines Benutzers bezogenen auf das Bett zu ermitteln, und für das Generieren von Kontrollsignalen für die Anpassung des Bettes auf die erhöhte Position oder auf die abgesenkte Position auf Basis des ermittelten Status,
- **dadurch gekennzeichnet, dass** in dem Ereignis, dass der Prozessor einen Status ermittelt, dass der Benutzer sich in das Bett begeben hat und im Bett liegt, der Prozessor konfiguriert ist ein Kontrollsignal zu generieren für die Anpassung des Bettes auf die abgesenkte Position.

2. Kontrollsystem (4) nach Anspruch 1, wobei in dem Ereignis, dass der Prozessor einen Status ermittelt, dass der Benutzer sich aus dem Bett begeben hat oder sich aus dem Bett (2) begibt, oder auf der Kante des Bettes gesetzt ist, der Prozessor (16) konfiguriert ist ein Kontrollsignal zu generieren für die Anpassung des Bettes auf die erhöhte Position, oder für das Halten des Bettes in der erhöhten Position, falls das Bett bereits in der erhöhten Position ist.

3. Kontrollsystem (4) nach Anspruch 2, wobei der Prozessor (16) konfiguriert ist zu ermitteln, dass der Benutzer sich aus dem Bett begeben hat oder sich aus dem Bett (2) begibt, oder auf der Kante des Bettes gesetzt ist, in dem Ereignis, dass die Amplitude des empfangenen Signals unterhalb eines Amplitudengrenzwertes ist.

4. Kontrollsystem (4) nach den Ansprüchen 1, 2 oder 3, wobei in dem Ereignis, dass der Prozessor (16) einen Status ermittelt, dass der Benutzer sich auf dem Bett (2) hinlegt, der Prozessor konfiguriert ist ein Kontrollsignal zu generieren für das Halten des Bettes in der abgesenkten Position, falls das Bett bereits in der abgesenkten Position ist.

5. Kontrollsystem (4) nach den Ansprüchen 1 bis 4, wobei der Prozessor (16) konfiguriert ist zu ermitteln, dass der Benutzer sich im Bett hinlegt in dem Ereignis, dass die Amplitude des empfangenen Signals oberhalb eines oder des Amplitudengrenzwertes ist und die Varianz des empfangenen Signals unterhalb eines Varianzgrenzwertes ist.

6. Kontrollsystem (4) nach jedwedem der zuvorgehenden Ansprüche, weiterhin bestehend aus einem benutzerbedienten Bedienung (22), die konfiguriert ist den Prozessor (16) zu veranlassen ein Kontrollsignal zu generieren für die Anpassung des Bettes auf die erhöhte Position oder auf die abgesengte Position als Antwort auf die Benutzereingabe.

7. Höhenverstellbares Bett (2), bestehend aus:

- einem Bett oder Matratzenteil (6);
- einem Sensor (12) angegliedert an das Bett oder das Matratzenteil;
- einem Höhenanpassungsmechanismus (10) für die Anpassung der Höhe des Bettes oder des Matratznteils auf die erhöhte Position oder auf die abgesenkte Position; und
- einem Kontrollsystem (4) nach jedwedem der zuvorgehenden Ansprüche gekoppelt an den Sensor und den Höhenanpassungsmechanismus, das Kontrollsystem ist konfiguriert um Kontrollsignale zu generieren für den Höhenanpassungsmechanismus.

8. Höhenverstellbares Bett (2) nach Anspruch 7 wobei der Sensor (12) ausgewählt ist aus einer Gruppe bestehend aus einem piezoelektrischem Schalter, einer piezoelektrischen Folie, einer Elektret-Folie und einem Dehnungsmessstreifen.

9. Verfahren zur Bedienung eines höhenverstellbaren Bettes (2), das höhenverstellbare Bett eine erhöhte Position und eine abgesenkte Position habend, bestehend aus:

- Signalempfang von einem Sensor (12) platziert in dem höhenverstellbaren Bett;
- Verarbeitung der empfangenen Signale um den Status eines Benutzers bezogenen auf das Bett zu ermitteln;
- Anpassung des Bettes auf die erhöhte Position

oder die abgesenkte Position auf Basis des ermittelten Status;
- wobei in dem Ereignis, dass ermittelt wurde, dass der Status ist, dass der Benutzer sich in das Bett begeben hat und im Bett liegt, der Schritt zur Anpassung besteht aus:

Anpassung des Bettes auf die abgesenkte Position.

