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(54) **APPARATUS AND METHOD FOR MEASURING ANATOMICAL AND PHYSIOLOGICAL PARAMETERS OF A BODY**

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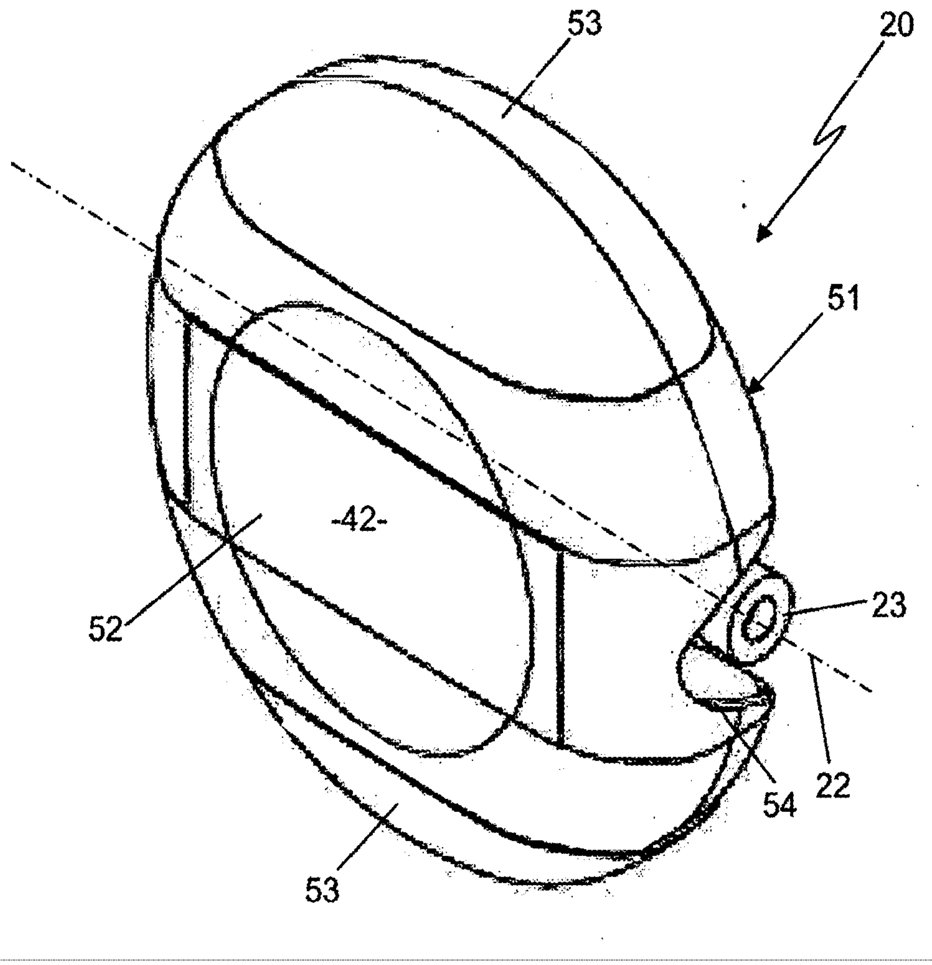
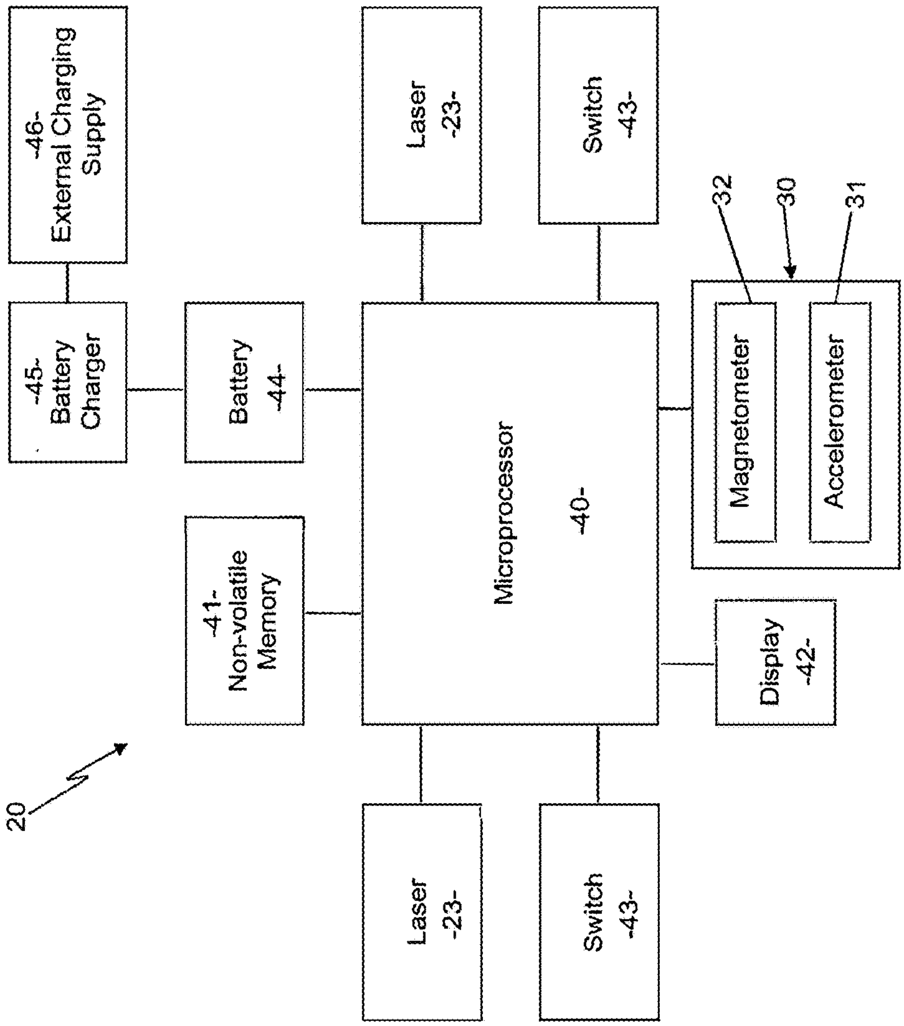
(57) **ABSTRACT**

An apparatus **20** for measuring an anatomical angle of a body, the apparatus **20** comprising aligning means **23** for aligning an axis **22** of the apparatus **20** with anatomical landmarks of the body, sensing means **30** for sensing an orientation of the axis **22** while the axis **22** is aligned with the landmarks, and processing means **40** for processing the sensed orientation.

Also disclosed is interactive support apparatus for measuring anatomical and physiological parameters of a body of a user and providing localised audio feedback to the user based on signals derived from measuring the anatomical and physiological parameters of the body;

said apparatus providing localised audio feedback to the user; the feedback derived from local sourced information.

