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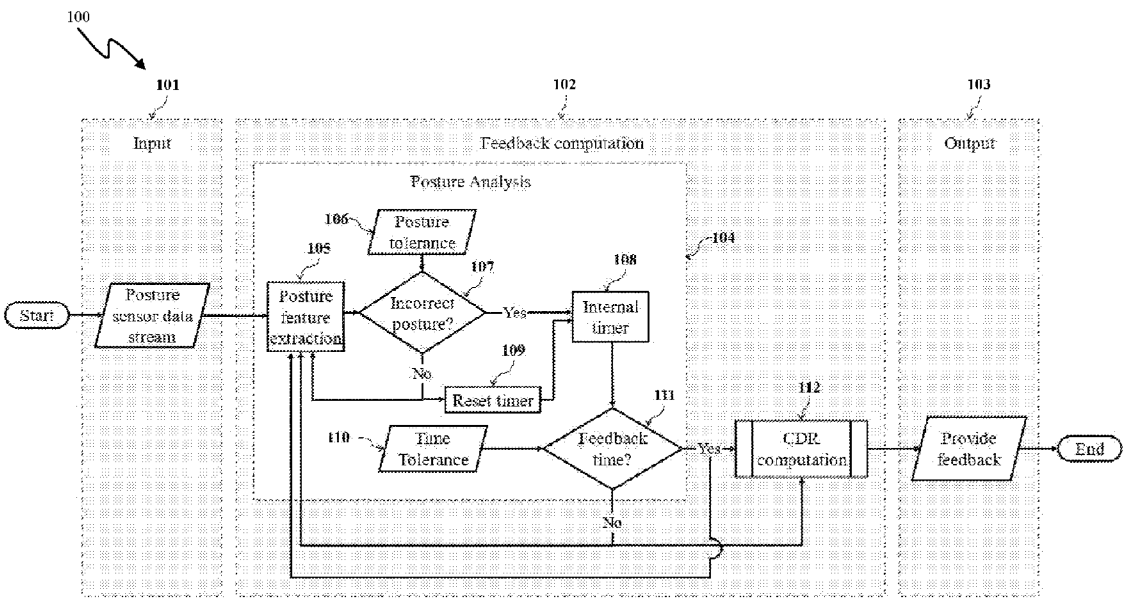

Fig. 3

(57) Abstract: POSTURE CORRECTION SYSTEM AND METHOD THEREOF The present invention relates to a system (100) for posture correction and a method thereof. The system (100) detects and analyses a posture of the user, and compares it with a set of pre-recorded healthy postures. The system (100) provides the 5 pseudo-haptic feedback to the user, if an incorrect posture maintained for a certain time period above a pre-defined threshold value is detected. The system (100) includes an input unit (101) for detecting the body posture of the user, a feedback computation unit (102) for determining if a feedback is required based on the current posture of the user, and an output unit (103) configured to provide the 10 pseudo-haptic feedback to the user. The feedback computation unit (102) is configured to determine an intensity and a time duration of the feedback to be provided to the user.

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POSTURE CORRECTION SYSTEM AND METHOD THEREOF

FIELD OF INVENTION

[0001] The present invention relates to posture correction systems, and more particularly to a system for posture correction of a user occupying a seat, using pseudo-haptic feedback, and a method thereof.

BACKGROUND OF THE INVENTION

[0002] The subject matter discussed in the background section should not be assumed to be prior art merely because of its mention in the background section. Similarly, a problem mentioned in the background section or associated with the subject matter of the background section should not be assumed to have been previously recognized in the prior art. The subject matter in the background section merely represents different approaches, which in and of themselves may correspond to implementations of the claimed technology.

[0003] Posture correction is required for people who work for long hours in a seated position. The number of occupations that require employees to work while being seated for long hours has exponentially increased in recent days. Long-term sitting leads to incorrect posture, primarily due to fatigue. Chronic incorrect posture leads to numerous health issues that include back pain and neck pain, forward neck syndrome (FNS), spinal dysfunction, etc. This not only affects lifestyle of the people, but also results in reduced work productivity and efficiency.

[0004] There are numerous posture correction techniques available in the art. Some of these include posture correction braces, ergonomic chairs, lumbar support belts, etc. While such devices help in correcting incorrect posture for individuals having long working hours, they cannot be efficiently used during working hours. For posture correction systems to be concurrently used during working hours, audio, visual and vibration-based feedback systems for posture correction are available. Such systems are used in conjunction with Inertial Measurement Units (IMUs), camera or other posture measurement devices.

[0005] Visual feedbacks include popup dialogue boxes on a display or notifications that are provided at regular intervals to help a user maintain appropriate posture while being seated. Audio feedbacks are also provided occasionally along with the visual feedback. The main drawback of such techniques is that a working user/individuals get accommodated/acclimatized to the feedbacks over time. Hence, such user lose their potency in correcting posture over time. Vibration based feedbacks are provided through various methods which include vibrating chair, vibration gloves, etc. Though these have a positive effect on posture correction initially, such devices induce a feeling of "phantom vibration" in the individuals using them. Phantom vibration refers to the feeling wherein one has a sensation of vibration without the presence of any actual vibration. This is especially undesirable from a long-term health perspective.

[0006] There is therefore a need in the art for techniques capable of addressing the above-mentioned shortcomings by providing a system and method for posture correction for allowing users to maintain anatomically healthy posture when sitting for long durations, while not affecting normal functioning for the users.

OBJECT OF THE INVENTION

[0007] The object of the present invention is to provide a system for posture correction of a user occupying a seat for long durations, and a method thereof.

[0008] Another object of the present invention is to improve posture anatomically while not affecting normal functioning for the user.

[0009] Another object of the present invention is to provide a system and a method for posture correction capable of providing real-time feedback to the user regarding incorrect posture, in form of a pseudo-haptic feedback, whenever the incorrect posture is detected. This is especially important for people who are subjected to long working hours in front of a computer as they develop wrong sitting posture over time.

SUMMARY OF THE INVENTION

[0010] An aspect of the present invention relates to a system and a method for posture correction of a user occupying a seat for long duration. It is possible to provide users with a false perception or an illusion of force or vibration because of the way brain combines sensory information from various sources. This technique of providing force sensation is known as “pseudo-haptic feedback”. Haptic feedback generally refers to a tactile feedback felt by receptors of skin of the user when it comes into contact with an object. Here, the term pseudo-haptic is used because there is no actual haptic feedback that is provided to the user. The only feedback that is provided is visual feedback that causes the user to experience force feedback in the form of resistance or assistance to motion. The method of the present invention involves providing feedback for correction of the posture of the user from an incorrect posture through a pseudo-haptic feedback.

[0011] An aspect of the present invention relates to a posture correction system which includes an input unit configured to detect a posture of a user operating a computing device while being seated, a feedback computation unit configured to determine whether a pseudo-haptic feedback is to be provided to the user by comparing the detected posture with a pre-defined set of correct postures, and an output unit configured to provide the pseudo-haptic feedback to the user for correction of the posture based on the determination of the feedback computation unit.

[0012] According to an embodiment of the present invention, the input unit detects the posture by sensing any of an upright posture, trunk rotation, trunk flexion, trunk extension, neck flexion, neck extension and neck twisting of the user. The input unit may include sensors that may be any or a combination of axis-related accelerometers in combination with one or more axis-related gyroscopes, a magnetometer, an inclinometer, pedometer, global positioning system (GPS) components, inertial measurement unit (IMU) devices, pressure sensors, optical sensors, proximity sensors or any other suitable sensors.

[0013] Another aspect of the present invention relates to a method of correcting posture of a user. The method includes detecting the posture of the user operating the computing device while being seated, comparing the detected posture with the pre-recorded set of healthy/correct postures to determine whether a pseudo-haptic feedback is to be provided to the user, and providing the pseudo-haptic feedback to the user for correction of the posture based on the determination of the feedback computation unit

[0014] According to an embodiment of the present invention, the feedback computation unit is configured to determine an intensity and a time duration of the pseudo-haptic feedback to be provided to the user.

[0015] According to an embodiment of the present invention, the feedback computation unit includes a Control Display Ratio (CDR) computation unit configured to determine the type of the pseudo-haptic feedback to be provided to the user by computing a CDR value as a ratio of a displacement made by the user using an external hardware input device to a displacement made by a cursor on a display unit of the computing device. According to an embodiment of the present invention, the output unit includes a pseudo-haptic feedback unit configured to provide the pseudo-haptic feedback to the user when the CDR value is greater than 1, and a feedback reset unit configured to stop the pseudo-haptic feedback provided to the user when the CDR value is equal to 1.

