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(54) **BODY MONITORING AND TRAINING DEVICE**

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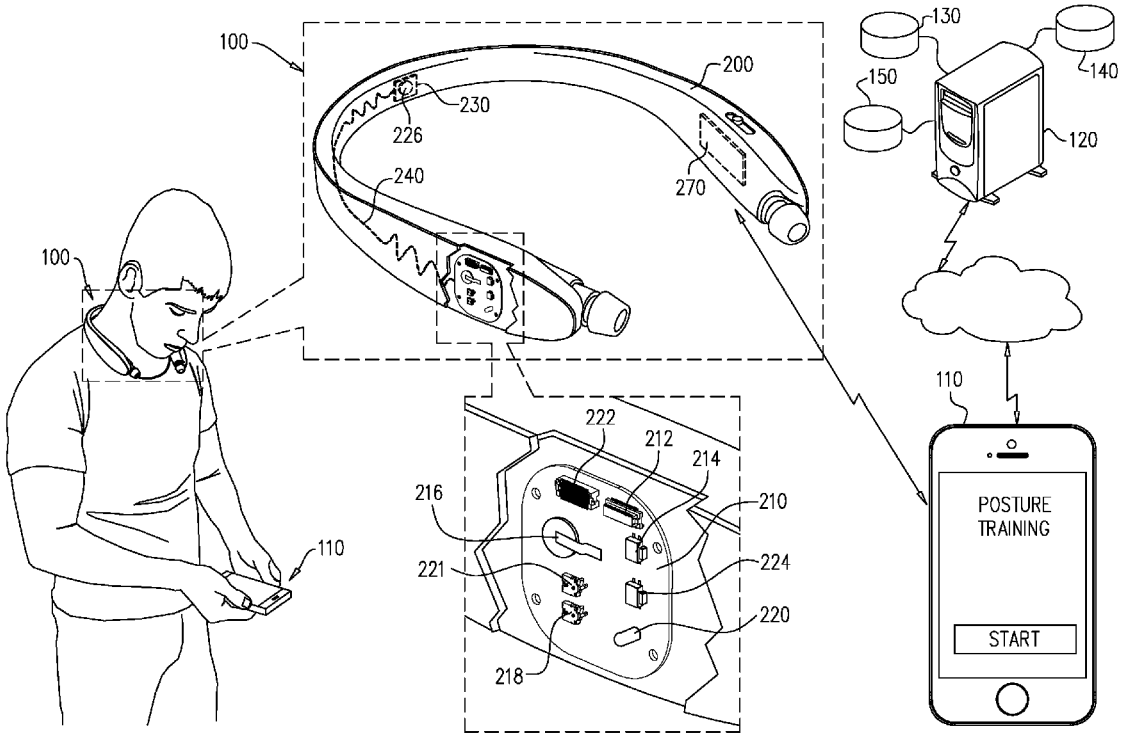
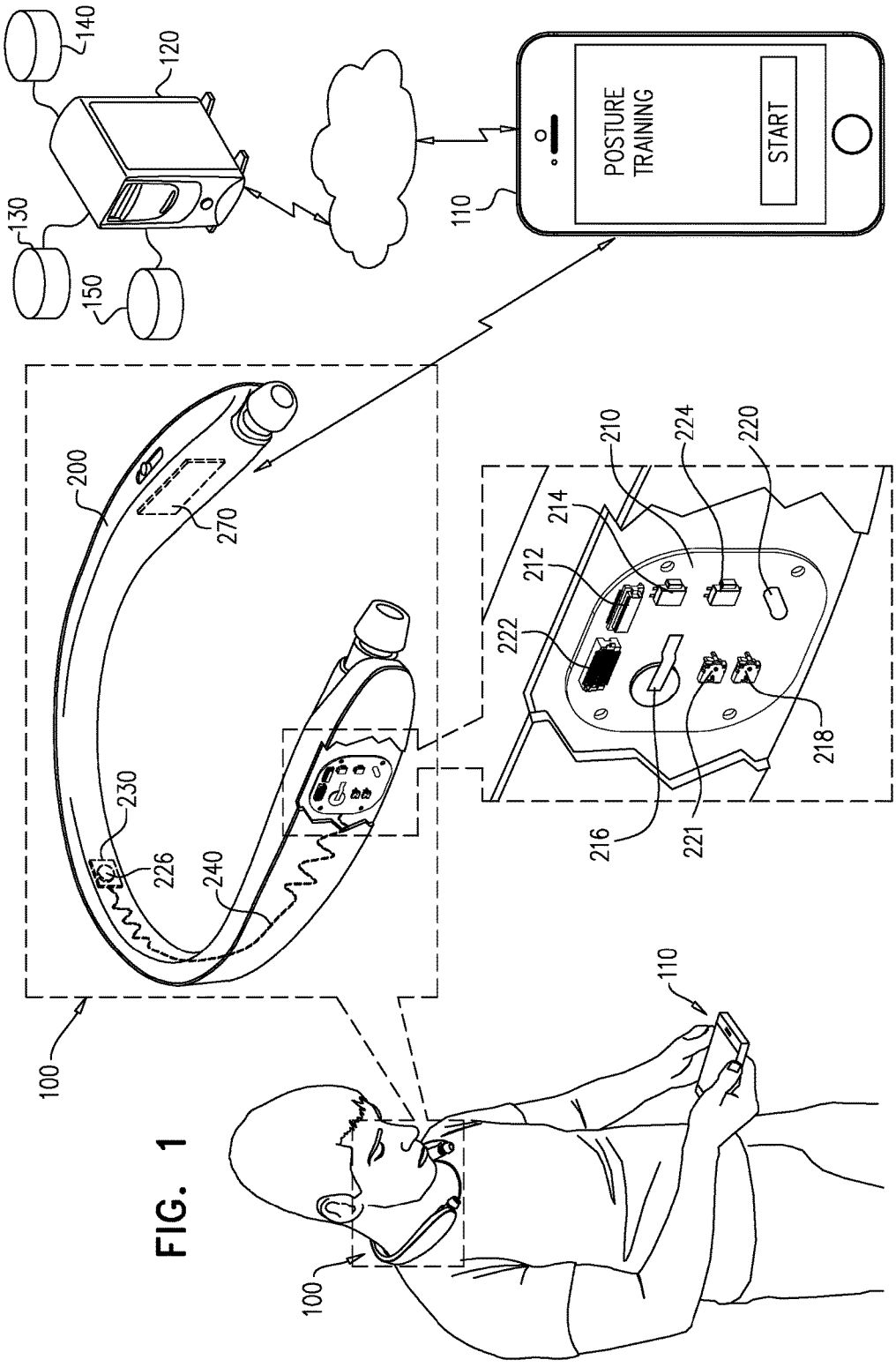
(57) **ABSTRACT**

A body movement feedback system including at least one position sensor operative to sense in real time at least relative positions of mutually articulated body portions of a user and to provide sensor outputs, a mutually articulated body portion position processor, receiving the sensor outputs of the at least one position sensor and providing processor outputs representing relative movements of the mutually articulated body portions and a real time user feedback generator operative to generate predetermined feedback to the user in response to predetermined selected movements of the mutually articulated body portions.