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-45-
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Charger
Battery
-44-
Laser
-23-
Switch
-43-
Microprocessor
-40-
-41-
Non-volatile
Memory
Magnetometer
Accelerometer
32
30
31
Display
-42-
Laser
-23-
Switch
-43-
20

FIG 1

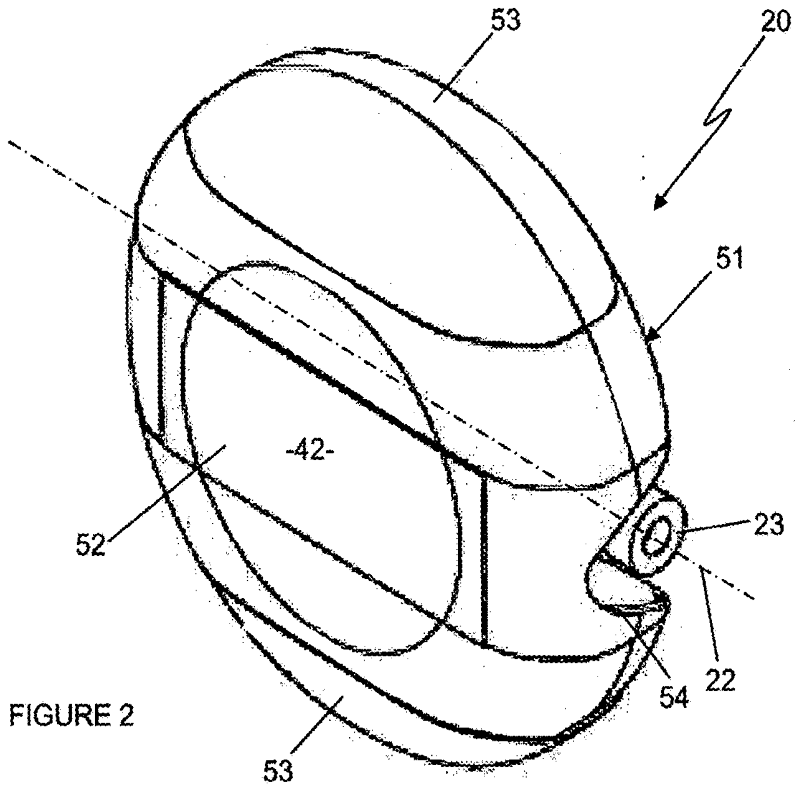
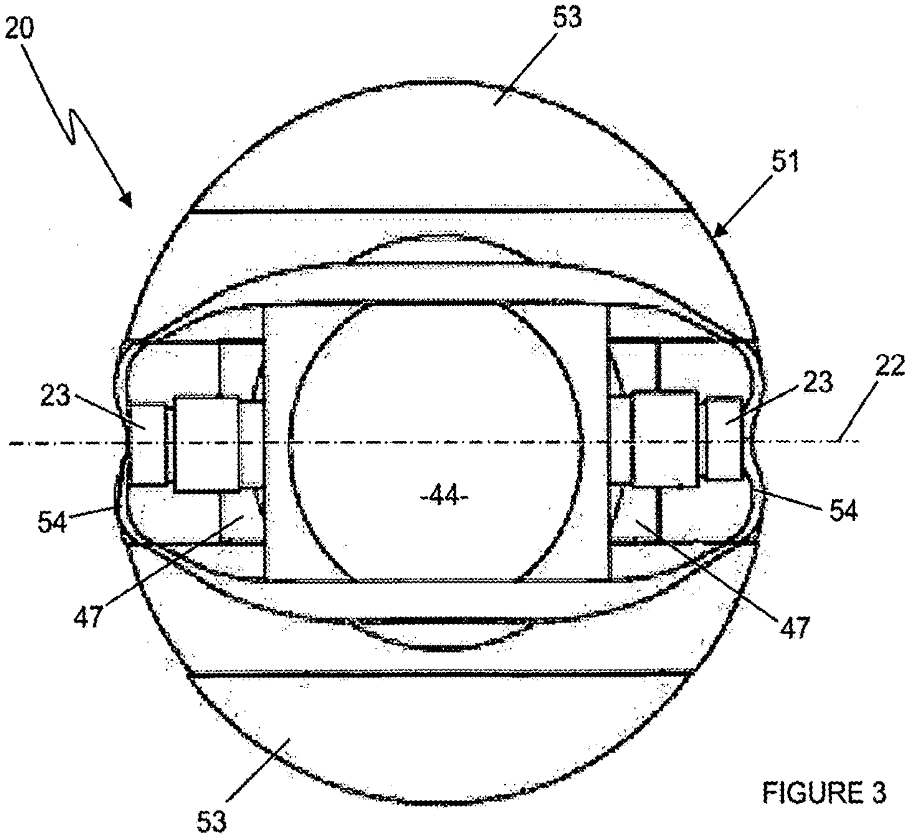


FIGURE 2



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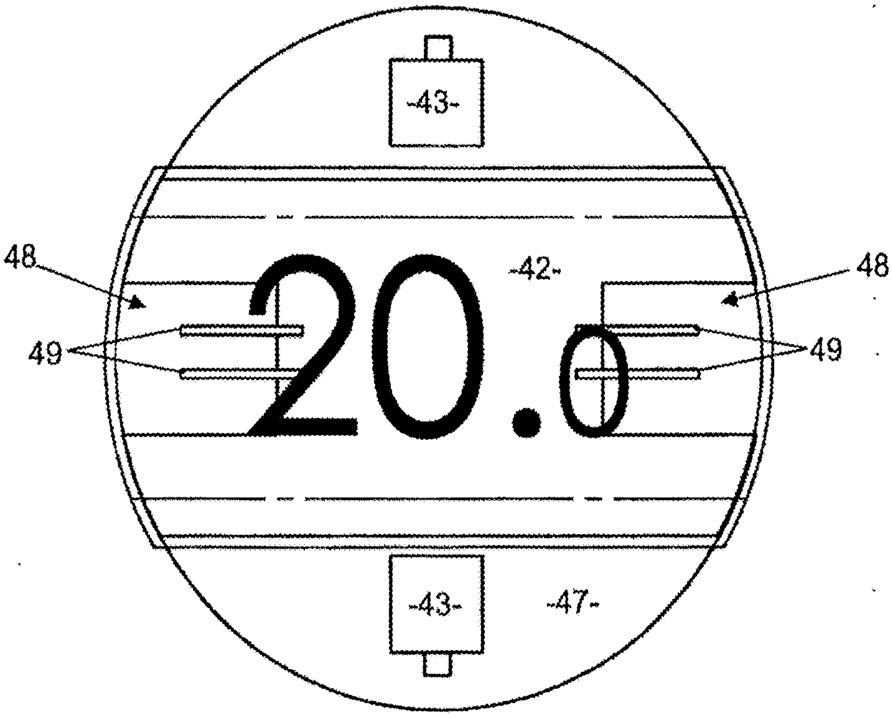