[0016] This pseudo-haptic feedback is provided by varying the CDR of the computing device, such as a computer or an apparatus that the user is working on while being seated on a seat. In order to provide the pseudo-haptic feedback, the CDR value greater than 1 is set when the posture correction system determines that the pseudo-haptic feedback is to be provided to the user to prompt posture correction. If the posture correction system determines that the pseudo-haptic feedback needs to be stopped or switched-off, then the CDR value is set to 1.

[0017] According to an embodiment of the present invention, the feedback computation unit includes a posture feature extraction unit configured to extract a feature value from the detected posture and a healthy feature value from the pre-defined set of correct postures, and calculate a postural error, defined as the difference between the extracted feature value and the healthy feature value. A posture comparison unit is configured to compare the postural error with a posture tolerance value (PTV) determining an acceptable range of deviation of the posture from the pre-defined set of correct postures, and determine whether the postural error exceeds the PTV. When the postural error exceeds the PTV, value of an internal timer unit of the feedback computation unit increases until an incorrect posture of the user is detected for a predetermined time interval. If the posture correction system detects an incorrect posture is being maintained for a time interval above a pre-defined threshold value, then the output unit provides the pseudo-haptic feedback to the user.

[0018] According to an embodiment of the present invention, the feedback computation unit includes a CDR determination unit configured to compute the CDR value as a function of the postural error difference. According to an embodiment of the present invention, the feedback computation unit includes a time comparison unit configured to compare the value of the internal timer unit with a time tolerance value (TTV) obtained from a time tolerance unit of the feedback computation unit, to determine whether the pseudo-haptic feedback is to be provided to the user.

[0019] According to an embodiment of the present invention, the posture correction system includes a mode selection unit configured to change between various body parts for posture correction. Using the mode selection unit, the user can periodically change a targeted body part that needs correction. The mode selection unit may also be configured to select/change the targeted body part according to a schedule based on a physician or a medical practitioners' recommendation for the user based on his/her health condition. The pseudo-haptic feedback unit of the output unit may be connected to the mode selection unit to provide the pseudo-haptic feedback in a plurality of modes to selected by the mode selection unit. The mode selection unit includes an upper trunk posture correction unit, a low back posture correction unit, a neck posture correction unit, a wrist posture correction unit and a leg posture correction unit. The mode selection unit provides the pseudo-haptic feedback generated by the pseudo-haptic feedback unit to the user until a posture of the respective targeted body part is corrected.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWINGS

[0020] The accompanying drawings constitute a part of the description and are used to provide a further understanding of the present invention. Such accompanying drawings illustrate the embodiments of the present invention used to describe the principles of the present invention. The embodiments are illustrated by way of example and not by way of limitation in the figures of the accompanying drawings in which references indicate similar elements. It should be noted that references to "an" or "one" embodiment in this invention are not necessarily to the same embodiment, and they mean at least one. In the drawings:

[0021] **Fig. 1** illustrates a representation of an incorrect posture of a user and correction of the same by a system for posture correction, in accordance with an embodiment of the present invention;

[0022] **Fig. 2** illustrates a flow diagram of a method for posture correction, in accordance with an embodiment of the present invention;

[0023] **Fig. 3** illustrates a flow diagram depicting a process for computing whether a feedback related to the incorrect posture is required by the system, in accordance with an embodiment of the present invention;

[0024] **Fig. 4** illustrates a flow diagram depicting a process to compute a Control Display Ratio (CDR) of a computing device being operated by the user to configure the pseudo-haptic feedback depending on a current posture of the user, in accordance with an embodiment of the present invention;

[0025] **Fig. 5A** illustrates a flow diagram depicting another process for computing the CDR as a function of upper body postural error to configure the pseudo-haptic feedback depending on the current posture of the user, in accordance with an embodiment of the present invention;

[0026] **Fig. 5B** illustrates a plurality of techniques for computing the CDR as a function of the upper body postural error, in accordance with an embodiment of the present invention;

[0027] **Fig. 6** illustrates a flow diagram depicting a process to determine the CDR in order to increase user perception of the pseudo-haptic feedback, in accordance with an embodiment of the present invention;

[0028] **Fig. 7** illustrates a flow diagram showing a process for storing data related to the posture of the user, in accordance with an embodiment of the present invention; and

[0029] **Figs. 8A** and **8B** illustrates a mode selection unit of the posture correction apparatus, and different modes in which the posture correction may be implemented.

DETAILED DESCRIPTION OF THE INVENTION

[0030] The detailed description set forth below in connection with the appended drawings is intended as a description of various embodiments of the present invention and is not intended to represent the only embodiments in which the present invention may be practiced. Each embodiment described in this disclosure is provided merely as an example or illustration of the present invention and should not necessarily be construed as preferred or advantageous over other embodiments. The detailed description includes specific details for the purpose of providing a thorough understanding of the present invention. However, it will be apparent to those skilled in the art that the present invention may be practiced without these specific details.

[0031] The present invention provides a system for posture correction of a user occupying a seat for long duration while operating a computing device, and a method thereof. **Fig. 1** illustrates a representation of an incorrect posture of a user and correction of the same by a system (also referred to as posture correction system hereinafter) **100**. The system **100** facilitates correction of posture of the user in real-time, by providing a pseudo-haptic feedback to prompt the user to correct his/her posture whenever the incorrect posture is detected by the system **100**. Extended periods of sitting, especially in front of a computing device, such as a computer, laptop, a printer, or an information processing device, often leads to bad posture of the user occupying a seat while operating the computing device. The bad posture increases the risk of developing issues such as Lower Back Pain (LBP), Forward Head Posture (FHP), Upper Crossed Syndrome (UCS), neck pain, breathing issues, digestive issues, etc. The posture correction system **100** is capable of providing the pseudo-haptic feedback to the user, whenever the incorrect posture is detected, as shown in **Fig. 1**. This pseudo-haptic feedback may be continuously provided to the user until the incorrect posture is corrected. The initiation and termination of the posture correction system **100** may be done manually by the user, or may be connected with a power supply unit of the computing device, or any combination thereof.

[0032] Referring to **Figs. 2** and **3**, the posture correction system **100** includes an input unit **101** configured to detect an upper body posture of the user operating the computing device while being seated, a feedback computation unit **102** configured to determine if a feedback is required based on the current posture of the user. The feedback computation unit **102** is also configured to determine an intensity and a time duration of the feedback to be provided to the user. The posture correction system **100** also includes an output unit **103** configured to provide the pseudo-haptic feedback to the user based on the determination of the feedback computation unit **102**.

[0033] When the posture correction system **100** is started, a trunk posture of the user is detected by input unit **101**. A trunk is the central axis of human body.

Limbs use the trunk as a base on which to move. When the user is upright, the trunk supports the head and maintains an erect posture with minimal effort. As shown in **Fig. 2**, in the method **200** of posture correction, at step **S201**, the upper body posture of the user is obtained by input unit **101** as a real-time continuous stream of data. This data is recorded through a set of sensors that may be one or more of axis-related accelerometers in combination with one or more axis-related gyroscopes, a magnetometer, an inclinometer, pedometer, global positioning system (GPS) components, inertial measurement unit (IMU) systems, pressure sensors, optical sensors, proximity sensors or any other suitable sensor or any combination thereof. The sensors may be mounted on the body of the user or on any of the objects in a working environment of the user, or a combination thereof. The detected posture is then compared, at step **S202**, with a pre-defined set of correct postures by the feedback computation unit **102**. If the detected posture of the user matches any one of the pre-defined correct posture, the pseudo-haptic feedback is not provided, and process flow of the system **100** returns to the input unit **101** where the posture is detected continuously. If the detected posture is incorrect, i.e., the detected posture does not match any of the pre-defined correct posture, the system **100** provides, at step **S203**, the pseudo-haptic feedback to the user through the output unit **103**. The system **100** then returns to the input unit **101** for continuous detection of current/instantaneous posture of the user. This process continues until the posture correction system **100** is manually stopped.

[0034] As shown in **Fig. 3**, the feedback computation unit **102** includes a posture analysis unit **104** that determines whether the feedback to the user is required and a Control Display Ratio (CDR) computation unit **112** configured to determine the kind of feedback that is to be provided to the user. The posture analysis unit **104** further includes a posture feature extraction unit **105**, a posture tolerance unit **106**, a posture comparison unit **107**, an internal timer unit **108**, a reset timer unit **109**, a time tolerance unit **110**, and a time comparison unit **111**.

[0035] When the posture correction system **100** is switched ON, a continuous data stream from the input unit **101** is sent to the posture feature extraction unit **105**.