10. Verfahren nach Anspruch 9, wobei in dem Ereignis, dass ermittelt wurde, dass der Status ist, dass der Benutzer sich aus dem Bett begeben hat oder sich aus dem Bett (2) begibt, oder auf der Kante des Bettes gesetzt ist, der Schritt zur Anpassung besteht aus:

Anpassung des Bettes auf die erhöhte Position oder Halten des Bettes in der erhöhten Position, falls das Bett bereits in der erhöhten Position ist.

11. Verfahren nach Anspruch 10, wobei der Schritt der Verarbeitung ermittelt, dass der Benutzer sich aus dem Bett (2) begeben hat oder sich aus dem Bett begibt (2), oder auf der Kante des Bettes gesetzt ist, in dem Ereignis, dass die Amplitude des empfangenen Signals unterhalb eines Amplitudengrenzwertes ist.

12. Verfahren nach den Ansprüchen 9, 10 oder 11, wobei in dem Ereignis, dass ermittelt wurde, dass der Status ist, dass der Benutzer sich auf dem Bett hinlegt, der Schritt zur Anpassung besteht aus:

- Halten des Bettes (2) in der abgesenkten Position, falls das Bett bereits in der abgesenkten Position ist.

13. Verfahren nach Anspruch 12, wobei der Schritt der Verarbeitung ermittelt, dass der Benutzer sich im Bett hinlegt in dem Ereignis, dass die Amplitude des empfangenen Signals oberhalb eines oder des Amplitudengrenzwertes ist und die Varianz des empfangenen Signals unterhalb eines Varianzgrenzwertes ist.

Revendications

1. Dispositif de contrôle (4) pour un lit réglable en hauteur (2), ce lit réglable en hauteur ayant une position relevée et une position abaissée, le dispositif de contrôle comprenant:

une entrée (14) pour recevoir des signaux provenant d'un capteur (12) situé dans le lit réglable en hauteur et
un calculateur (16) pour analyser les signaux reçus pour déterminer l'état d'un utilisateur par rapport au lit et pour générer des signaux de contrôle à fin d'ajuster le lit dans sa position relevée ou abaissée en fonction de l'état déterminé,
caractérisé en ce que, lorsque le calculateur détermine l'état de l'utilisateur comme étant que l'utilisateur est entré dans le lit et est allongé dans le lit, le calculateur est configuré pour générer des signaux de contrôle pour ajuster le lit dans la position abaissée.

2. Dispositif de contrôle (4) selon la revendication 1, **caractérisé en ce que**, lorsque le calculateur détermine l'état de l'utilisateur comme étant que l'utilisateur est sorti ou est en train de sortir du lit (2), ou est assis sur le bord du lit, le calculateur (16) est configuré pour générer
des signaux de contrôle pour ajuster le lit dans la position relevée, ou pour maintenir le lit dans la position relevée si le lit est déjà dans la position relevée.

3. Dispositif de contrôle (4) selon la revendication 2, dans lequel le calculateur (16) est configuré pour déterminer que l'utilisateur est sorti ou est en train de sortir du lit (2), ou est assis sur le bord du lit, lorsque l'amplitude des signaux reçus est en dessous d'un seuil d'amplitude.

4. Dispositif de contrôle (4) selon la revendication 1,2 ou 3, **caractérisé en ce que**, lorsque le calculateur (16) détermine l'état de l'utilisateur comme étant que l'utilisateur est allongé sur le lit (2), le calculateur est configuré pour générer des signaux de contrôle pour maintenir le lit dans la position abaissée si le lit est déjà dans la position abaissée.

5. Dispositif de contrôle (4) selon une des revendications 1 à 4, **caractérisé en ce que** le calculateur (16) est configuré pour déterminer que l'utilisateur est allongé dans le lit lorsque l'amplitude des signaux reçus est au dessus d'un ou du seuil d'amplitude et la variance des signaux reçus est en dessous d'un seuil de variance.

6. Dispositif de contrôle (4) selon une des revendications précédentes, comprenant en plus une interface utilisateur interactive (22) qui a été configurée pour faire générer par le calculateur (16) des signaux de contrôle pour ajuster le lit dans la position relevée ou la position abaissée en réponse d'une entrée utilisateur.