FIGURE 4

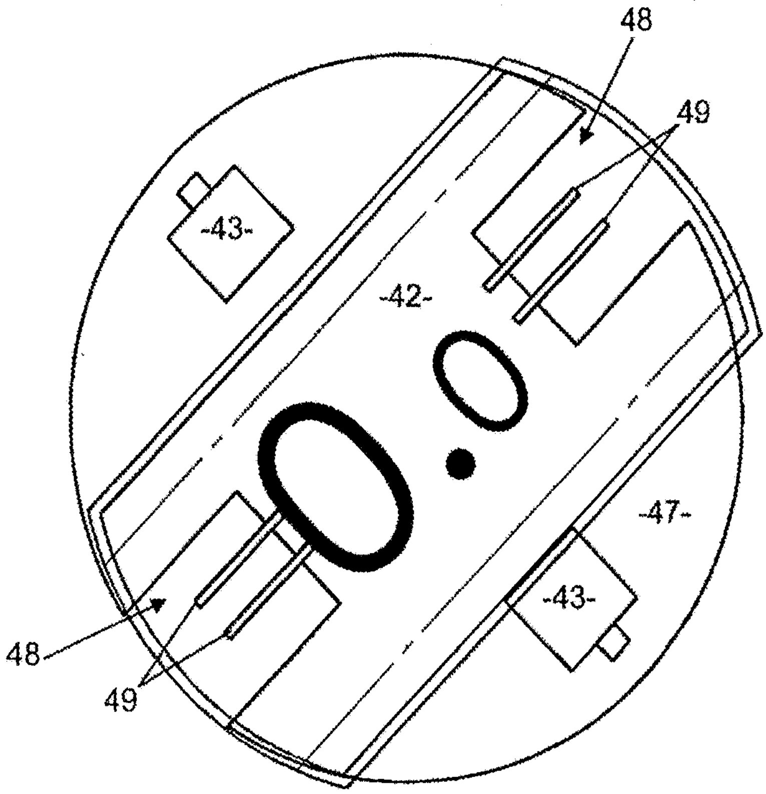


FIGURE 5

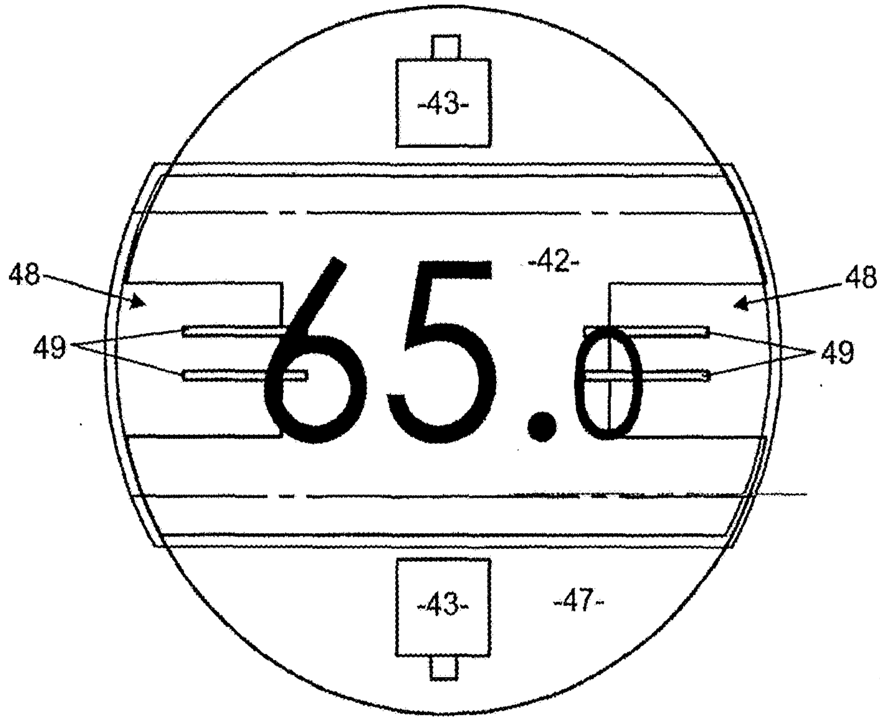


FIGURE 6

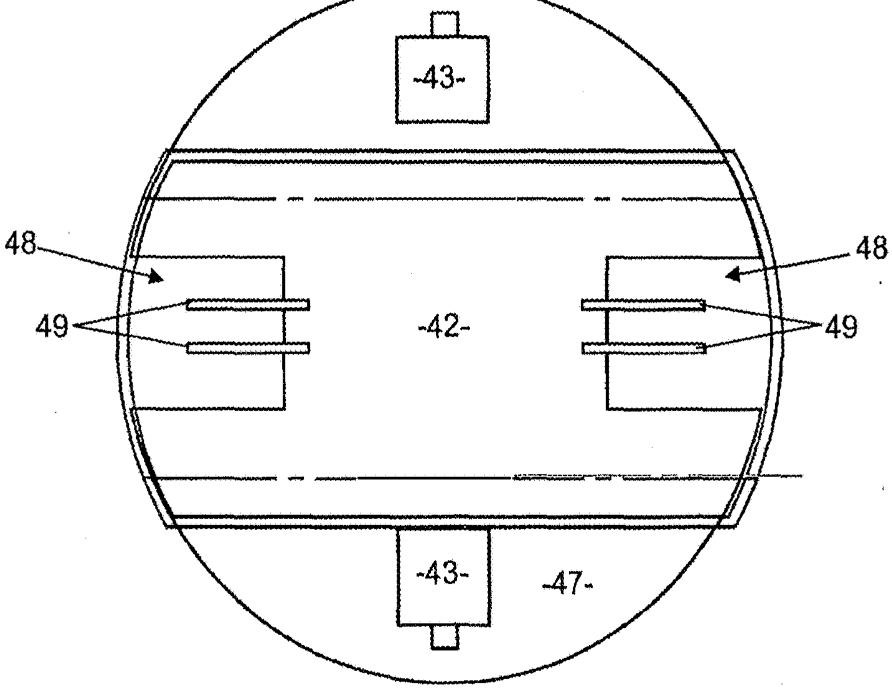


FIGURE 7

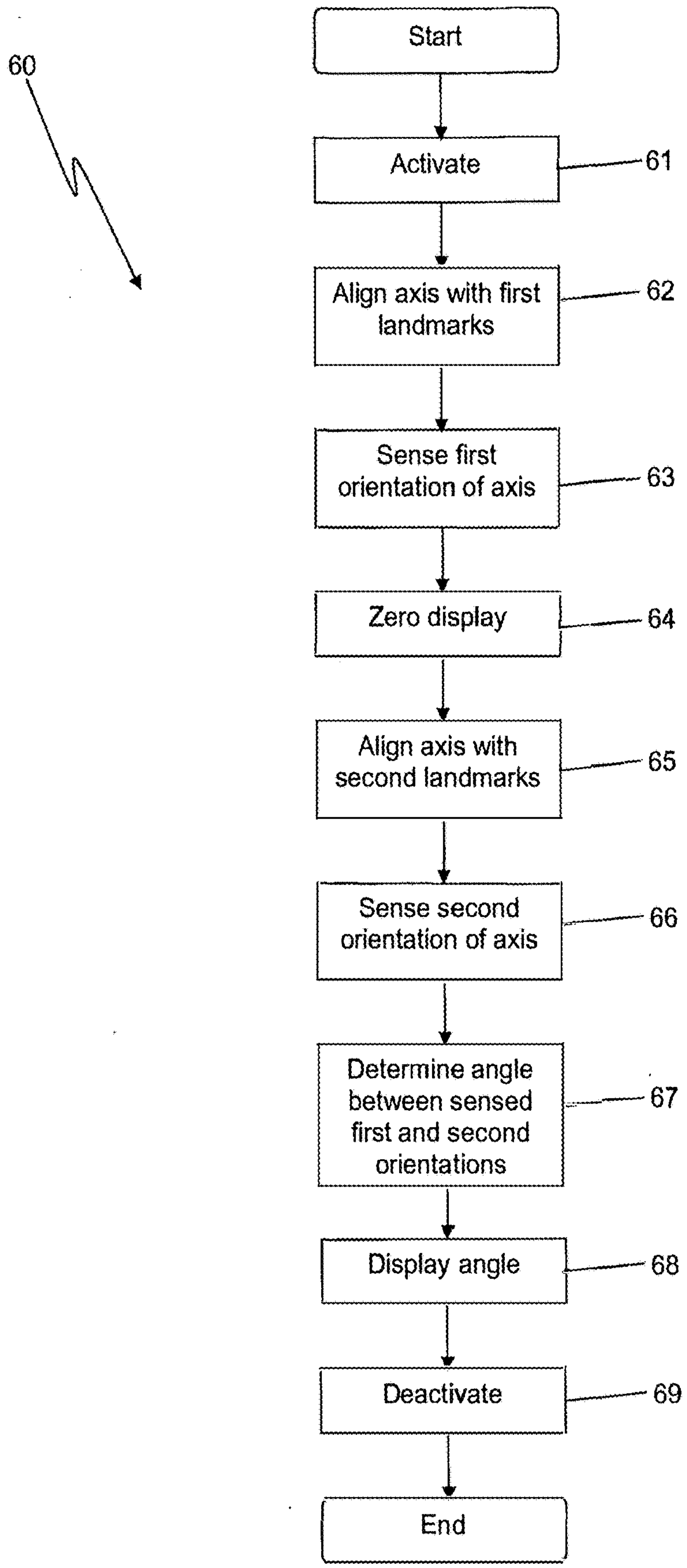

60
Start
Activate
61
Align axis with first landmarks
62
Sense first orientation of axis
63
Zero display
64
Align axis with second landmarks
65
Sense second orientation of axis
66
Determine angle between sensed first and second orientations
67
Display angle
68
Deactivate
69
End