140
120
130
150
110
POSTURE TRAINING
START
200
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230
226
240
210
224
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214
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218
216
221
100
110
100

FIG. 1

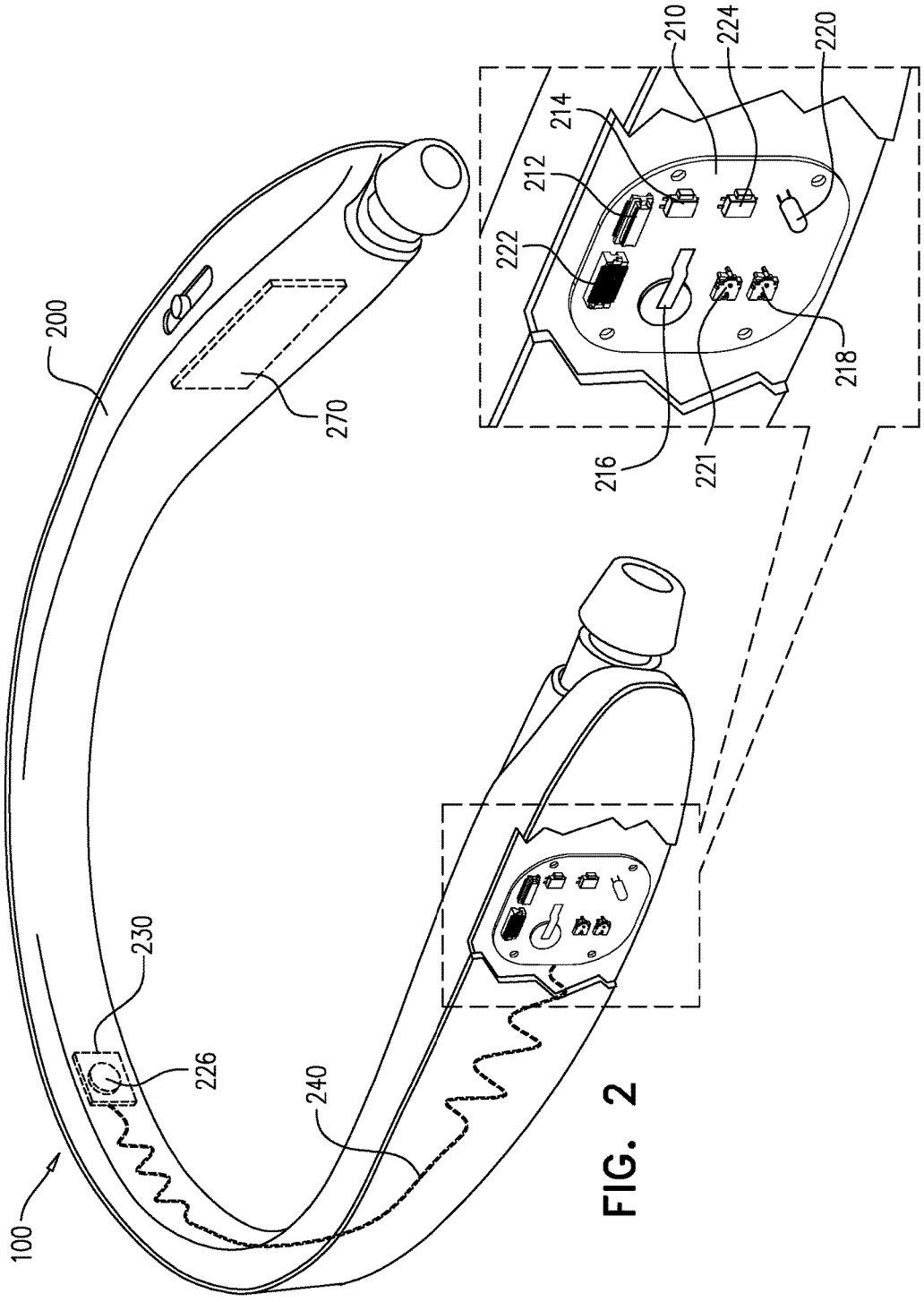
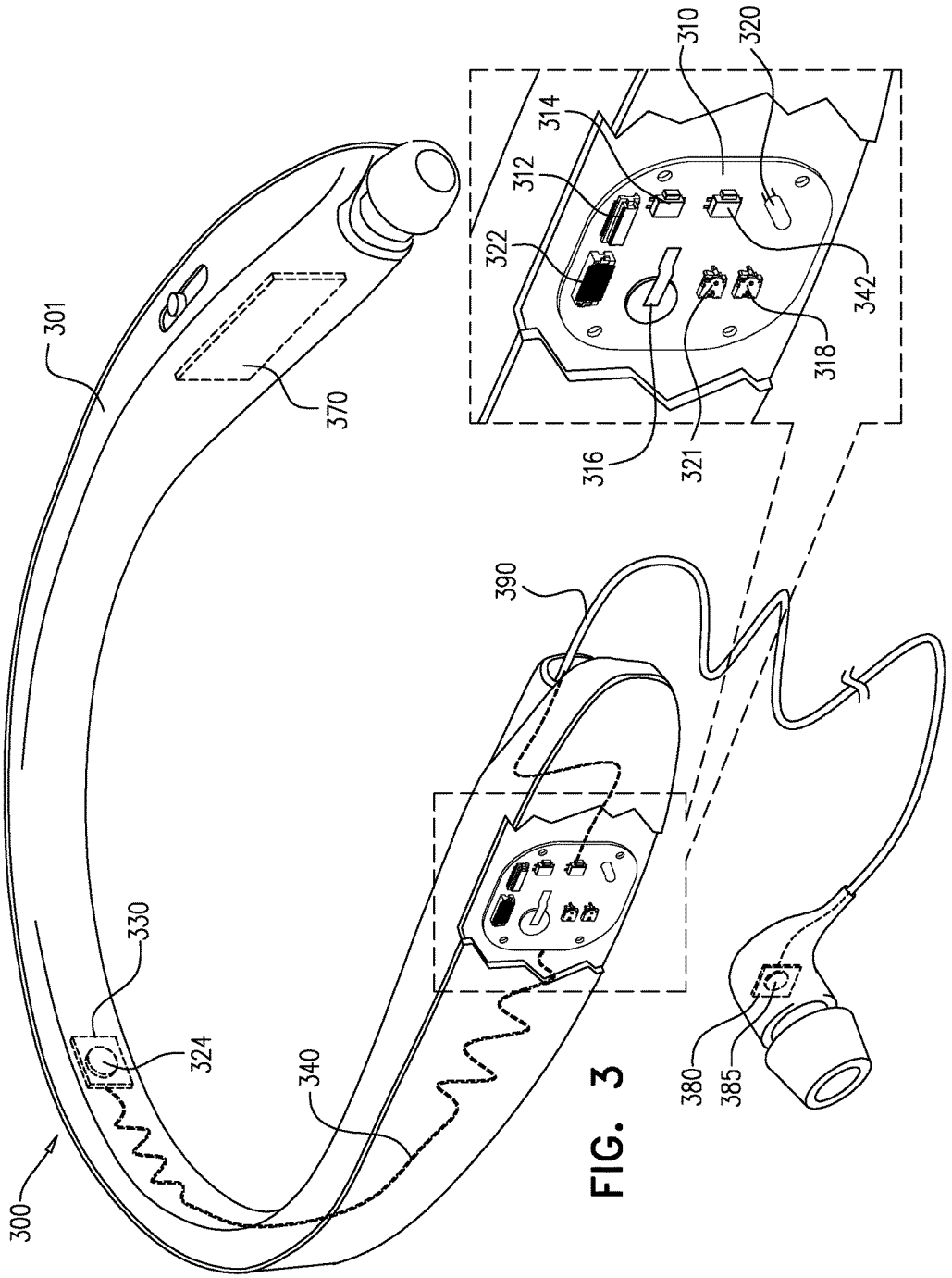