In the posture feature extraction unit **105**, raw data stream is analysed to extract numerous meaningful features including but not limited to, trunk deviation from an upright posture, trunk rotation, trunk flexion, trunk extension, neck flexion, neck extension, neck twisting or any combination thereof. The posture correction system **100** can be utilized to improve different aspects of the posture. Therefore, depending on the application, one or more of the above-mentioned features may be extracted to compute a postural error. Deviation from the desired posture is called postural error, defined as a difference between an extracted feature value and a healthy feature value for that particular feature. The healthy feature value is obtained from the pre-defined set of correct postures for the corresponding extracted feature. The postural error that is computed is the output of the posture feature extraction unit **105.** This postural error output is provided to the posture comparison unit **107** that compares the postural error with a posture tolerance value (PTV) obtained from the posture tolerance unit **106**. The posture tolerance unit **106** determines acceptable range of deviation from the desired or pre-defined set of postures.

[0036] The PTV is provided to allow some deviation from a fixed desired posture. Even perfectly healthy people do not maintain a particular rigid posture. Some amount of variability is always present and is in fact considered healthy. The allowed deviation from the desired posture is termed as posture tolerance. Depending on the purpose for which the posture correction system **100** is used, and which feature is extracted from the posture feature extraction unit **105**, the PTV from the posture tolerance unit **106** varies. The PTV may be decided in consultation with therapists and other healthcare professionals, or may be fixed based on existing literature defining the desired sitting postures.

[0037] Moreover, instead of a fixed PTV, the PTV may also be varied based on different parameters. Initially, more deviation may be allowed from the desired posture. Thereafter, the PTV can be reduced gradually depending on the duration for which the posture correction system **100** has been used. Alternatively, the PTV may also be varied based on the postural error of the user such that initially more deviation from the desired posture is allowed, but as user starts showing a decrease in the postural error obtained from the posture feature extraction unit **105**, the PTV can be gradually decreased.

[0038] The posture comparison unit **107** compares the extracted features from the posture feature extraction unit **105** with the PTV obtained from the posture tolerance unit **106**, to decide if the current postural error is within the defined PTV. If the postural error is less than the pre-defined PTV, then the internal timer unit **108** is reset by the reset timer unit **109**. Once the internal timer unit **108** has been reset, the posture correction system **100** returns to the posture feature extraction unit **105**. If the postural error exceeds the pre-defined PTV, then a value of the internal timer unit **108** is incremented. The value of the internal timer unit **108** keeps on increasing till the incorrect posture is detected. Therefore, output from the internal timer unit **108** is the duration for which the incorrect posture is maintained continuously. A time tolerance value (TTV) from the time tolerance unit **110** is defined in the posture correction system **100** to allow for occasional deviations from the incorrect posture for short-term time intervals. The time tolerance unit **110** determines the duration for which deviation from the desired posture is acceptable. The TTV ensures that sudden bursts in the postural error while adjusting the sitting posture is not mistaken with the incorrect posture, and the feedback is provided only if undesired/unhealthy posture is maintained for a predetermined long-term time interval defined by the TTV.

[0039] The time comparison unit **111** is configured to compare the value obtained from the internal timer unit **108** with the TTV obtained from the time tolerance unit **110** to determine if the pseudo-haptic feedback is to be provided to the user. If the incorrect posture duration is less than the TTV, then the posture correction system **100** is considered to be in a no-postural error state. If the incorrect posture duration is more than the TTV, then the posture correction system **100** is considered to be in a postural error state. In both these states, the corresponding CDR is computed by the CDR computation unit **112**. The posture correction system **100** returns to the posture feature extraction unit **105** for obtaining the latest feature from the incoming posture sensor data stream of the input unit **101**. The computed CDR value from the CDR computation unit **112** is sent to the output unit **103**, and the corresponding pseudo-haptic feedback is provided to the user by the posture correction system **100**.

[0040] CDR of a computing device is the ratio of a displacement made by the user using an external hardware input device, such as a mouse connected to the computing device, to a displacement made by a cursor on a display unit of the computing device. Studies have shown that a CDR value of greater than 1 can provide users a sense of friction or heaviness, and a CDR value of less than 1 can give the users a sense of gliding or lightness. Therefore, varying the CDR value may provide users with a sense of force without incorporating any external force or feedback, thereby providing an illusion of force to the user. Some processes to calculate the CDR is depicted in **Figs. 4**, **5A**, **5B** and **6**. It is possible to give users a false perception or an "illusion" of force because of the way brain combines sensory information from various sources. This technique of providing force sensation is known as "pseudo-haptic feedback". Haptic feedback generally refers to tactile feedback felt by receptors of the skin when it comes into contact with an object. The term pseudo-haptic denotes that there is no actual haptic feedback that is provided to the user. The only feedback that is provided is visual feedback that causes the user to experience force feedback in the form of resistance or assistance to motion. The present invention uses pseudo haptics as an effective methodology for posture correction.

[0041] Depending on whether the system is in the postural error state or the no-postural error state, the CDR is computed by CDR computation unit **112** as shown in **Fig. 4**. If the pseudo-haptic feedback is required to be provided to the user, the posture correction system **100** is considered to be in the postural error state. In this state, CDR value is set greater than 1 by a first CDR setting unit **113** of the CDR computation unit **112**. The output from the first CDR setting unit **113** is sent to a pseudo-haptic feedback unit **115** of the output unit **103**, and the corresponding pseudo-haptic feedback is provided to the user. If the pseudo-haptic feedback is not required to be provided to the user, the posture correction system **100** is considered to be in the no-postural error state, and the CDR value is set as 1 by a second CDR setting unit **114**. The output from the second CDR setting unit **114** is sent to a feedback reset unit **116,** where the pseudo-haptic feedback, if present, is removed. The pseudo-haptic feedback unit **115** and the feedback reset unit **116** constitute the output unit **103** of the posture correction system **100.**

[0042] **Fig. 5A** depicts an alternate process to calculate the CDR. In case of the postural error state, the CDR value may be computed as a function of the postural error by a CDR determination unit **117**. In the CDR determination unit **117**, depending on the extent of the postural error, the CDR value is computed, thereby allowing variable pseudo-haptic feedback to be provided to the user. The output from the CDR determination unit **117** is sent to the pseudo-haptic feedback unit **115** of the output unit **103**, and the corresponding pseudo-haptic feedback is provided to the user. In case of the no-postural error state, the CDR value is set as 1 by the second CDR setting unit **114**. The output from the second CDR setting unit **114** is then sent to the feedback reset unit **116,** where the pseudo-haptic feedback, if present, is removed. Some processes to compute the CDR value as a function of the postural error are depicted in **Fig. 5B**. The CDR value as a function of the postural error is set by the CDR determination unit **117**. One method of calculating the CDR value is by having a linear function **118** between the postural error and the CDR value. In such a process, as the postural error increases, the CDR is increased as a linearly increasing function of the postural error. Another process of calculating the CDR value is by having an exponential function **119** between the postural error and the CDR value. In such a process, as the postural error increases, the CDR is increased as an exponential growth function of postural error. Another possible method of calculating the CDR value is by having a sigmoid function **120** between the postural error and the CDR value, in which as the postural error increases, the CDR is increased as a sigmoidal growth function of the postural error. Additionally or alternatively, functions other than the linear function **118**, the exponential function **119** and the sigmoidal function **120**, may be used by the CDR determination unit **117** to compute the CDR value as a function of the postural error.

[0043] **Fig. 6** shows another process to compute the CDR value in order to increase the users' perception of the pseudo-haptic feedback. In case of the postural error state, the CDR value is set greater than 1 by the first CDR setting unit **113**. In case of the no-postural error state, the CDR value is set as a value less than 1 by a third CDR setting unit **121**. The output from the first CDR setting unit **113** and the third CDR setting unit **121** is sent to the pseudo-haptic feedback unit **115**, and the corresponding pseudo-haptic feedback is provided to the user. The CDR value less than 1 during the no-postural error state ensures a larger gap between the CDR values during the no-postural error state the postural error state, thereby increasing the perception of change in feedback in case of both these states.

[0044] Referring now to **Fig. 7**, apart from providing the pseudo-haptic feedback to the user depending on the upper body posture, the posture correction system **100** may store data pertaining to different postures of the user by a data storage unit **122**. The data storage unit **122** includes a storage unit **123**, a storage feature extraction unit **124** and a report generation unit **125**. Raw data about the upper body posture of the user generated by the set of sensors of the input unit **101** may be stored on the computing device's internal hard disk and/or any external storage device connected to the computing device by the storage unit **123**. Further, the raw data pertaining to the upper body posture of the user generated by the set of sensors of the input unit **101** may also be stored on an internet-based cloud storage server or database by the storage unit **123**. Moreover, some features could be extracted from the raw data by the storage feature extraction unit **124** which can also be saved by the storage unit **123**. Some possible features that can be extracted by the storage feature extraction unit **124** from the raw data for storage may include trunk deviation from the upright posture, trunk rotation, trunk flexion, trunk extension, neck flexion, neck extension, neck twisting, duration for which the user maintained correct/incorrect posture for each day, change in duration for which user maintained correct/incorrect posture over a period of time or any combination thereof. Moreover, the stored data can be used to generate reports by the report generation unit **125**. The generated reports may be used for various purposes. The reports can be used for consultation with physical therapists to get advice about postural habits of the user while working on the computing device. Moreover, such reports may also be used by organizations to incentivize employees for maintaining good posture in order to encourage a healthy work environment. Although the invention is not limited in this respect, depicted elements of the system **100** may be implemented by hardware components. Any other suitable combination of hardware and/or software components is also within the scope of embodiments of the invention.