7. Lit réglable en hauteur (2), comprenant:

- une partie lit ou matelas (6);
- un capteur (12) associé à la partie lit ou matelas;

- un mécanisme d'ajustement en hauteur (10) pour ajuster la hauteur de la partie lit ou matelas jusqu'à la position relevée ou la position abaissée;
et un dispositif de contrôle (4) selon une des revendications précédentes couple au capteur et le mécanisme d'ajustement en hauteur, le dispositif de contrôle étant configuré pour générer des signaux de contrôle pour le mécanisme d'ajustement en hauteur.

8. Lit réglable en hauteur (2) selon la revendication 7 dans lequel le capteur (12) est sélectionné parmi un groupe comprenant un transducteur piézoélectrique, une feuille piézoélectrique, une feuille d'électret et une jauge de déformation.

9. Méthode pour actionner un lit réglable en hauteur (2), le lit réglable en hauteur ayant une position relevée et une position abaissée, la méthode comprenant:

la réception de signaux provenant d'un capteur (12) situé dans le lit ajustable en hauteur;

- le traitement des signaux reçus pour déterminer la position relative d'un utilisateur par rapport au lit réglable en hauteur;
- l'ajustement du lit vers la position relevée ou la position abaissée en fonction de l'état de l'utilisateur déterminé ;
- dans laquelle, lorsqu'il est déterminé que l'état de l'utilisateur est que l'utilisateur est entré dans le lit et est allongé dans le lit, l'étape d'ajustement comprend:

l'ajustement du lit vers la position abaissée.

10. Méthode selon la revendication 9, dans laquelle, lorsqu'il est déterminé que l'état de l'utilisateur est que l'utilisateur est sorti ou est en train de sortir, ou est assis sur le bord du lit (2), l'étape d'ajustement comprend:

l'ajustement du lit vers la position relevée ou maintenir le lit dans la position relevée si le lit est déjà dans la position relevée.

11. Méthode selon la revendication 10, dans laquelle l'étape de traitement détermine que l'utilisateur est sorti ou est en train de sortir du lit (2), ou est assis sur le bord du lit, lorsque l'amplitude des signaux reçus est en dessous d'un seuil d'amplitude.

12. Méthode selon les revendications 9, 10 ou 11, dans laquelle, lorsqu'il est déterminé que l'état de l'utilisateur est que l'utilisateur est allongé sur le lit, l'étape d'ajustement comprend:

maintenir le lit dans la position abaissée si la position du lit est déjà abaissée.

13. Méthode selon la revendication 12, dans laquelle l'étape de traitement détermine que l'utilisateur est allongé dans le lit lorsque l'amplitude des signaux reçus est au dessus d'un ou du seuil d'amplitude et la variance des signaux reçus est en dessous d'un seuil de variance.