FIGURE 8

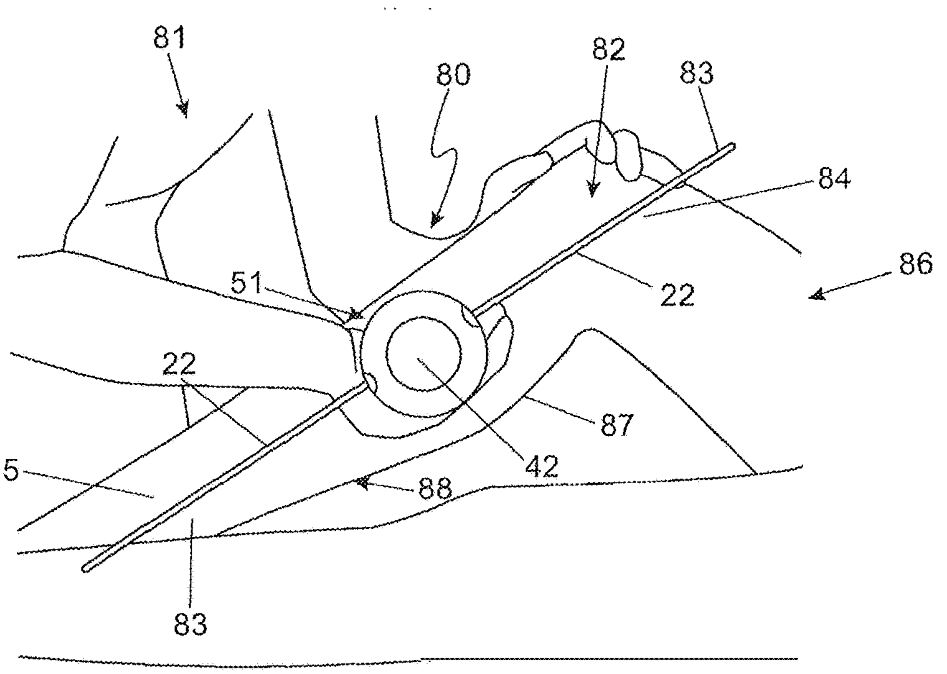


FIGURE 9

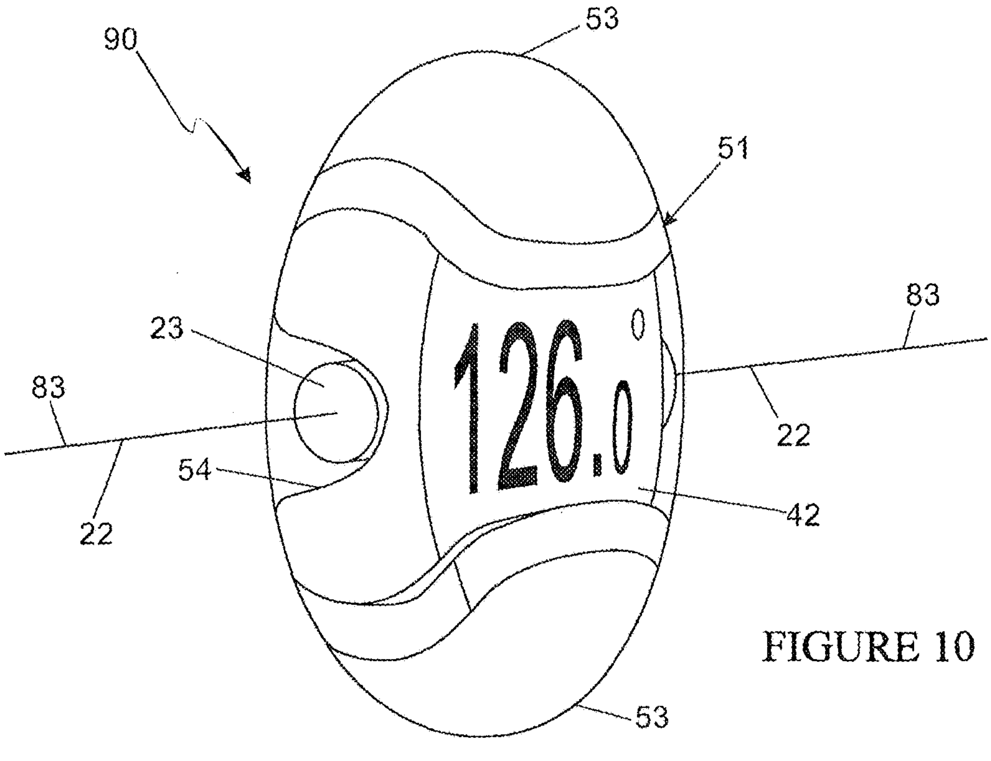


FIGURE 10

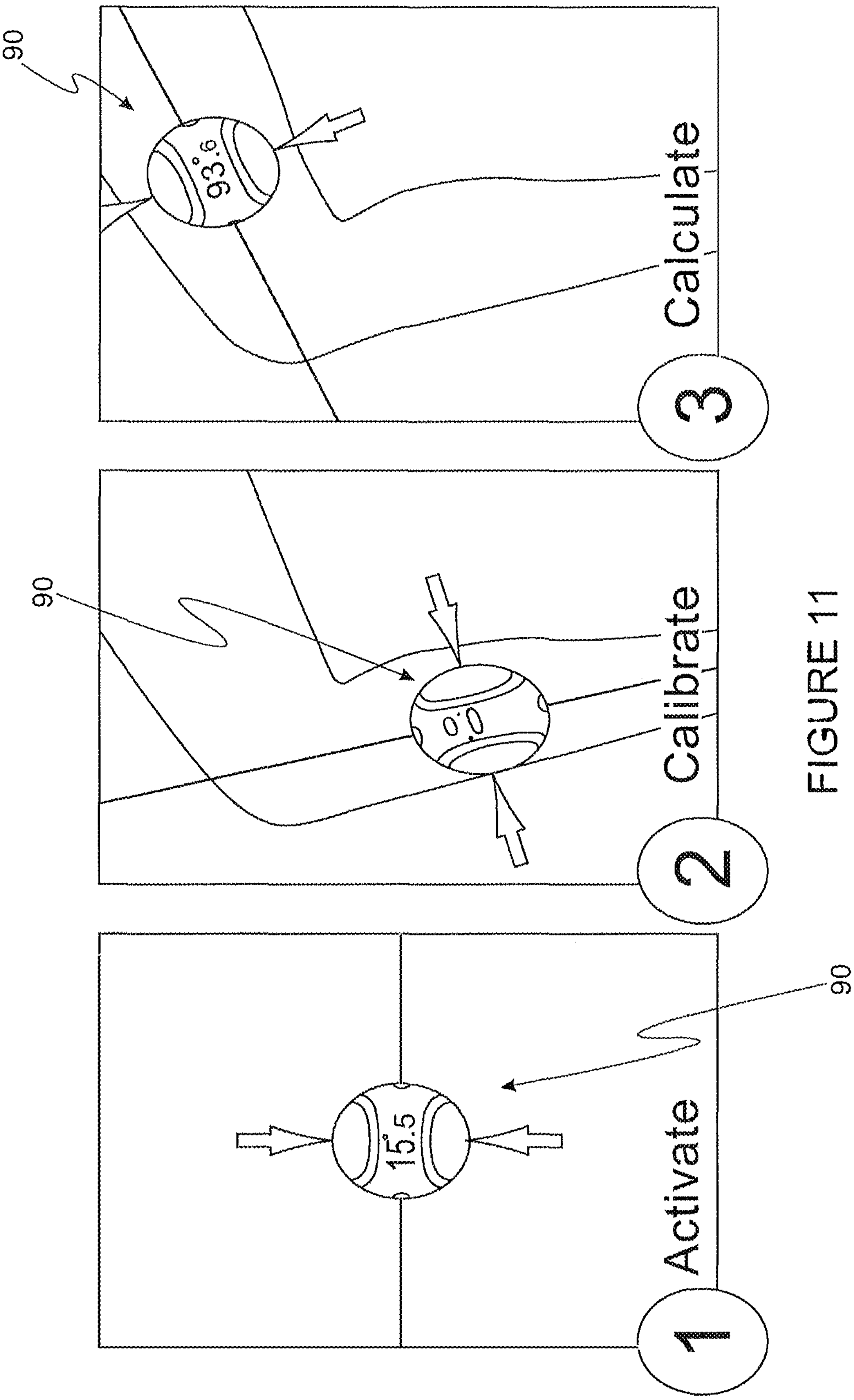


FIGURE 11