[0045] In order to change between various body parts for posture correction, the posture correction system **100** is provided with a mode selection unit **800**. Using the mode selection unit **800**, the user can periodically change a targeted body part that needs correction. The mode selection unit **800** may also be configured to select/change the targeted body part according to a schedule based on a physician or a medical practitioners' recommendation for the user based on his/her health condition. The pseudo-haptic feedback unit **115** of the output unit **103** may be connected to the mode selection unit **800** to provide the pseudo-haptic feedback in a plurality of modes, as shown in **Figs. 8A** and **8B**. The multiple modes that can be selected by the mode selection unit **800** may include upper trunk posture correction unit **801**, a low back posture correction unit **802**, a neck posture correction unit **803**, a wrist posture correction unit **804** and a leg posture correction unit **805**. The mode selection unit **800** may be configured to provide the pseudo-haptic feedback generated by the pseudo-haptic feedback unit **115** to the user until a posture of the respective targeted body part by any of the low back posture correction unit **802**, a neck posture correction unit **803**, a wrist posture correction unit **804** and a leg posture correction unit **805** is corrected.

[0046] The upper trunk posture correction unit **801** is configured to target correction of the upper trunk posture of the user. This is done to prevent slouching, upper cross syndrome, etc. in the long term. The lower back posture correction unit **802** is configured to target correction of the lower body posture of the user. This helps in reducing lower back pain in users by helping them maintain appropriate posture during long working hours. The neck posture correction unit **803** targets correction of neck posture so that the users do not develop neck pain, or forward head posture syndrome while working in front of the computing device. The wrist correction unit **804** may be configured to correct posture of a wrist of the user to prevent carpal tunnel syndrome, as it can have serious debilitating influence on performing activities of daily life.

[0047] The leg posture correction unit **805** is configured to correct posture of legs of the user, to reduce the probability of having diseases such as deep vein thrombosis. The leg posture correction unit **805** may be operated in a primary mode and an advanced mode. In the primary mode, the leg posture correction unit **805** transmits the pseudo-haptic feedback to the user until sufficient leg activity is recorded in the seating position itself. The primary mode may be used at frequent intervals to improve leg activity levels. The advanced mode of the leg posture correction unit **805** involves completely stopping functioning of the posture correction system **100** for a brief time interval to allow the users to take a short walk. The selection or change between various modes of the posture correction by the mode selection unit **800** may be accompanied by a prompt message displayed on the display unit of the computing device.

[0048] The posture correction system and method of the present invention provide a pseudo-haptic feedback to a user operating a computing device while being in a seated condition. The pseudo-haptic feedback is provided through an external hardware input device connected to the computing device, such that the user experiences the pseudo-haptic feedback without actual haptic feedback being provided to the user. The only feedback that is provided is visual feedback that causes the user to experience force/feedback in the form of resistance or assistance to motion of the external hardware input device. The posture correction system and method facilitate the user to correct his/her posture in real-time, while working on the computing device for long hours without affecting the work performance.

[0049] In view of the present disclosure, which describes the present invention, all changes, modifications and, variations within the meaning and range of equivalency are considered within the scope of the invention. It is to be understood that the aspects and embodiment of the disclosure described above may be used in any combination with each other. Several of the aspects and embodiment may be combined together to form a further embodiment of the disclosure.

We Claim:

1. A posture correction system (100) comprising:

an input unit (101) configured to detect a posture of a user operating a computing device while being seated,

a feedback computation unit (102) configured to determine whether a pseudo-haptic feedback is to be provided to the user by comparing the detected posture with a pre-defined set of correct postures; and

an output unit (103) configured to provide the pseudo-haptic feedback to the user for correction of the posture based on the determination of the feedback computation unit (102).

2. The posture correction system (100) as claimed in claim 1, wherein the input unit (101) detects the posture by sensing any of an upright posture, trunk rotation, trunk flexion, trunk extension, neck flexion, neck extension and neck twisting of the user.

3. The posture correction system (100) as claimed in claim 1, wherein the feedback computation unit (102) is configured to determine an intensity and a time duration of the pseudo-haptic feedback to be provided to the user.

4. The posture correction system (100) as claimed in claim 1, wherein the feedback computation unit (102) comprises a Control Display Ratio (CDR) computation unit (112) configured to determine the type of the pseudo-haptic feedback to be provided to the user by computing a CDR value as a ratio of a displacement made by the user using an external hardware input device to a displacement made by a cursor on a display unit of the computing device.

5. The posture correction system (100) as claimed in claim 4, wherein the output unit (103) comprises:

a pseudo-haptic feedback unit (115) configured to provide the pseudo-haptic feedback to the user when the CDR value is greater than 1; and

a feedback reset unit (116) configured to stop the pseudo-haptic feedback provided to the user when the CDR value is equal to 1.

6. The posture correction system (100) as claimed in claim 1, wherein the feedback computation unit (102) comprises:

a posture feature extraction unit (105) configured to extract a feature value from the detected posture and a healthy feature value from the pre-defined set of correct postures, and calculate a postural error difference between the extracted feature value and the healthy feature value; and

a posture comparison unit (107) configured to compare the extracted feature value with a posture tolerance value (PTV) determining an acceptable range of deviation of the posture from the pre-defined set of correct postures, and determine whether the postural error difference exceeds the PTV,

wherein when the postural error difference exceeds the PTV, value of an internal timer unit (108) of the feedback computation unit (102) increases until an incorrect posture of the user is detected for a predetermined time interval.

7. The posture correction system (100) as claimed in claim 6, wherein the feedback computation unit (102) comprises a CDR determination unit (117) configured to compute the CDR value as a function of the postural error difference.

8. The posture correction system (100) as claimed in claim 1, wherein the feedback computation unit (102) comprises a time comparison unit (111) configured to compare the value of the internal timer unit (108) with a time tolerance value (TTV) obtained from a time tolerance unit (110) of the feedback computation unit (102), to determine whether the pseudo-haptic feedback is to be provided to the user.

9. The posture correction system (100) as claimed in claim 1, wherein the pseudo-haptic feedback unit (115) is connected to a mode selection unit (800) configured to provide the pseudo-haptic feedback generated by the pseudo-haptic feedback unit (115) to the user in a plurality of modes until a posture of a targeted body part is corrected.

10. A method (200) of correcting posture of a user, the method (200) comprising:

detecting (S201), by an input unit (101), a posture of the user operating a computing device while being seated,

comparing (S202), by a feedback computation unit (102), the detected posture with a pre-defined set of correct postures to determine whether a pseudo-haptic feedback is to be provided to the user, and

providing (S203), by an output unit (103), the pseudo-haptic feedback to the user for correction of the posture based on the determination of the feedback computation unit (102).

wherein the comparing (S202) comprises determining an intensity and a time duration of the pseudo-haptic feedback to be provided to the user, and determining, by a CDR computation unit (112), the type of the pseudo-haptic feedback to be provided to the user by computing a CDR value as a ratio of a displacement made by the user using an external hardware input device to a displacement made by a cursor on a display unit of the computing device, and

the providing (S203) comprises providing, by a pseudo-haptic feedback unit (115), the pseudo-haptic feedback to the user when the CDR value is greater than 1.

11. The method (200) as claimed in claim 10, wherein the comparing (S202) comprises:

extracting, by a posture feature extraction unit (105), a feature value from the detected posture and a healthy feature value from the pre-defined set of correct postures, and calculate a postural error difference between the extracted feature value and the healthy feature value; and

comparing, by a posture comparison unit (107), the extracted feature value with a posture tolerance value (PTV) determining an acceptable range of deviation of the posture from the pre-defined set of correct postures, and determine whether the postural error difference exceeds the PTV,

wherein when the postural error difference exceeds the PTV, value of an internal timer unit (108) of the feedback computation unit (102) increases until an incorrect posture of the user is detected for a predetermined time interval.

12. The method (200) as claimed in claim 11, wherein the CDR value is computed as a function of the postural error difference.

13. The method (200) as claimed in claim 10, wherein the comparing (S202) comprises comparing, by a time comparison unit (111), the value of the internal timer unit (108) with a time tolerance value (TTV) obtained from a time tolerance unit (110) of the feedback computation unit (102), to determine whether the pseudo-haptic feedback is to be provided to the user.