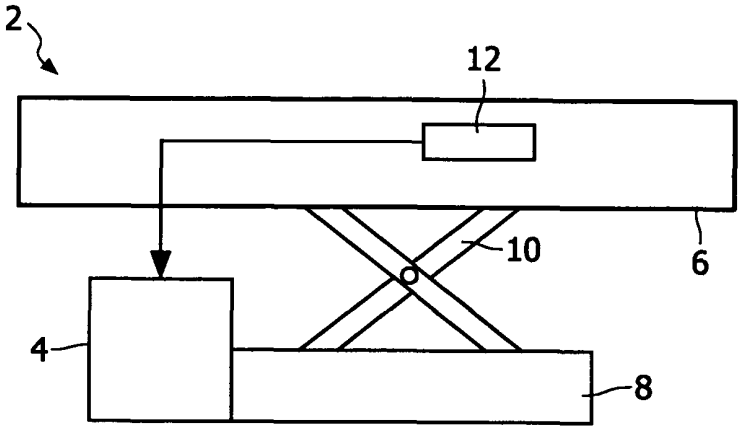

2
12
10
6
4
8

FIG. 1

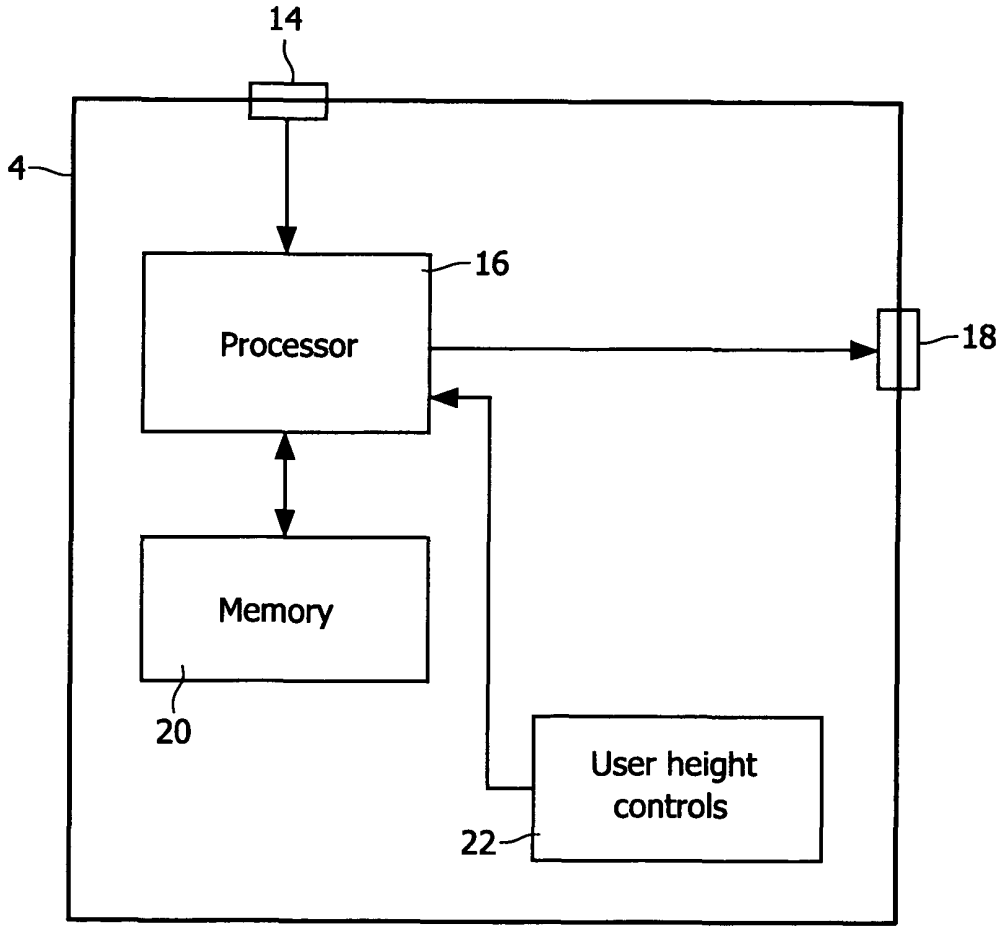

14
4
16
Processor
18
Memory
20
User height controls
22

FIG. 2

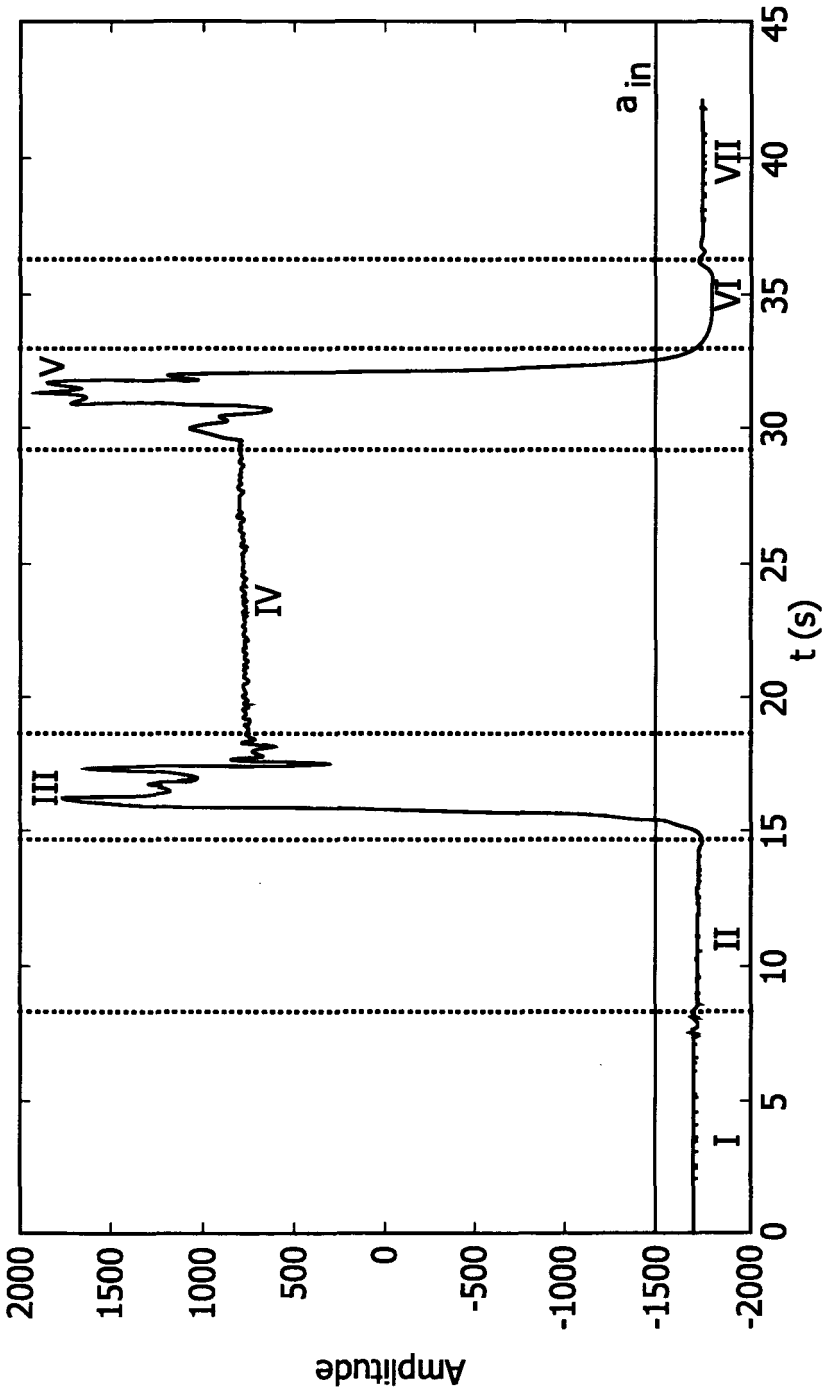

a in
I
II
III
IV
V