FIG. 2


300
301
310
312
314
316
318
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322
324
330
340
342
370
380
385
390

FIG. 3

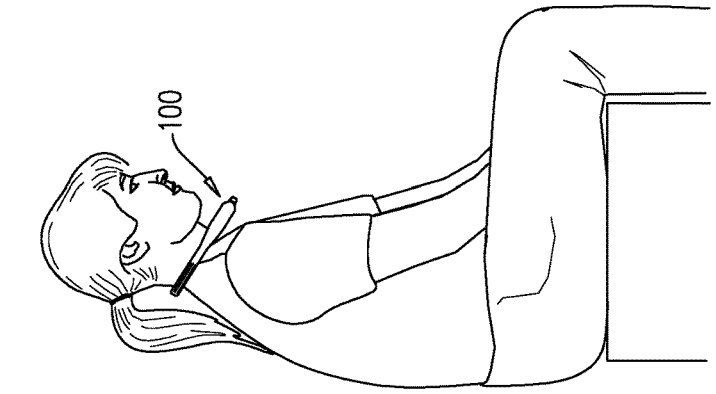


FIG. 4C


FIG. 4B

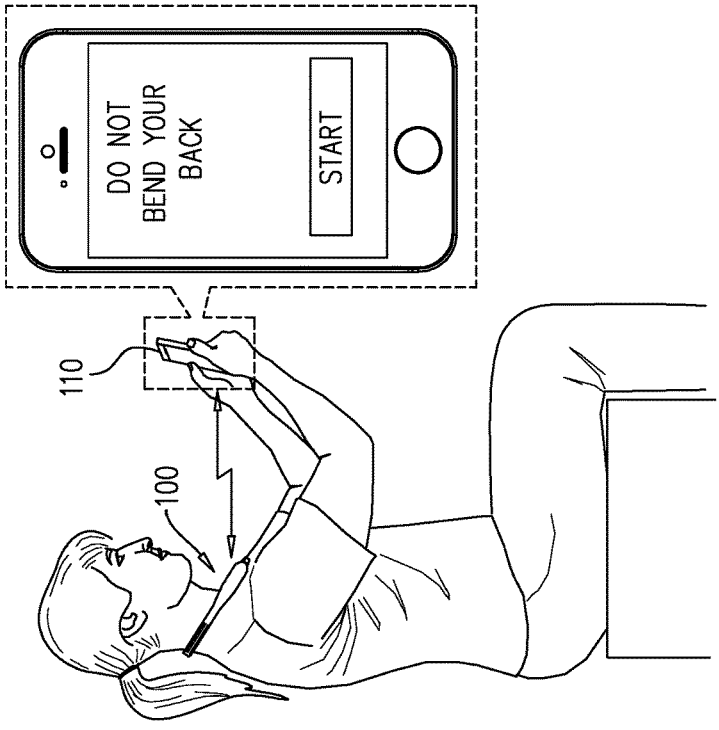


FIG. 4A

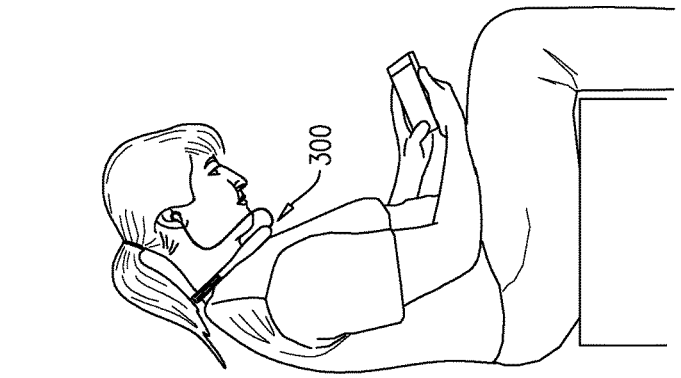


FIG. 5C


FIG. 5B

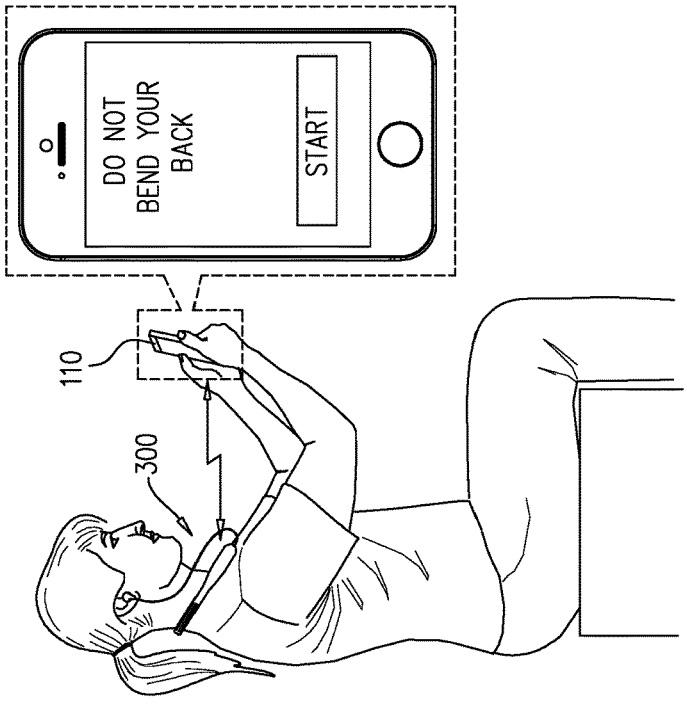


FIG. 5A

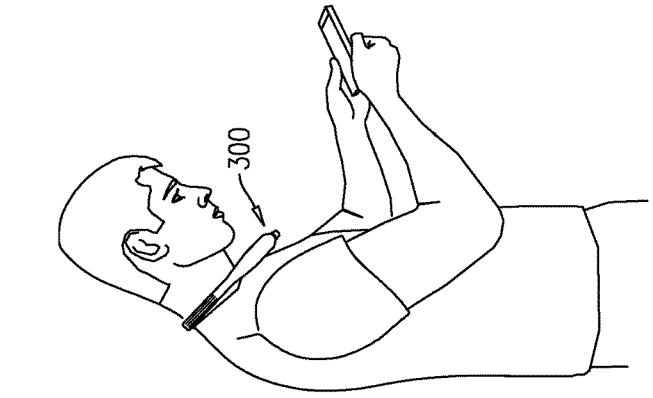


FIG. 6C

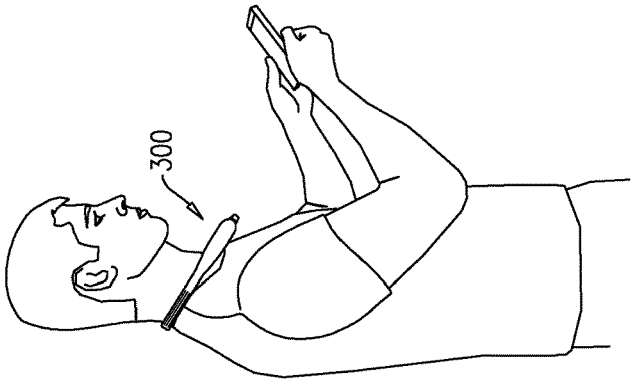


FIG. 6B

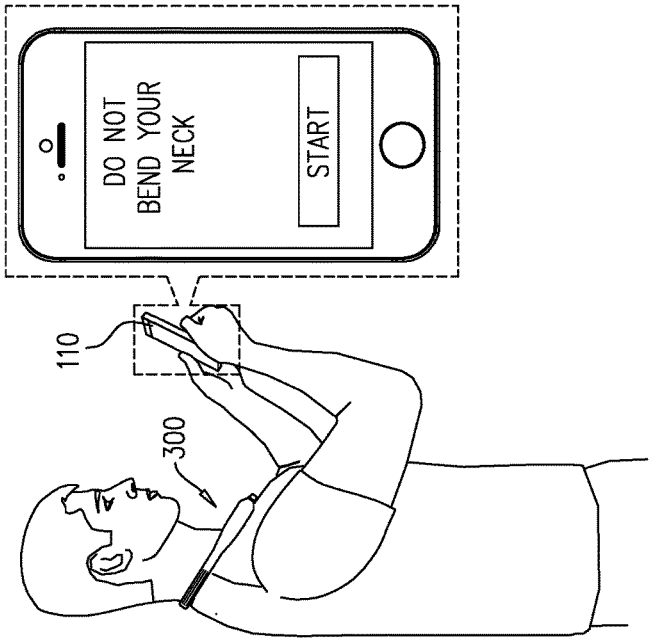


FIG. 6A

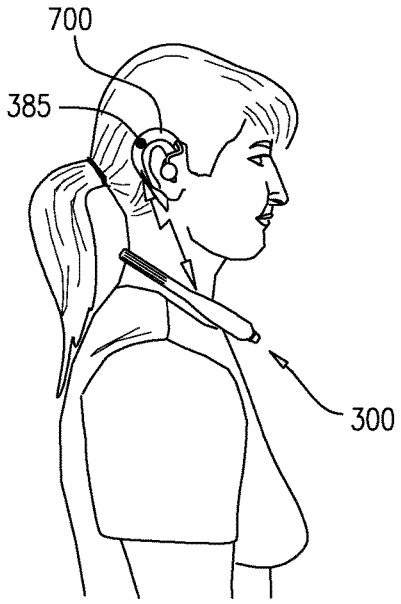


FIG. 7A

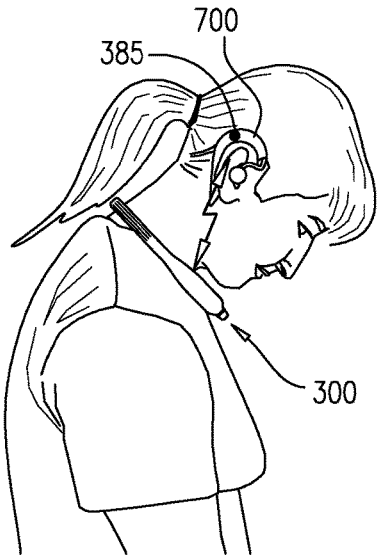


FIG. 7B

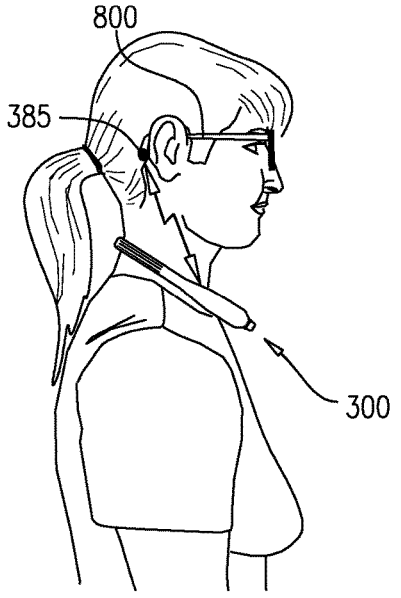


FIG. 8A

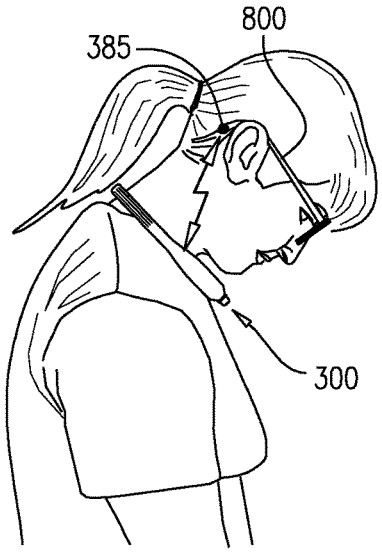


FIG. 8B

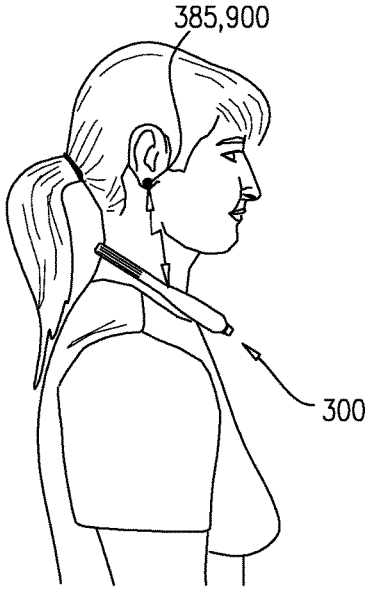


FIG. 9A

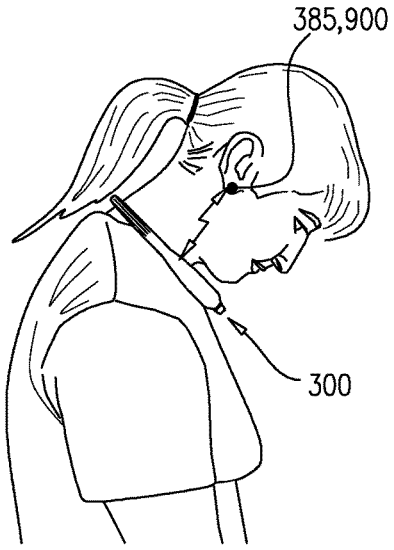


FIG. 9B

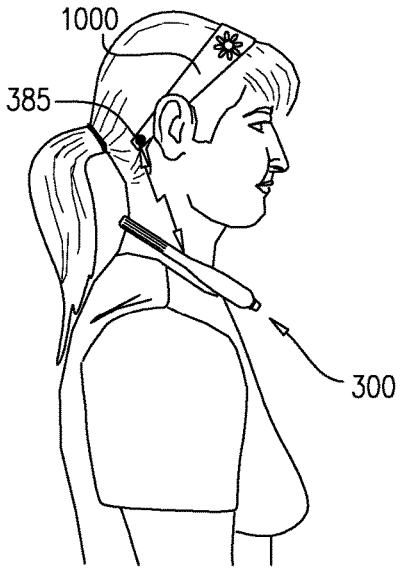


FIG. 10A

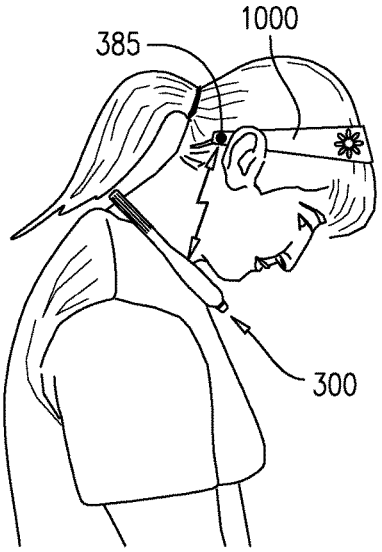


FIG. 10B

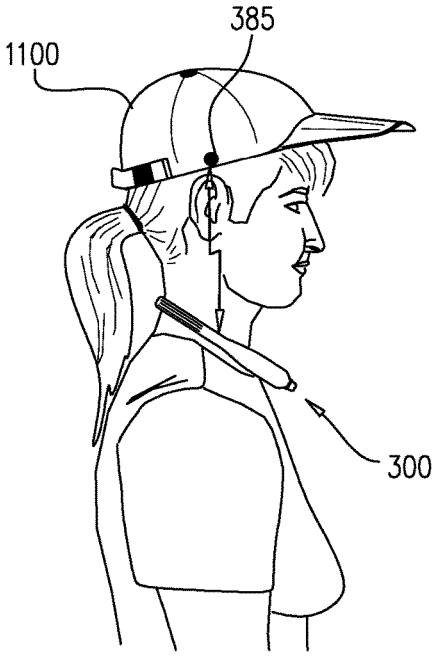


FIG. 11A

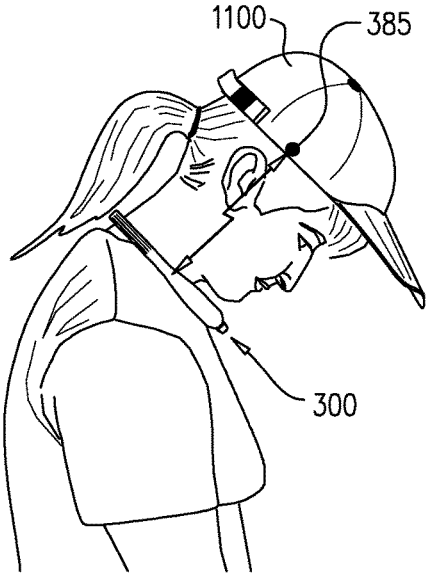


FIG. 11B