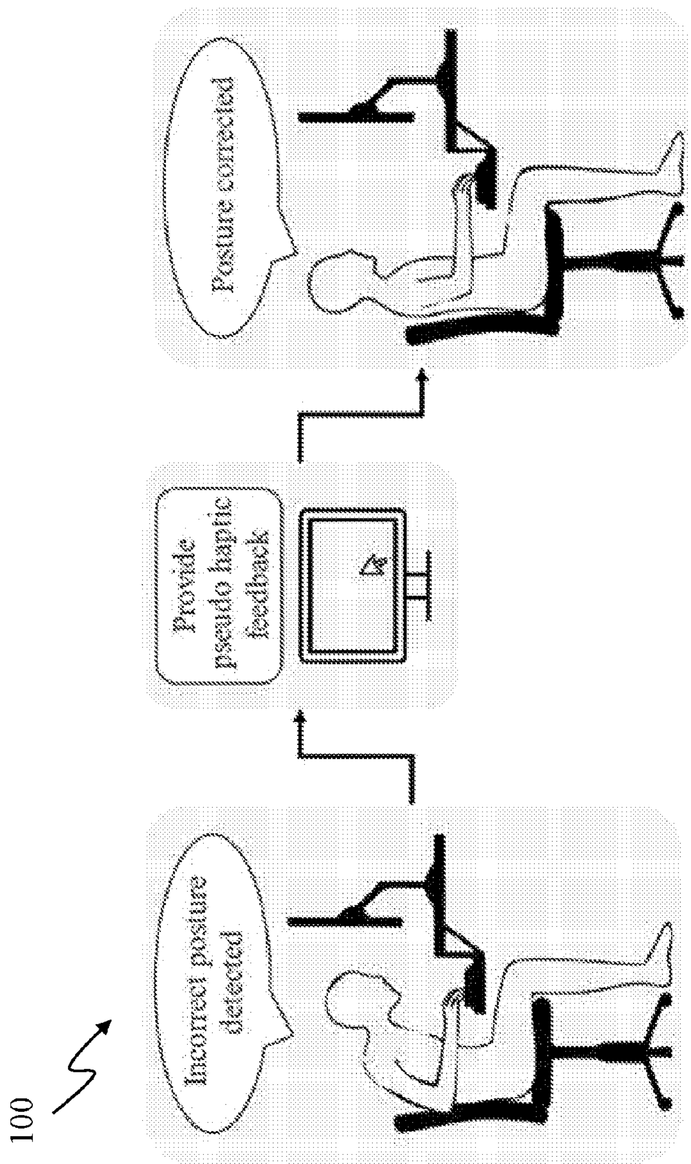
100
Incorrect posture detected
Provide pseudo haptic feedback
Posture corrected

Fig. 1

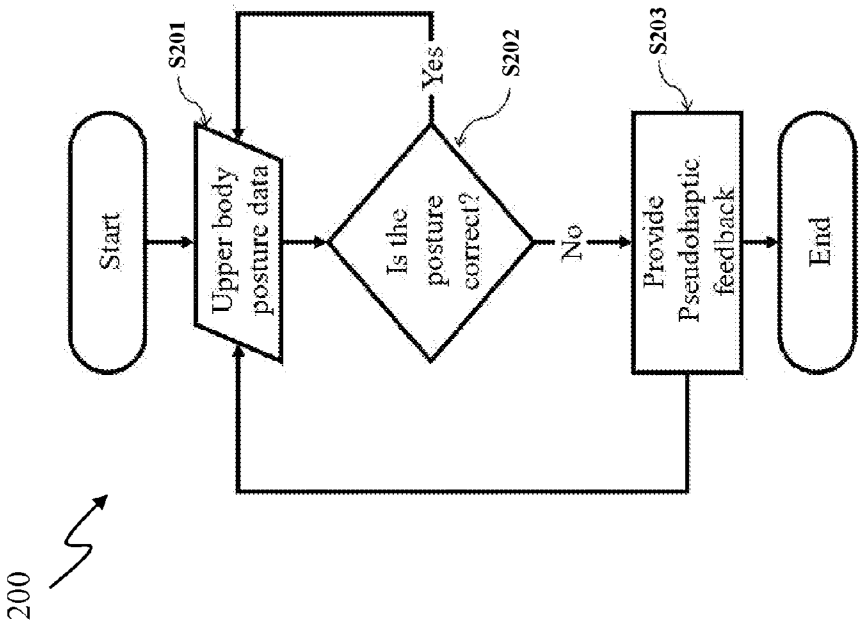
200
Start
S201
Upper body posture data
S202
Is the posture correct?
Yes
No
S203
Provide Pseudohaptic feedback
End

Fig. 2

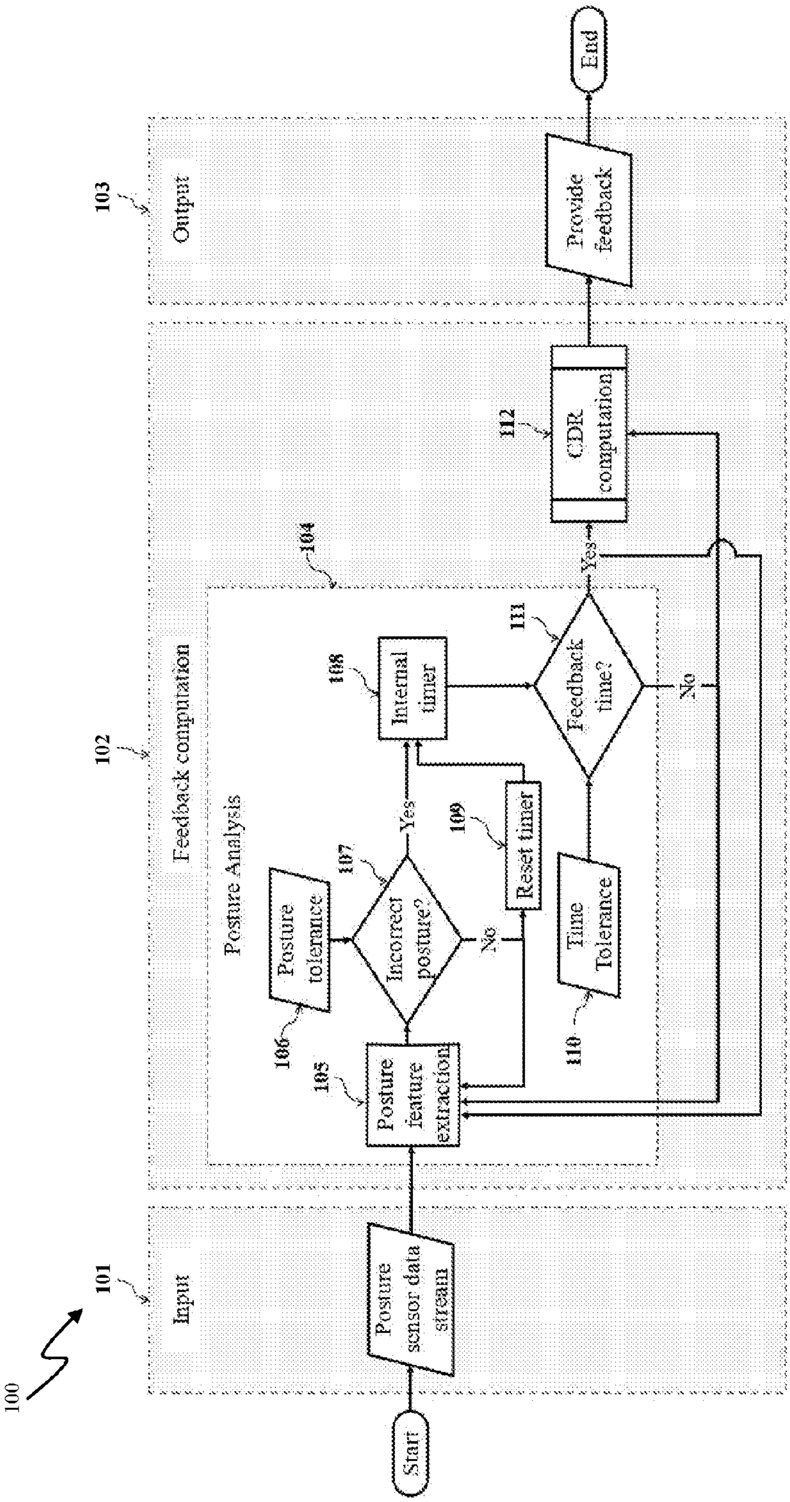
100
101
Input
Start
Posture sensor data stream
102
Feedback computation
104
Posture Analysis
105
Posture feature extraction
106
Posture tolerance
107
Incorrect posture?
Yes
No
108
Internal timer
109
Reset timer
110
Time Tolerance
111
Feedback time?
Yes
No
112
CDR computation
103
Output
Provide feedback
End