VI
VII
t (s)
Amplitude
2000
1500
1000
500
0
-500
-1000
-1500
-2000
0
5
10
15
20
25
30
35
40
45

FIG. 3

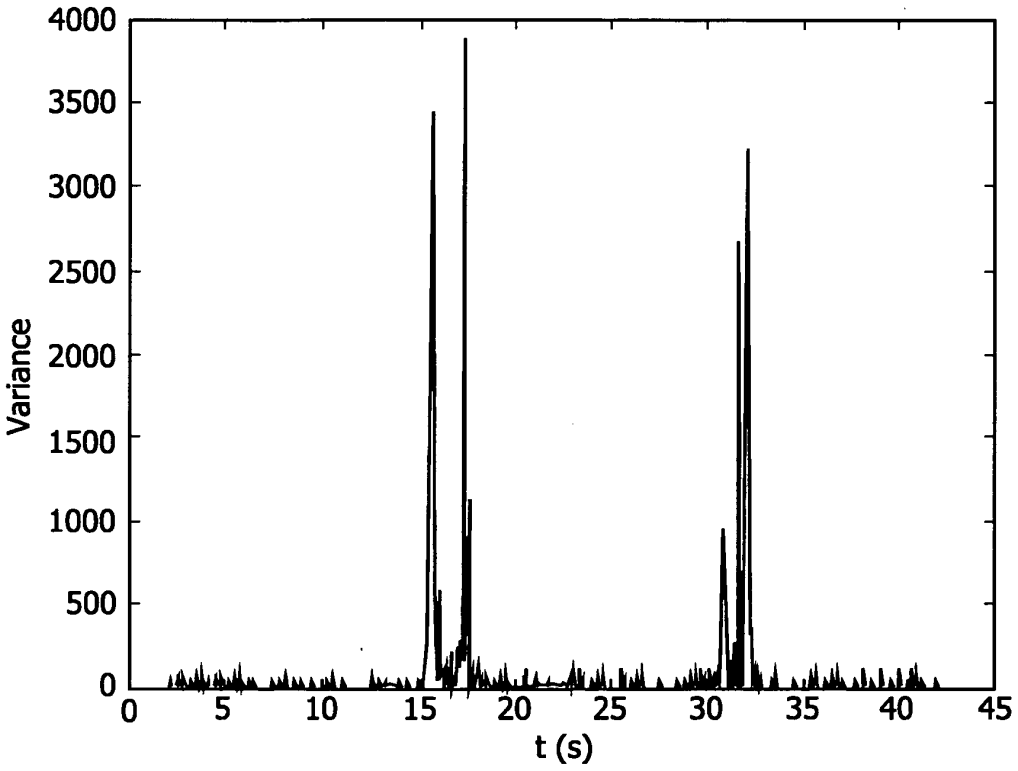

4000
3500
3000
2500
2000
1500
1000
500
0
Variance
0
5
10
15
20
25
30
35
40
45
t (s)