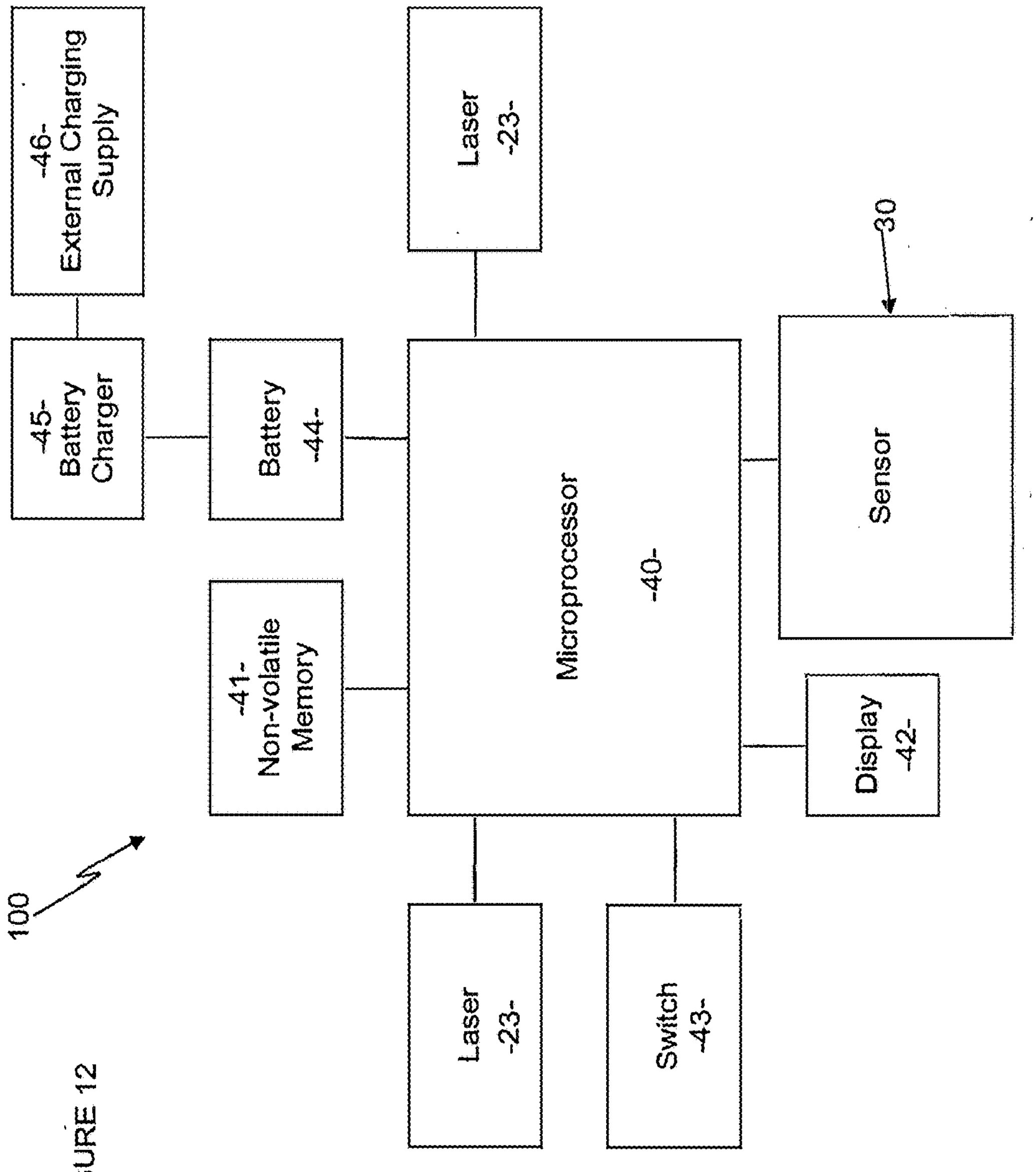

-46-
External Charging
Supply
-45-
Battery
Charger
Battery
-44-
Laser
-23-
Microprocessor
-40-
-41-
Non-volatile
Memory
Sensor
30
Display
-42-
Laser
-23-
Switch
-43-
100