Fig. 3

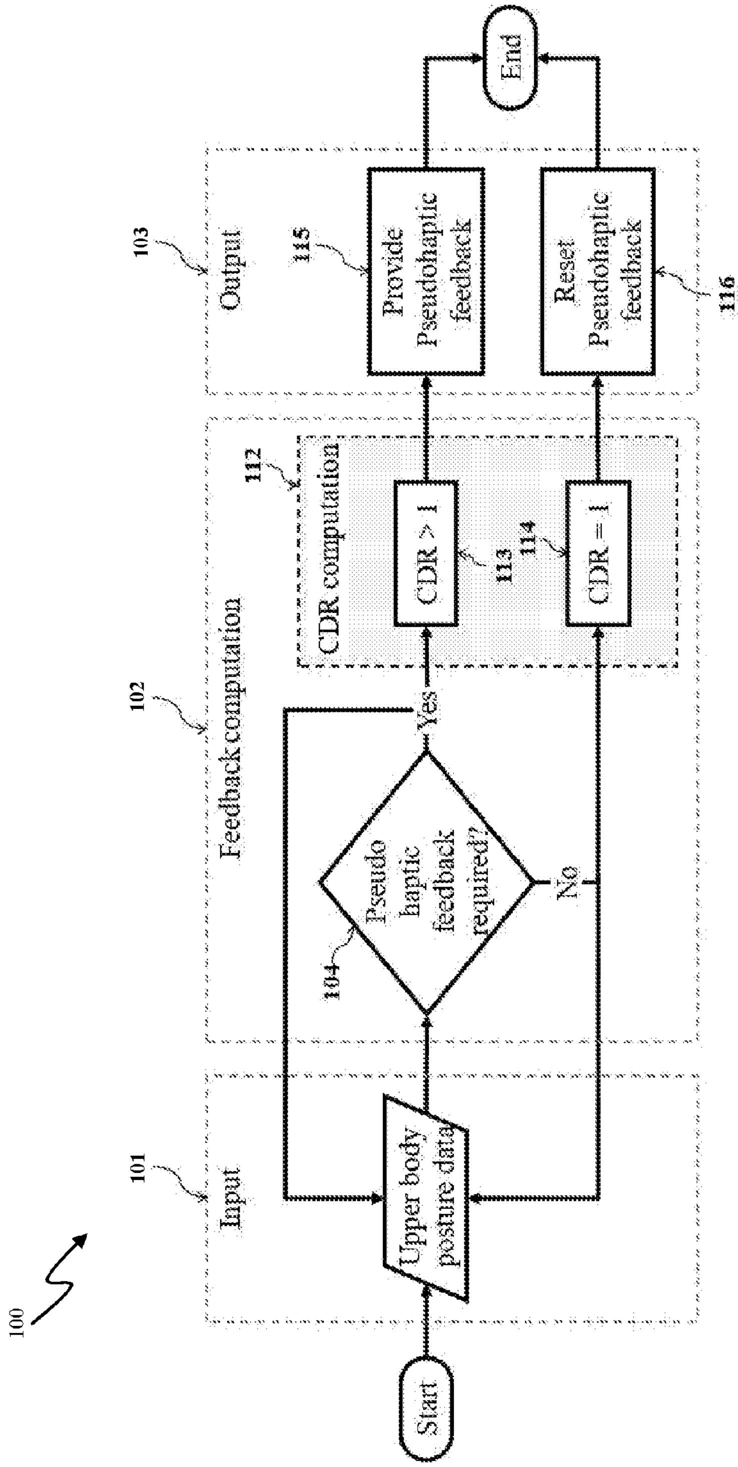
100
101
Input
Start
Upper body posture data
102
Feedback computation
104
Pseudo haptic feedback required?
Yes
No
112
CDR computation
CDR > 1
113
114
CDR = 1
103
Output
115
Provide Pseudohaptic feedback
116
Reset Pseudohaptic feedback
End

Fig. 4

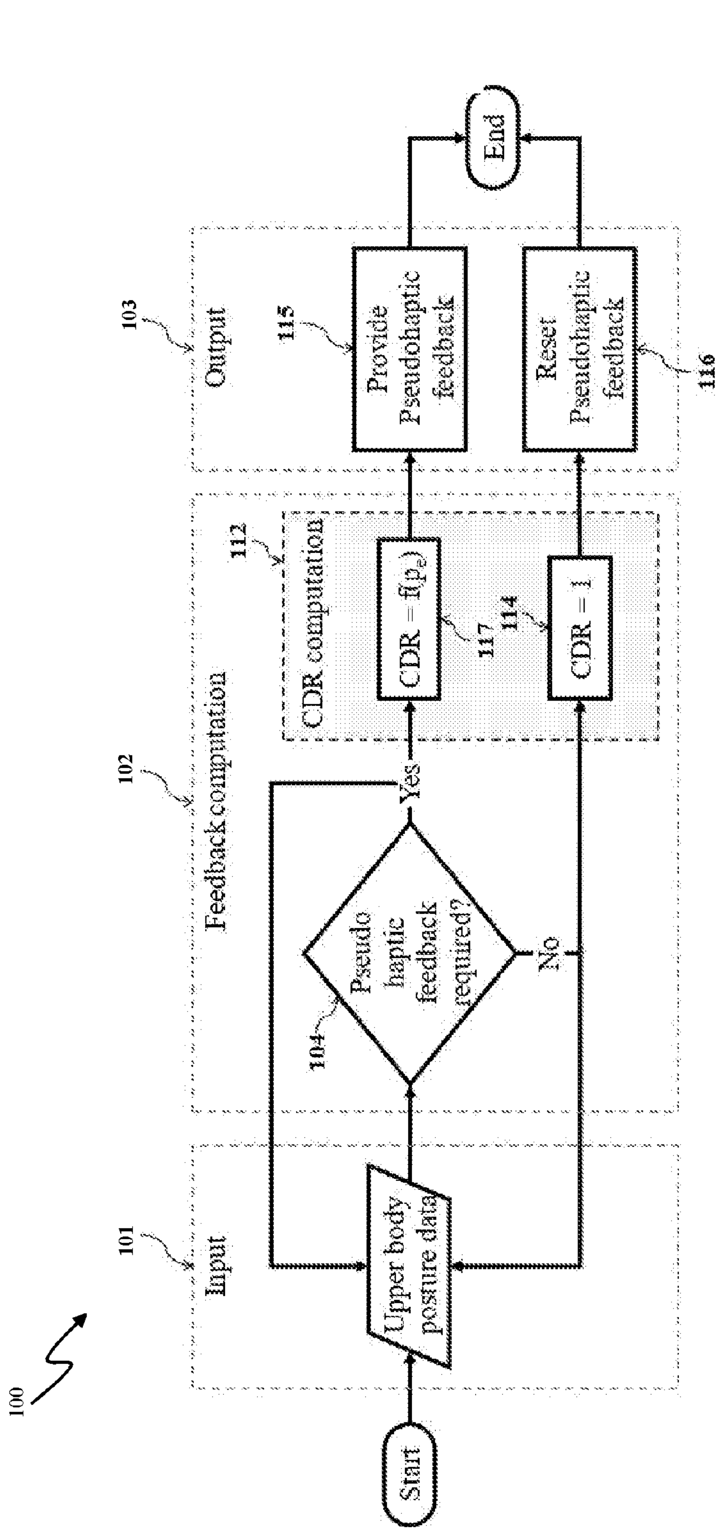
100
Start
101
Input
Upper body posture data
102
Feedback computation
104
Pseudo haptic feedback required?
Yes
No
112
CDR computation
CDR = f(pe)
117
114
CDR = 1
103
Output
115
Provide Pseudohaptic feedback
116
Reset Pseudohaptic feedback
End