FIG. 4

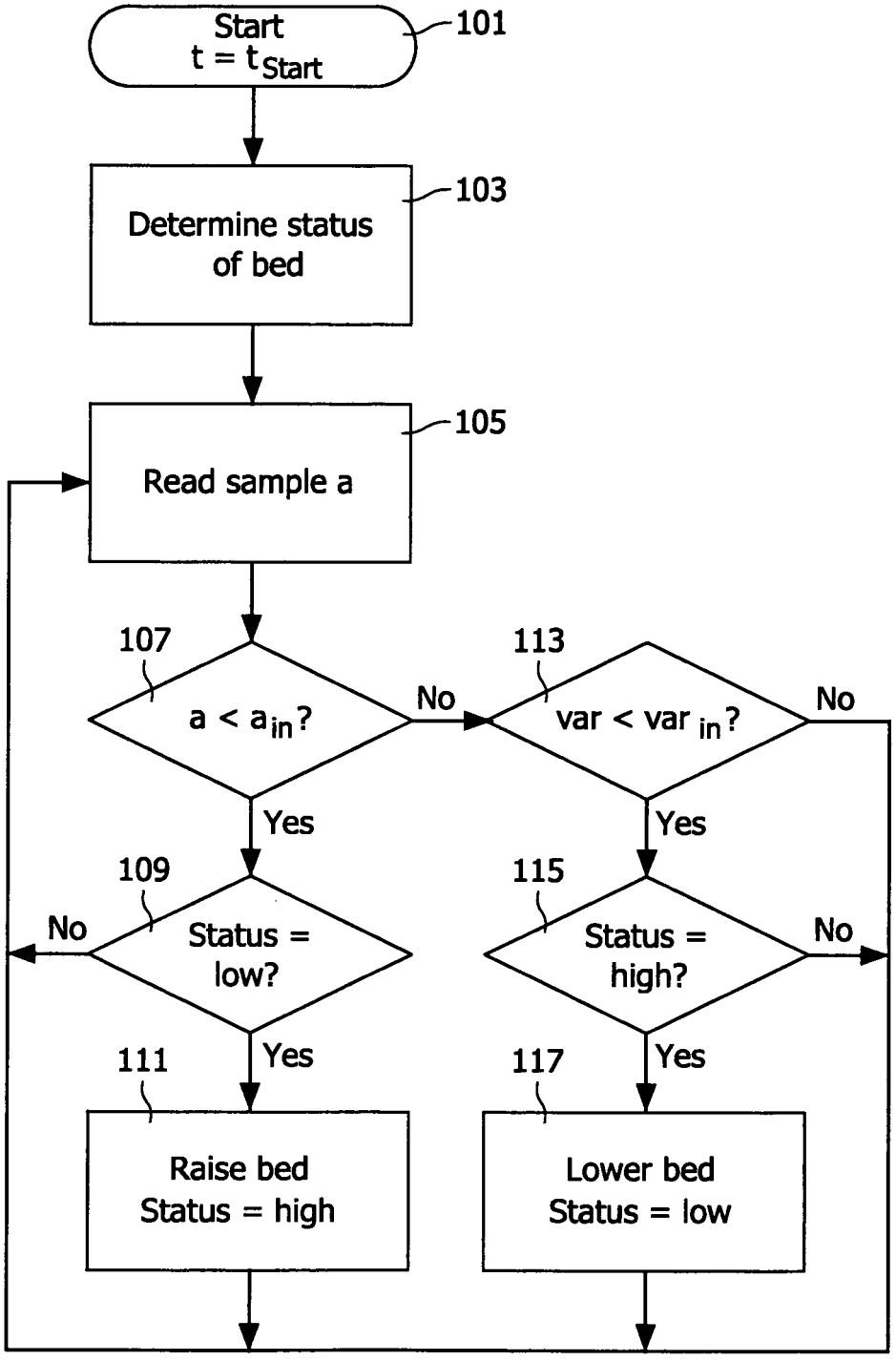

Start
t = t Start
101
Determine status of bed
103
Read sample a
105
107
a < a in?
No
113
var < var in?
No
Yes
Yes
109
Status = low?
No
115
Status = high?
No
Yes
Yes
111
Raise bed
Status = high
117
Lower bed
Status = low

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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