# BODY MONITORING AND TRAINING DEVICE

## REFERENCE TO RELATED APPLICATIONS

**[0001]** Reference is hereby made to U.S. Provisional Patent Application Ser. No. 62/376,467, filed Aug. 18, 2016, entitled: UPPER BACK AND NECK MONITORING AND TRAINING DEVICE, the disclosure of which is hereby incorporated by reference and priority of which is hereby claimed pursuant to 37 CFR 1.78(a).

**[0002]** Reference is also made to PCT Application No. PCT/IB2014/059041, filed Feb. 17, 2014, and entitled POSTURE DETECTION DEVICE, published Aug. 21, 2014 as PCT Published Patent Application WO 2014/125448 A1, the disclosure of which is hereby incorporated by reference.

**[0003]** Reference is also made to PCT Application No. PCT/IL2016/050847, filed Aug. 3, 2016, and entitled BODY MOVEMENT FEEDBACK SYSTEM AND METHOD, the description of which is hereby incorporated by reference and priority of which is hereby claimed pursuant to 37 CFR 1.78(a).

## FIELD OF THE INVENTION

**[0004]** The present invention relates to body motion training systems and methodologies.

## BACKGROUND OF THE INVENTION

**[0005]** There exist various systems and devices for body motion training.

## SUMMARY OF THE INVENTION

**[0006]** The present invention seeks to provide improved systems and devices for body motion training.

**[0007]** There is thus provided in accordance with a preferred embodiment of the present invention a body movement feedback system including at least one position sensor operative to sense at least relative positions of mutually articulated body portions of a user, and particularly the upper back, chest or neck orientation relative to the gravity or relative to the head orientation in real time and to provide sensor outputs, a mutually articulated body portion position processor, receiving the sensor outputs of the at least one position sensor and providing processor outputs representing relative movements of the mutually articulated body portions and a real time user feedback generator operative to generate predetermined feedback to the user in response to predetermined selected movements of the mutually articulated body portions.