Fig. 5A

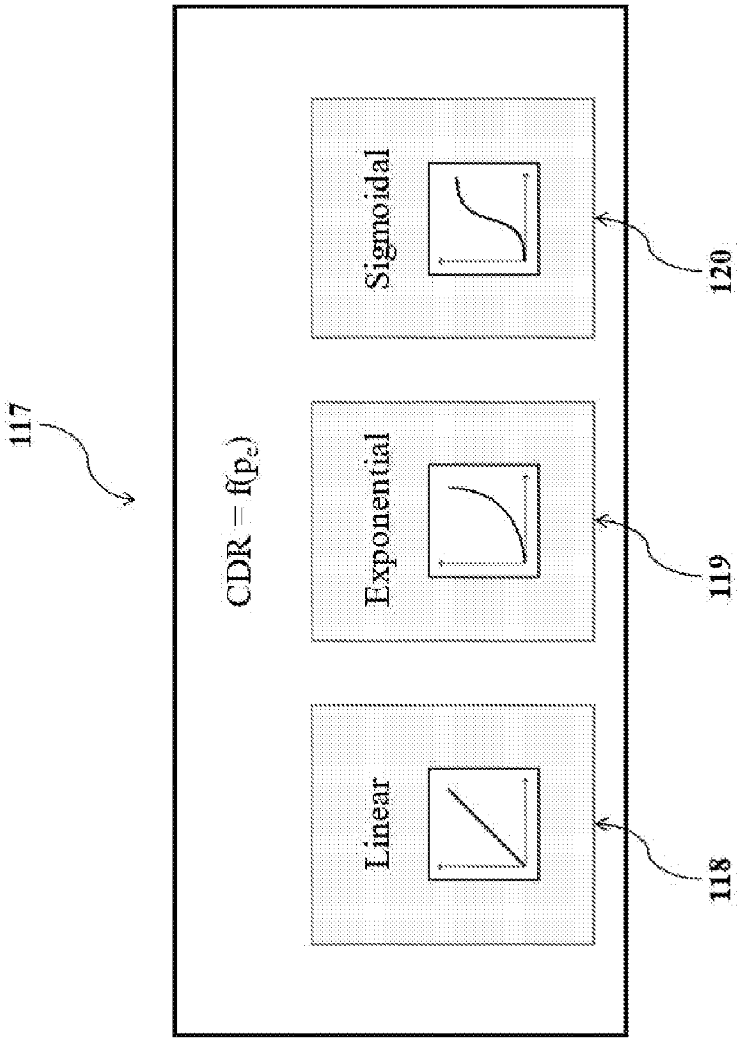

Fig. 5B

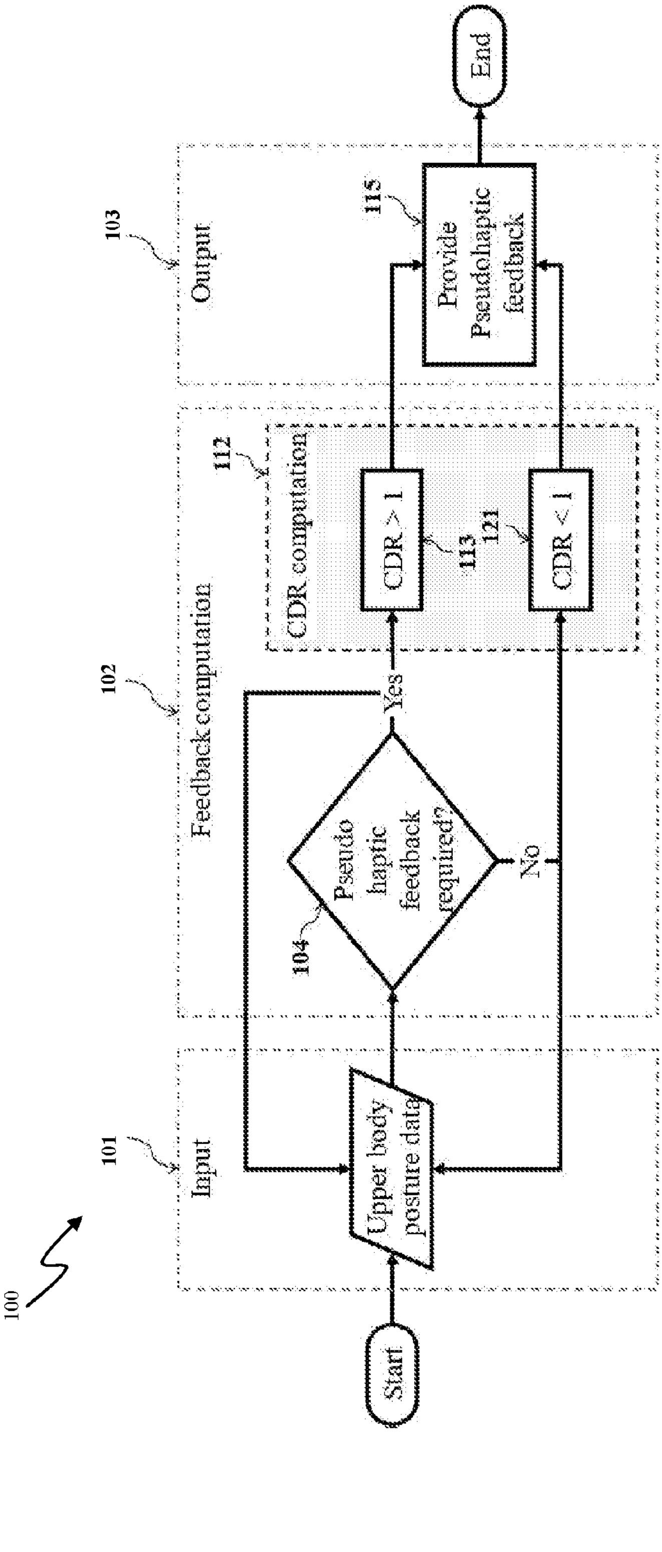
100
Start
Input
101
Upper body posture data
Feedback computation
102
Pseudo haptic feedback required?
104
Yes
No
CDR computation
112
CDR > 1
113
CDR < 1
121
Output
103
Provide Pseudohaptic feedback
115
End

Fig. 6

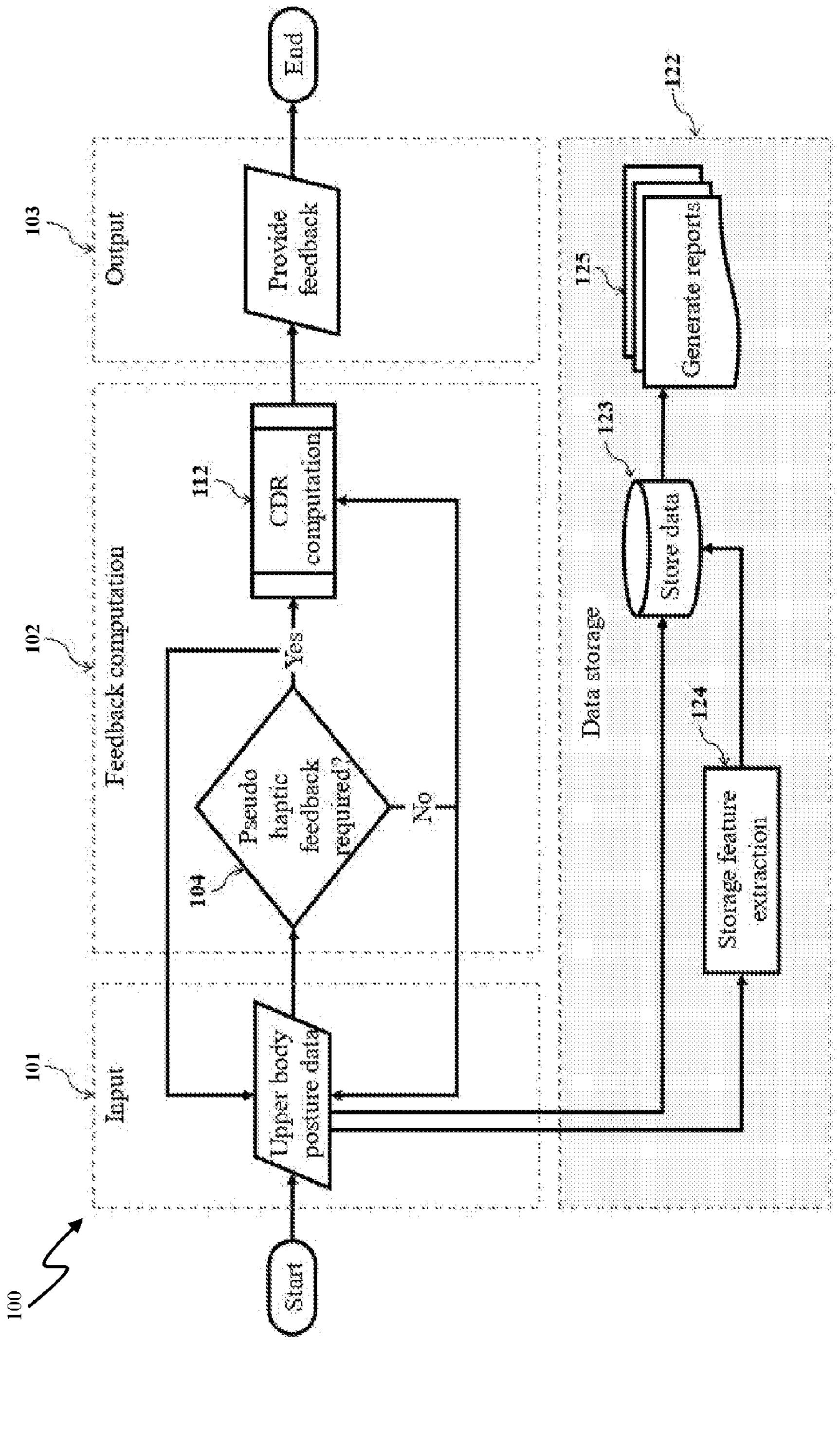
100
101
Input
102
Feedback computation
103
Output
Start
Upper body posture data
104
Pseudo haptic feedback required?
Yes
No
112
CDR computation
Provide feedback
End
122
Data storage
123
Store data
124
Storage feature extraction
125
Generate reports