FIGURE 12

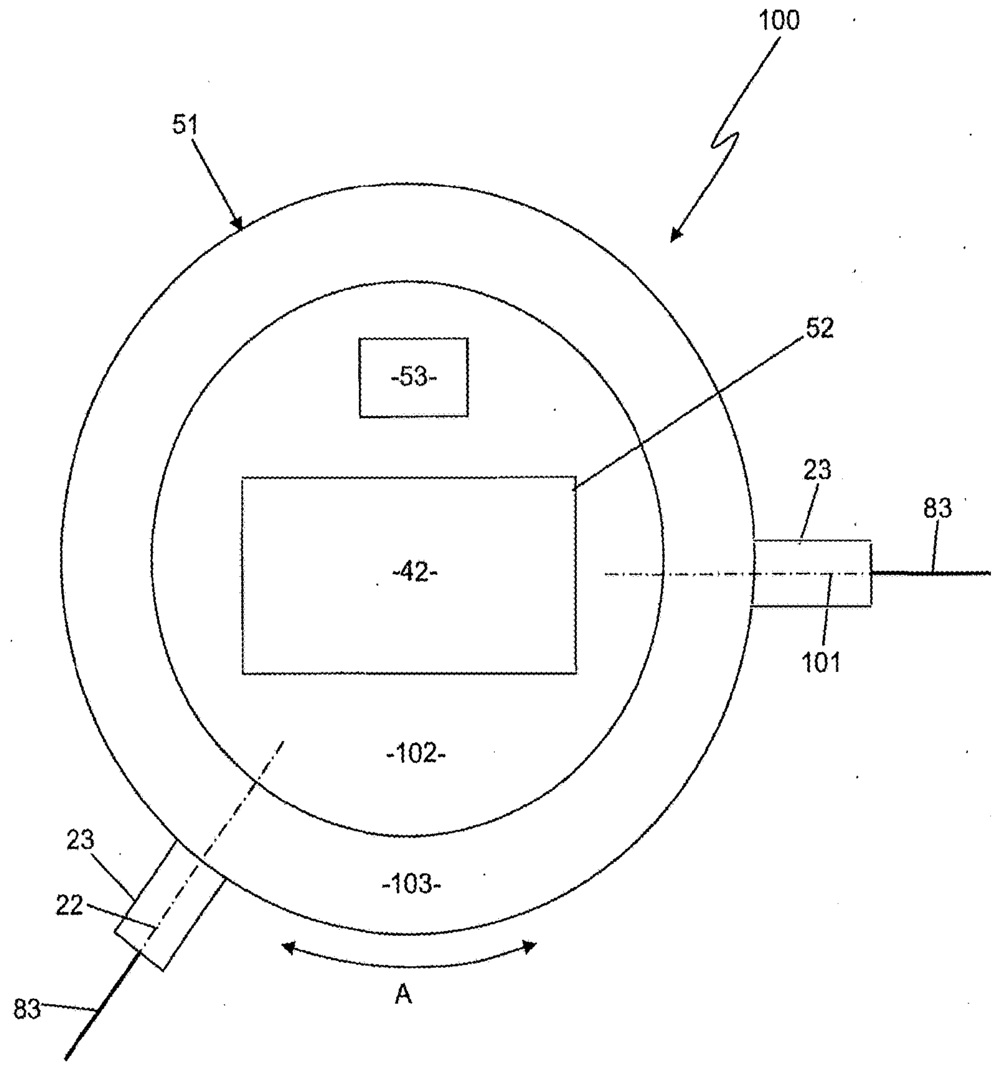


FIGURE 13

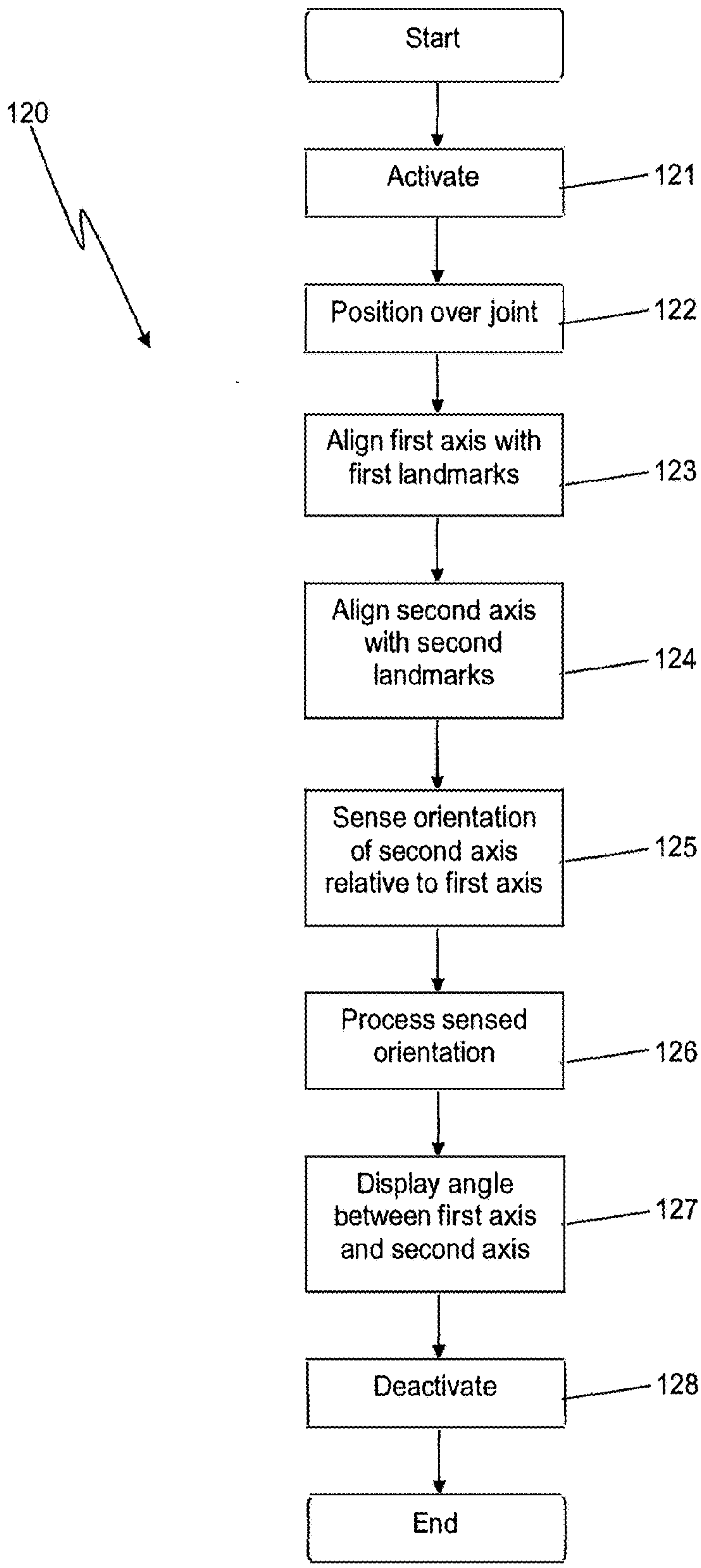

Start
Activate
Position over joint
Align first axis with first landmarks
Align second axis with second landmarks
Sense orientation of second axis relative to first axis
Process sensed orientation
Display angle between first axis and second axis
Deactivate
End
120
121
122
123
124
125
126
127
128