**[0008]** In accordance with a preferred embodiment of the present invention the body movement feedback system also includes a user feedback selector adapted to receive feedback selection inputs from a person and operative to assign selectable user feedbacks to selectable movements of the mutually articulated body portions.

**[0009]** Preferably, the at least one position sensor includes at least two body portion orientation sensors attached to the upper back, chest or neck and the head. Alternatively, the at least one position sensor includes at least one body portion orientation sensor attached to the upper back, chest or neck and the head.

**[0010]** Preferably, the predetermined feedback includes at least one of tactile feedback, auditory feedback and visual feedback.

**[0011]** In accordance with a preferred embodiment of the present invention the at least one position sensor includes at least one first sensor mounted onto a user's upper back, chest or neck preferably by a necklace, headset (as LG TONE, SOL REPUBLICK Shadow) or headphone (as LG TONE, SOL REPUBLICK Shadow) that lays on the user's neck at a first location. In an alternative embodiment of the present invention the at least one position sensor includes at least one first sensor mounted onto a user's upper back, chest or neck preferably by a necklace, headset (as LG TONE, SOL REPUBLICK Shadow) or headphone (as LG TONE, SOL REPUBLICK Shadow) that lays on the user's neck at a first location and at least a second sensor mounted to the user's head, preferably by an earphone, earring, audio aid device, hat, hair pin, eye-glasses and hair bow at a second location, the first and second locations being mutually separated.

**[0012]** Preferably, the real time user feedback generator includes a feedback transducer operative to provide a real time notification to a user when at least one predetermined orientation is reached.

**[0013]** Preferably, the body movement feedback system also includes a portable controller communicating wirelessly with the microprocessor.

**[0014]** There is also provided in accordance with another preferred embodiment of the present invention a method for body movement feedback including the steps of sensing, preferably the user's upper back, chest or neck relative to gravity and alternatively the user's upper back, chest or neck and head relative positions of a user in real time and providing sensor outputs, receiving the sensor outputs and providing processor outputs representing relative movements and generating predetermined feedbacks to the user in response to predetermined movements.

**[0015]** In accordance with a preferred embodiment of the present invention the method for body movement feedback also includes receiving feedback selection inputs from a person and assigning selectable user feedbacks to selectable movements of the mutually articulated body portions.

**[0016]** In accordance with a preferred embodiment of the present invention the sensing the orientation of at one body portions includes measuring orientation of the upper back, chest or the neck relative to gravity. Alternatively, in accordance with a preferred embodiment of the present invention the sensing the orientation of the upper back, chest or neck and the head includes measuring mutual orientation. Preferably, the predetermined feedback includes at least one of tactile feedback, auditory feedback and visual feedback.

**[0017]** There is further provided in accordance with yet another preferred embodiment of the present invention a body position training device for measuring a user's posture by measuring the upper back, chest or neck orientation including at least one sensor mounted onto a user's upper back, chest or neck preferably by necklace, headset (as LG TONE, SOL REPUBLICK Shadow), headphone (as LG TONE, SOL REPUBLICK Shadow) that lays on the user's neck, a microprocessor receiving inputs from sensor for calculating an orientation of the users posture and a feedback transducer operative to provide a real time notification to a user when a predetermined orientation of the upper back, chest or neck is reached. Alternatively, in another embodiment of the present invention there is provided a body position training device for measuring a user's posture and the orientation of the upper back, chest or neck relative to the head including at least one first sensor mounted onto

a user's upper back, chest or neck preferably by necklace, headset (as LG TONE, SOL REPUBLICK Shadow), headphone (as LG TONE, SOL REPUBLICK Shadow) that lays on the user's neck, at least a second sensor mounted to the user's head preferably by an earphone, earring, audio aid device, hat, eye-glasses and hair bow, a microprocessor receiving inputs from the first and second sensors for calculating an orientation of the user's posture and the orientation of the head relative to the upper back, chest or neck and a feedback transducer operative to provide a real time notification to a user when a predetermined orientation is reached.

**[0018]** In accordance with a preferred embodiment of the present invention the body position training device for measuring a user's posture and/or the orientation of the head relative to the upper back, chest or neck orientation also includes a portable controller communicating wirelessly with the microprocessor.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0019]** The present invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings in which:

**[0020]** FIG. **1** is a simplified illustration of a body position training system including a body-mounted body position training device and a portable control device in accordance with a preferred embodiment of the present invention;

**[0021]** FIG. **2** is a simplified perspective illustration of the body-mounted body position training device of FIG. **1**;

**[0022]** FIG. **3** is a simplified perspective illustration of a body position training device constructed and operative in accordance with another preferred embodiment of the present invention;

**[0023]** FIGS. **4**A, **4**B and **4**C are simplified pictorial illustrations of two phases in the operation of the body position training system for training;

**[0024]** FIGS. **5**A, **5**B and **5**C are simplified pictorial illustrations of two phases in the operation of the body position training system for training;

**[0025]** FIGS. **6**A, **6**B and **6**C are simplified pictorial illustrations of two phases in the operation of the body position training system for training;

**[0026]** FIGS. **7**A and **7**B are simplified illustrations of an alternative embodiment of the second sensor mounted on a hearing aid device;

**[0027]** FIGS. **8**A and **8**B are simplified illustrations of an alternative embodiment of the second sensor mounted on glasses;

**[0028]** FIGS. **9**A and **9**B are simplified illustrations of an alternative embodiment of the second sensor mounted on an earring;

**[0029]** FIGS. **10**A and **10**B are simplified illustrations of an alternative embodiment of the second sensor mounted on a hair bow; and

**[0030]** FIGS. **11**A and **11**B are simplified illustrations of an alternative embodiment of the second sensor mounted on a hat.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

**[0031]** Reference is now made to FIG. **1**, which is a simplified illustration of a body position training system including a body-mounted body position training device **100** that is preferably worn by a user and a portable control device **110** that is preferably controlled by the user, and to FIG. **2**, which illustrates the body position training device **100** seen in FIG. **1**.

**[0032]** The body-mounted body position training device **100** is preferably controlled by portable control device **110**, which may be embodied in a generic smartphone, a smartwatch or any other suitable mobile communication device, which may or may not be specifically designed for use in the system.

**[0033]** The portable control device **110** preferably communicates wirelessly with the body-mounted body position training device **100** and wirelessly, typically via the Internet, with a server **120**. The user preferably is the only person who can control the body position training device **100**.