Fig. 7

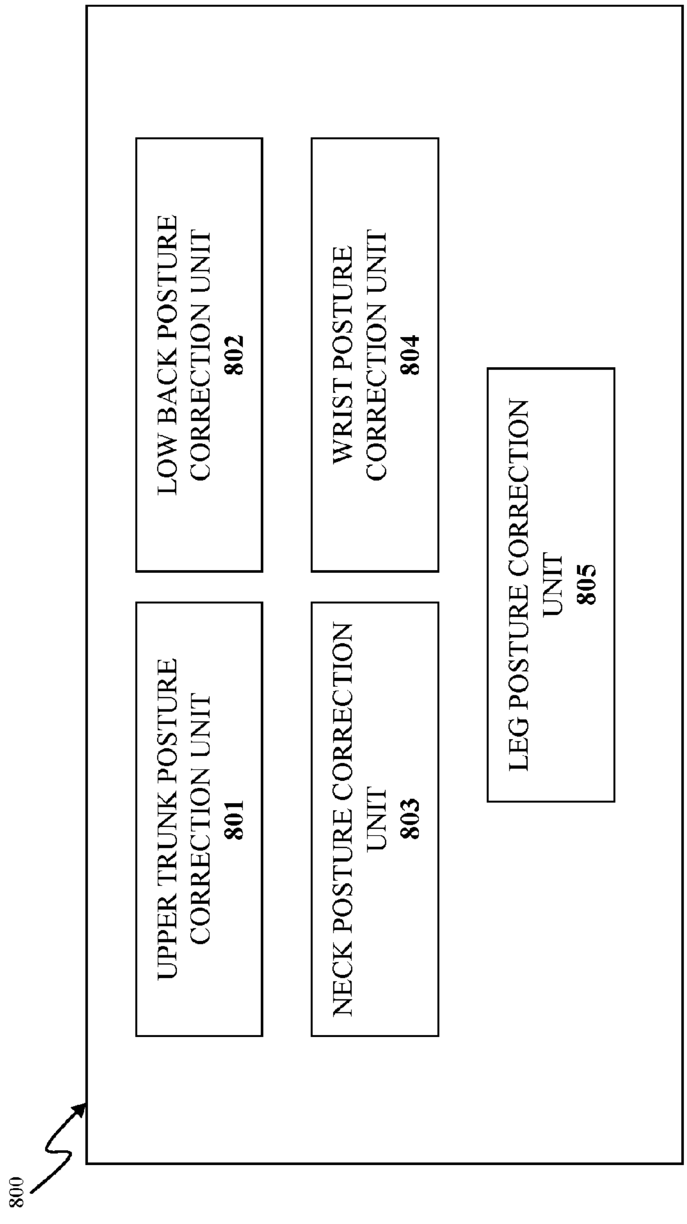
800
UPPER TRUNK POSTURE CORRECTION UNIT
801
LOW BACK POSTURE CORRECTION UNIT
802
NECK POSTURE CORRECTION UNIT
803
WRIST POSTURE CORRECTION UNIT
804
LEG POSTURE CORRECTION UNIT
805

Fig. 8A

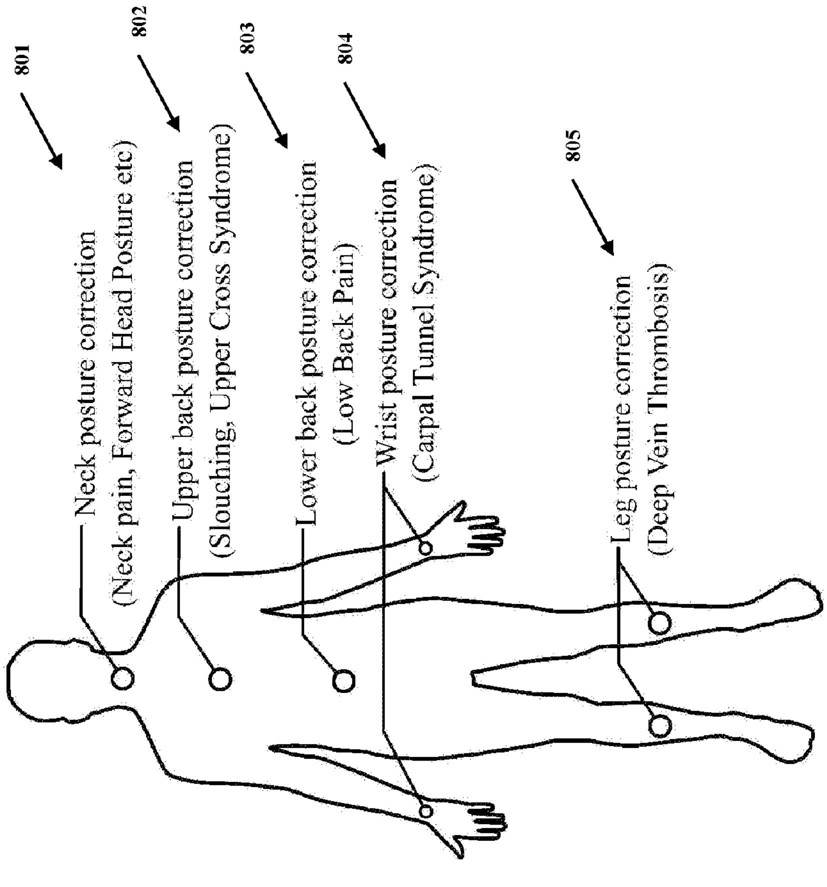
801
802
803
804
805
Neck posture correction
(Neck pain, Forward Head Posture etc)
Upper back posture correction
(Slouching, Upper Cross Syndrome)
Lower back posture correction
(Low Back Pain)
Wrist posture correction
(Carpal Tunnel Syndrome)
Leg posture correction
(Deep Vein Thrombosis)

Fig. 8B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG2024/050326

A. CLASSIFICATION OF SUBJECT MATTER

A61B 5/00 (2006.01) A61B 5/11 (2006.01)

According to International Patent Classification (IPC)

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

FAMPAT/IEEE/COMPENDEX/INSPEC/EMBASE/MEDLINE/BIOSIS/Internet: posture, sitting position, seated, pseudo-haptic, visuo-haptic and like terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AGARWAL R. ET AL., How to Train Your Posture: Haptic Feedback Can be Used for Postural Adaptation of the Trunk During Upper-Limb Motor Training. *IEEE TRANSACTIONS ON HAPTICS*, 24 February 2023, Vol. 16, No. 2, pages 182-193 [Retrieved on 2024-08-08] <DOI: 10.1109/TOH.2023.3248619> Whole document	1-13
X	AGARWAL, R. ET AL., Let the force guide you: a performance-based adaptive algorithm for postural training using haptic feedback. *Front Hum Neurosci*, 24 November 2022, Vol. 16, No. 968669, pages 1-13 [Retrieved on 2024-08-08] <DOI: 10.3389/FNHUM.2022.968669> Whole document	1-13

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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

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

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

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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08/08/2024 *(day/month/year)*	15/08/2024 *(day/month/year)*

Name and mailing address of the ISA/SG	Authorized officer
Intellectual Property Office of Singapore 1 Paya Lebar Link, #11-03 PLQ 1, Paya Lebar Quarter Singapore 408533	Angelina Lim (Dr)
Email: pct@ipos.gov.sg	IPOS Customer Service Tel. No.: (+65) 6339 8616

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KATZAKIS N. ET AL., Stylo and Handifact: Modulating Haptic Perception through Visualizations for Posture Training in Augmented Reality. *SUI '17: Proceedings of the 5th Symposium on Spatial User Interaction*, 16 October 2017, pages 58-67 [Retrieved on 2024-08-08] <DOI: 10.1145/3131277.3132181> Whole document, particularly figure 1; section 3	-
A	LÉCUYER A., Simulating Haptic Feedback Using Vision: A Survey of Research and Applications of Pseudo-Haptic Feedback. *presence*, 27 January 2009, Vol. 18, No. 1, pages 39-53 [Retrieved on 2024-08-08] <DOI: 10.1162/PRES.18.1.39> Whole document	-
A	DOMINJON L. ET AL., Influence of Control/Display Ratio on the Perception of Mass of Manipulated Objects in Virtual Environments. *IEEE Virtual Reality 2005*, April 2005, pages 19-25 [Retrieved on 2024-08-08] <DOI: 10.1109/VR.2005.1492749> Whole document	-