FIGURE 14

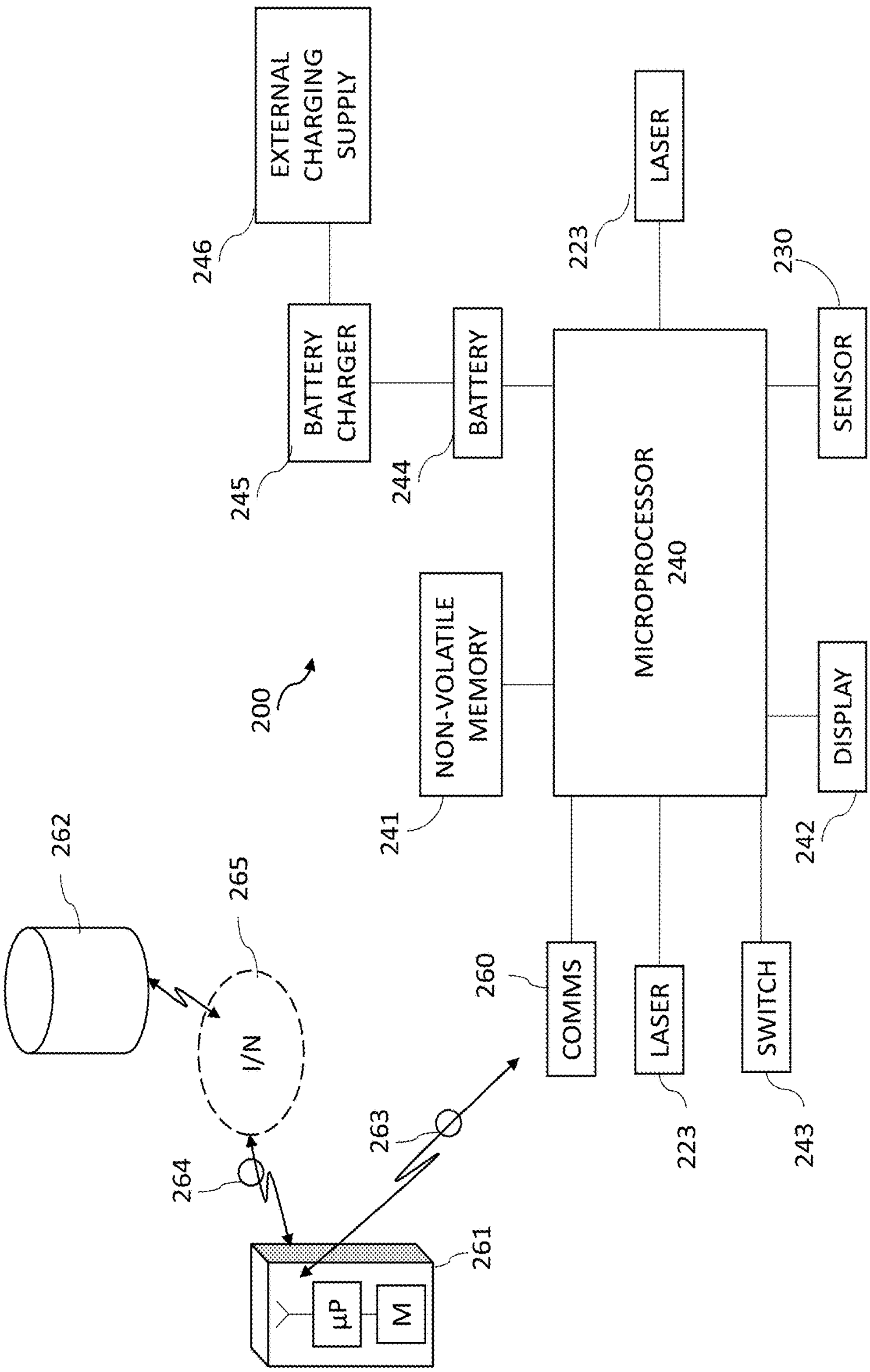
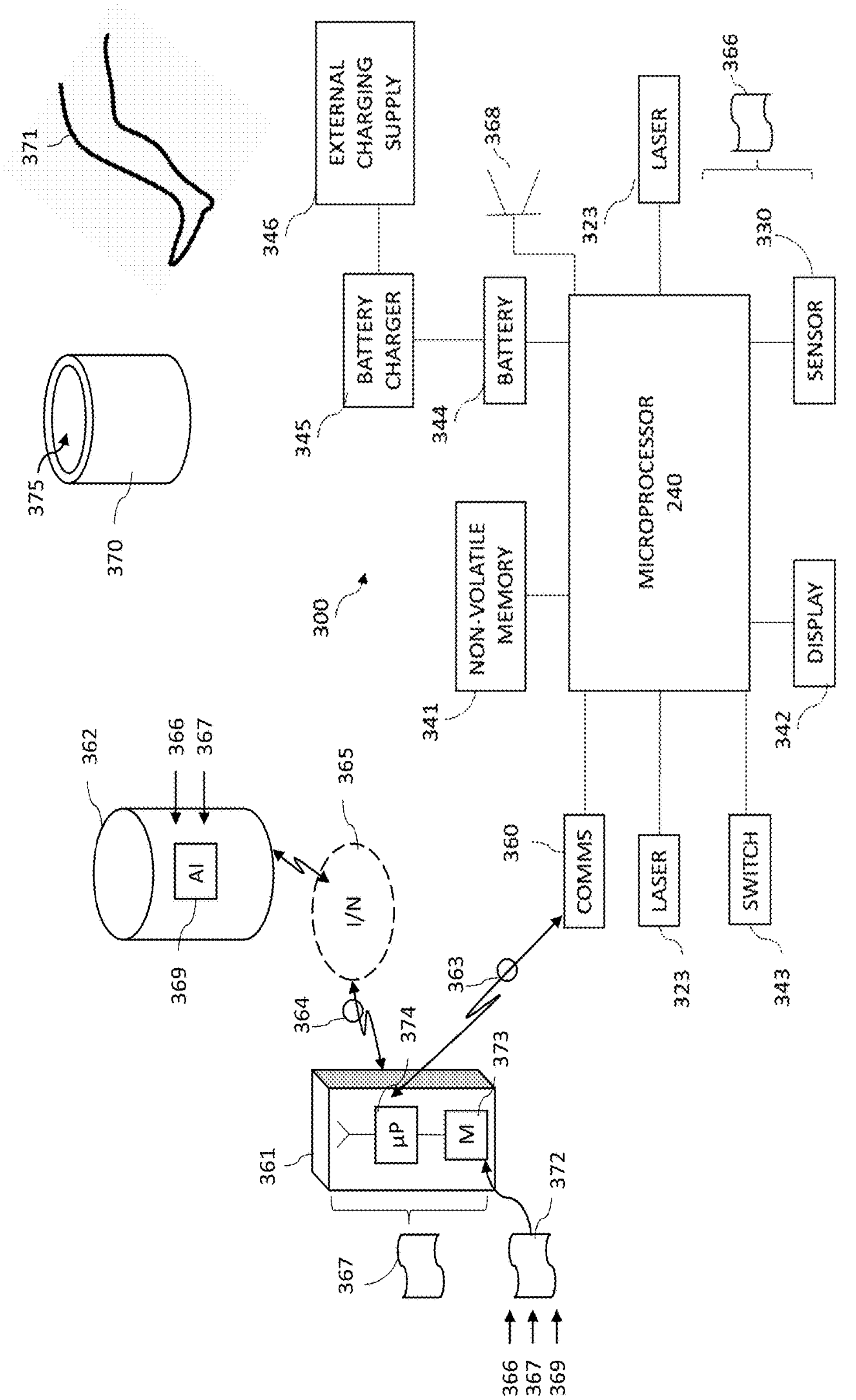

EXTERNAL CHARGING SUPPLY
246
BATTERY CHARGER
245
BATTERY
244
LASER
223
SENSOR
230
MICROPROCESSOR 240
NON-VOLATILE MEMORY
241
DISPLAY
242
200
262
265
I/N
COMMS
260
LASER
223
SWITCH
243
263
264
261
μP
M

FIG 15


371
346
EXTERNAL CHARGING SUPPLY
368
LASER
323
366
375
370
345
BATTERY CHARGER
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BATTERY
MICROPROCESSOR 240
330
SENSOR
300
341
NON-VOLATILE MEMORY
DISPLAY
342
362
366
367
AI
369
365
I/N
360
COMMS
LASER
323
SWITCH
343
363
364
374
373
361
µP
M
372
367
366
367
369

FIG 16

APPARATUS AND METHOD FOR MEASURING ANATOMICAL AND PHYSIOLOGICAL PARAMETERS OF A BODY

FIELD OF THE INVENTION

[0001] The present invention relates generally to an apparatus and method for measuring anatomical and physiological parameters of a body.