**[0034]** The server **120** may provide selectable access to one or more of the following: a user database **130**, a training program database **140** and an exercise protocol database **150**. Training programs from training program database **140** and exercise protocols from exercise protocol data base **150**, as well as other data and information, may be sent, via server **120**, to portable control device **110**, to be carried out by the user.

**[0035]** Programmed commands and conditions related to the assigned training programs and exercise protocols may be sent from the portable control device **110** to the body position training device **100**. According to these commands and conditions, the body position training device **100** collects data from the user and administers feedback to the user during monitoring and training. For example, such data and feedback could be related to the user's incorrect head orientation relative to his neck.

**[0036]** Information sent to a user's portable control device **110**, such as exercise protocols, training programs and data collected by the body position training device **100**, is preferably stored in the user's profile in the user database **130**. Furthermore, the aforementioned user profile may preferably be accessed, preferably by the user, via the server **120**.

**[0037]** During use of the system, data collected by the body position training device **100** is sent wirelessly by the body position training device **100** to the portable control device **110**. From the portable control device **110**, information and data preferably is exported to the server **120**.

**[0038]** Preferably, the body position training device **100** provides feedback to the user. The body position training device **100** preferably transmits data acquired during the exercises to the portable control device **110**, typically for viewing by the user and also, preferably, transmits the data acquired, via the portable control device **110**, to the server **120**.

**[0039]** As seen in FIGS. **1-2**, the body position training device **100** preferably includes an enclosure **200**. Enclosure **200** includes the body position training device components described hereinbelow and preferably also includes headphones (such as LG Tone, SOL REPUBLICK Shadow) or any other suitable electronic device.

**[0040]** Disposed within enclosure **200** is a printed circuit board **210**, on which are preferably mounted a microprocessor **212**, as well as a tactile feedback generator **214**, a battery **216**, a wireless transceiver **218**, a visual feedback generator **220**, a memory **221** and an auditory feedback generator **222**, all coupled to microprocessor **212**. Optionally, an orientation sensor **224** may also be mounted on printed circuit board **210** and coupled to the microprocessor

**212**. In one embodiment, an auditory compatible device **270** is incorporated within enclosure **200** of the body position training device **100**. Preferably, the audio feedback occurs through the auditory compatible device **270** and optionally, feedback may be provided through auditory feedback generator **222**.

**[0041]** Preferably, an orientation sensor **226**, preferably mounted on a circuit board **230**, is also disposed within enclosure **200**. As noted above, an additional orientation sensor **224** is optionally mounted on circuit board **210**. Circuit board **230** is preferably not rigidly coupled to printed circuit board **210**. Circuit boards **230** and **210** are preferably connected via flexible wire conductors **240**. Orientation sensors **224** and **226** are preferably model numbers BHI **160** or BMI **160** manufactured by Bosch Sensor Tech from Gerhard-Kindler-StraBe 9 72770 Reutlingen/Kusterdingen, Germany.

**[0042]** Orientation sensors **224** and **226** preferably each include an accelerometer, for measuring the angle relative to gravity, and/or a gyroscope, for measuring the orientation of the body position training device **100**.

**[0043]** Reference is now made to FIG. **3**, which illustrates an alternative embodiment of the body position training device **100** shown in FIG. **1**.

**[0044]** As seen in FIG. **3**, the body position training device, here designated by reference numeral **300**, preferably includes an enclosure **301**, which includes body position training device components, as described in detail hereinbelow, and preferably also includes headphone components (such as LG Tone, SOL REPUBLICK Shadow) or any other suitable electronic device components.

**[0045]** Disposed within enclosure **301** is a printed circuit board **310**, on which are preferably mounted a microprocessor **312**, as well as a tactile feedback generator **314**, a battery **316**, a wireless transceiver **318**, a visual feedback generator **320**, a memory **321** and an auditory feedback generator **322**, all coupled to microprocessor **312**. An orientation sensor **324** is preferably mounted on circuit board **330**, which is connected, preferably via conductors **340**, to circuit board **310**. Optionally, an additional orientation sensor **342** may also be mounted on printed circuit board **310** and coupled to microprocessor **312**.

**[0046]** In one embodiment, an auditory compatible device **370** is incorporated within enclosure **301** of the body position training device **300**. In this embodiment, the audio feedback preferably occurs through the auditory compatible device **370** and optionally, audio feedback may be provided through auditory feedback generator **322**.

**[0047]** Also disposed within enclosure **301** of body position training device **300** is an additional orientation sensor **380**, preferably mounted on a circuit board **385**, which is not rigidly mounted to circuit board **310** and is located on the head of the user when in use, preferably in an earphone. Circuit board **385** is preferably connected to circuit board **310** via conductors **390**. Alternatively, circuit boards **310** and **385** connected via wireless connection. Orientation sensors **324**, **342** and **380** are preferably model numbers BHI **160** or BMI **160** manufactured by Bosch Sensor Tech from Gerhard-Kindler-StraBe 9 72770 Reutlingen/Kusterdingen, Germany.

**[0048]** Orientation sensors **324**, **342** and **380** preferably each include an accelerometer, for measuring the angle relative to gravity, and/or a gyroscope, for measuring the orientation of the body position training device **100**.

**[0049]** Reference is now made to FIGS. **4**A, **4**B and **4**C, which are simplified pictorial illustrations of the operation of the body position training system for training. For simplicity, the description refers to body position training system of FIGS. **1** and **2** including body-mounted body position training device **100** and portable control device **110**.

**[0050]** FIG. **4**A illustrates an initial phase in which training instructions are downloaded to portable control device **110**.

**[0051]** The training instructions, downloaded to portable control device **110**, preferably include instructions to the user, which are intended for display on portable control device **110**, as shown, as well as instructions to body-mounted body position training device **100**, which are preferably relayed to body-mounted body position training device **100** via the portable control device **110**. The instructions to the body position training device preferably include at least one of:

**[0052]** 1. Feedback generation instructions based on a predetermined operative orientation of the body-mounted body position training device **100**, such as a 30 degree bend of the upper back, as shown in FIG. **4**C.

**[0053]** 2. Feedback generation instructions based on exceedance of a predetermined operative orientation threshold of the body-mounted body position training device **100**, such as a bend of the upper back exceeding 15 degrees, as seen in FIG. **4**B.

**[0054]** Reference is now made to FIGS. **5**A, **5**B and **5**C, which are simplified pictorial illustrations of the operation of the body position training system for training. For simplicity, the description refers to body position training device **300** shown in FIG. **3** including body-mounted body position training device **300** and portable control device **110**.

**[0055]** FIG. **5**A illustrates an initial phase in which training instructions are downloaded to the portable control device **110**.

**[0056]** The training instructions, downloaded to portable control device **110**, preferably include instructions to the user, which are intended for display on portable control device **110**, as shown, as well as instructions to body-mounted body position training device **300**, which are preferably relayed to body-mounted body position training device **300** via the portable control device **110**. The instructions to the body position training device preferably include at least one of:

**[0057]** 1. Feedback generation instructions based on a predetermined operative orientation of the body-mounted body position training device **300**, such as a 30 degree bend of the upper back, as shown in FIG. **5**C.

**[0058]** 2. Feedback generation instructions based on exceedance of a predetermined operative orientation threshold of the body-mounted body position training device **300**, such as a bend of the upper back exceeding 15 degrees as seen in FIG. **5**B.

**[0059]** Reference is now made to FIGS. **6**A, **6**B and **6**C, which are simplified pictorial illustrations of the operation of the body position training system for training. For simplicity, the description refers to body position training device **300** shown in FIG. **3** including body-mounted body position training device **300** and portable control device **110**.

**[0060]** FIG. **6**A illustrates an initial phase in which training instructions are downloaded to the portable control device **110**.

**[0061]** The training instructions, downloaded to portable control device **110**, preferably include instructions to the user, which are intended for display on portable control device **110**, as shown, as well as instructions to the body-mounted body position training device **300**, which are preferably relayed to body-mounted body position training device **300** via the portable control device **110**. The instructions to the body position training device preferably include at least one of:

**[0062]** 1. Feedback generation instructions based on a predetermined operative orientation of the body-mounted body position training device **300**, such as a 45 degree bend of the neck, as shown in FIG. **6**C.

**[0063]** 2. Feedback generation instructions based on exceedance of a predetermined operative orientation threshold of the body-mounted body position training device **300**, such as a bend of the neck exceeding 30 degrees as seen in FIG. **6**B.

**[0064]** Reference is now made to FIGS. **7**A and **7**B, which are simplified illustrations of the body-mounted body position training device **300** as seen in FIG. **3**. Orientation sensor **385** forms part of a hearing aid device **700** and is wirelessly connected to microprocessor **312** via wireless transceiver **318**.

**[0065]** Reference is now made to FIGS. **8**A and **8**B, which are simplified illustrations of the body-mounted body position training device **300** as seen in FIG. **3**. Orientation sensor **385** forms part of eyeglasses **800** and is wirelessly connected to microprocessor **312** via wireless transceiver **318**.

**[0066]** Reference is now made to FIGS. **9**A and **9**B, which are simplified illustrations of the body-mounted body position training device **300** as seen in FIG. **3**. Orientation sensor **385** is attached to an earring **900** and is wirelessly connected to microprocessor **312** via a wireless transceiver **318**.

**[0067]** Reference is now made to FIGS. **10**A and **10**B, which are simplified illustrations of the body-mounted body position training device **300** as seen in FIG. **3**. Orientation sensor **385** is attached to a hair-bow **1000** and is wirelessly connected to microprocessor **312** via wireless transceiver **318**.

**[0068]** Reference is now made to FIGS. **11**A and **11**B, which are simplified illustrations of the body-mounted body position training device **300** as seen in FIG. **3**. Orientation sensor **385** is attached to a hat **1100** and is wirelessly connected to microprocessor **312** via a wireless transceiver **318**.

**[0069]** It will be appreciated by persons skilled in the art that the present invention is not limited by what has been particularly claimed and includes both combinations and subcombinations of features described and shown hereinabove as well as modifications thereof which are not in the prior art.

**1**. A body movement feedback system comprising:

at least one position sensor operative to sense in real time at least relative positions of mutually articulated body portions of a user and to provide sensor outputs;

a mutually articulated body portion position processor, receiving said sensor outputs of said at least one position sensor and providing processor outputs representing relative movements of the mutually articulated body portions; and

a real time user feedback generator operative to generate predetermined feedback to the user in response to predetermined selected movements of the mutually articulated body portions.

**2**. The body movement feedback system according to claim **1** and wherein said at least one position sensor is operative to sense at least relative orientations of at least one of the upper back, chest and neck relative to at least one of gravity and an orientation of a user's head.

**3**. The body movement feedback system according to claim **1** and also including a user feedback selector receiving feedback selection inputs from a person and operative to assign selectable user feedbacks to selectable movements of the mutually articulated body portions.

**4**. The body movement feedback system according to claim **1** and wherein said at least one position sensor includes at least two body portion orientation sensors.

**5**. The body movement feedback system according to claim **4** and wherein said at least two body portion orientation sensors include body portion orientation sensors attached to at least two of an upper back, a chest, a neck and a head of a user.

**6**. The body movement feedback system according to claim **1** and wherein said at least one position sensor includes at least one body portion orientation sensor attached to at least one of an upper back, a chest, a neck and a head of a user.

**7**. The body movement feedback system according to claim **1** and wherein said real time user feedback generator is operative to generate at least one of tactile feedback, auditory feedback and visual feedback.

**8**. The body movement feedback system according to claim **1** and wherein said at least one position sensor comprises at least one first sensor mounted at a first location onto at least one of a user's upper back, chest and neck by one of a necklace, a headset and a headphone.

**9**. The body movement feedback system according to claim **8** and wherein said at least one position sensor also comprises at least a second sensor mounted onto the user's head at a second location, said first and second locations being mutually separated.

**10**. The body movement feedback system according to claim **1** and wherein said real time user feedback generator comprises a feedback transducer operative to provide a real time notification to a user when at least one predetermined orientation is reached.

**11**. The body movement feedback system according to claim **1** and also comprising a portable controller communicating wirelessly with said processor.

**12**. A method for providing body movement feedback, the method comprising:

sensing in real time at least relative positions of mutually articulated body portions of a user and providing sensor outputs;

receiving said sensor outputs and providing processor outputs representing relative movements of the mutually articulated body portions; and

generating predetermined feedback to the user in response to predetermined selected movements of the mutually articulated body portions.

**13**. The method for providing body movement feedback according to claim **12** and wherein said relative positions comprise relative orientations of at least one of the upper

back, chest and neck relative to at least one of gravity and an orientation of a user's head.

**14**. The method for providing body movement feedback according to claim **12** and also comprising:

receiving feedback selection inputs; and

selecting said predetermined feedback based on said selection inputs.

**15**. The method for providing body movement feedback according to claim **12** and wherein said sensing comprises sensing orientation of at least two of an upper back, a chest, a neck and a head of a user.

**16**. The method for providing body movement feedback according to claim **12** and wherein said predetermined feedback comprises at least one of tactile feedback, auditory feedback and visual feedback.

**17**. The method for providing body movement feedback according to claim **12** and wherein said predetermined feedback comprises a real time notification to a user when at least one predetermined orientation is reached.

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