[0002] In one form, the anatomical parameter measured is an anatomical angle. In other forms, various other anatomical parameters and/or physiological parameters are measured and displayed. In some forms, the parameters are transmitted from the measuring apparatus.

[0003] In further particular forms, data is transmitted to the apparatus.

BACKGROUND ART

[0004] A goniometer is an apparatus which is used by physiotherapists and the like to measure anatomical angles of a body. For example, they are often used to measure the range of angular motion of joints. It is one example of a group of devices that may take the form of a goniometer or inclinometer or petrometer.

[0005] The following patent documents disclose examples of known goniometers as well as other apparatus for measuring angles: U.S. Pat. No. 4,771,548 (Donnery), United States Patent Application Publication No. 2006/0137201 A1 (Dixon, et al.), U.S. Pat. No. 6,469,666 (Tonn), U.S. Pat. No. 7,337,751 (Lopez, et al.), U.S. Pat. No. 4,442,606 (Graham, et al.), U.S. Pat. No. 7,204,030 (Kattar), U.S. Pat. No. 7,293,363 (Emmett L. Parker), United States Patent Application Publication No. 2007/0266579 A1 (Briscoe, et al.), U.S. Pat. No. 5,163,228 (Edwards, et al.), U.S. Pat. No. 4,665,928 (Linial, et al.), U.S. Pat. No. 3,879,136 (Takeda), U.S. Pat. No. 4,665,928 (Linial, et al.), United States Patent Application Publication No. 2003/0226268 A1 (Gibson), U.S. Pat. No. 7,359,750 (Song, et al.), U.S. Pat. No. 5,253,655 (Stone, et al.), and International Patent Application No. PCT/DE1993/000891.

[0006] Many existing goniometers include a pair of aligning arms which are able to pivot relative to each other. In use, each arm is aligned with anatomical landmarks which are adjacent to the body part whose angle is being measured. For example, if a goniometer with arms is used to measure the angle between the upper part of a person's leg and the lower part of their leg, one of the arms of the goniometer will be aligned with landmarks on the upper part of the leg while the other arm is aligned with landmarks on the lower part of the leg. Once the arms have been properly aligned with the upper and lower leg parts, the angle between the arms corresponds to the angle between the leg parts and can be read off an analogue scale of the goniometer.

[0007] Goniometers of the above-described type suffer from the disadvantage that the arms are often not long enough to accurately align them with some anatomical landmarks. When this situation arises, the person using the goniometer will usually use an eye-balling approach to align the arms with the landmarks as best they can. The accuracy of the measurement which is obtained will be reduced if the arms are not properly aligned with the landmarks.

[0008] Although this problem can be overcome by extending the length of the arms (e.g. by making the arms extendable) so that they are able to reach all of the landmarks that they need to be aligned with when making a measurement, doing so would make the arms somewhat of an obstruction to a user and also make them more vulnerable to being broken or bent.

[0009] Measurement inaccuracy can also be introduced by the analogue scale of the goniometer from which the angle measurement is read. This is because the user needs to interpret the reading from the scale. Although some devices include a digital display which can address this problem, the displays tend to be small and difficult to read.

[0010] For various reasons, including those given above, many existing goniometers have poor inter therapist reliability because the variability of readings from one user to another tends to be significant. For example, there can be a 5-10 degree variance between different users. Similarly, many existing goniometers have poor intra therapist reliability because the variability of readings from the same user tends to be significant. As a consequence, measurements obtained from such goniometers are generally not taken seriously.

[0011] The inaccuracy and variance of readings obtained from existing goniometers can have significant negative consequences. For example, if a post-operative patient who has had a joint operated on must gain a certain amount of range of motion in that joint before they are able to be discharged from hospital, and if a therapist uses a goniometer to measure the range of motion of the joint to determine whether or not the patient has gained the required amount of motion, the date on which the patient is discharged will be unnecessarily delayed if the patient does have the required range of motion but, due to an inaccurate measurement obtained from the goniometer, the measured range indicates that they do not have the required range. An unnecessary delay in the patient being discharged means that the patient will needlessly be occupying a hospital bed which should be made available to someone else.

[0012] Another problem with many existing goniometers is that a user often needs to operate them with both of their hands. This means that while they are performing a measurement with such a device they do not have a hand available to assist the person on whom they are performing the measurement, or to write down the measurement which is obtained from the device.

[0013] Furthermore, many existing goniometers (particularly those which have aligning arms) are quite bulky. This bulkiness can contribute to the need for users to operate them with both hands.

[0014] Existing goniometers which have short aligning arms and/or analogue scales can also be time-consuming to use, particularly if an accurate measurement is required. This is because it can take time to properly align the arms with landmarks that the arms cannot reach, and because it can take time to properly read the scale.

[0015] In addition, at present, different sized goniometers are required to obtain measurements of different sized joints. A large goniometer is required in order to take measurements for the hip and other large joints. A small goniometer is required in order to take measurements of medium size joints and also to take measurements on the pediatric population. A finger joint goniometer is required in order to measure the angle of finger joints.

[0016] It is against this background that the present invention has been developed.

[0017] Furthermore the basic goniometer and like devices do not permit of interactive support to the user.

[0018] It is an object of the present invention to overcome, or at least ameliorate, one or more of the deficiencies of the prior art mentioned above, or to provide the consumer with a useful or commercial choice.

[0019] Other objects and advantages of the present invention will become apparent from the following description, taken in connection with the accompanying drawings, wherein, by way of illustration and example, a preferred embodiment of the present invention is disclosed.

SUMMARY OF THE INVENTION

[0020] Accordingly in one broad form of the invention there is provided an apparatus for measuring anatomical and physiological parameters of a body; apparatus comprising a processor and a memory in communication with at least one sensor; said apparatus sensing at least one anatomical or physiological parameter of a body with which the sensor is associated thereby to output a signal comprising a measurement of the at least one anatomical or physiological parameter.

[0021] Preferably said processor is further in communication with a communications module; said communications module transmitting the signal to an external location.

[0022] Preferably the external location comprises a portable digital communications device.

[0023] Preferably the external location comprises a database.

[0024] Preferably the signal is a short range signal.

[0025] Preferably the signal is a Bluetooth signal.

[0026] Preferably the signal is a WiFi signal.

[0027] Preferably the signal is a long range signal.

[0028] Preferably the long range signal utilises TCP/IP protocol over a network.

[0029] Preferably the signal is a packet switched signal.

[0030] Preferably the database includes a AI Engine.

[0031] Preferably the portable digital communications device is in bidirectional communication with the communications module.

[0032] Preferably the database is in bidirectional communication with the communications module.

[0033] Preferably the apparatus further includes an audio output device whereby the apparatus provides interactive audio guidance to a user.

[0034] Preferably the sensor comprises one or more of accelerometer, Magnetometer, GPS Unit, EGC Sensor, Blood Pressure Sensor, Temperature Sensor, Range of Motion Sensor.

[0035] Preferably the sensor is incorporated within a cuff.

[0036] Preferably the sensor is incorporated in a cover.

[0037] Preferably the sensor is incorporated in a joint cover.

[0038] Preferably the sensor is incorporated in a knee cover.

[0039] Preferably the cover includes an inner sleeve.

[0040] Preferably the apparatus incorporates a medicine dispensing capability.

[0041] Preferably the sensor is a goniometer.

[0042] In a further broad form of the invention there is provided a method for measuring anatomical and physiological parameters of a body; said method comprising sensing at least one anatomical or physiological parameter of a body thereby to output a signal comprising a measurement of at least one anatomical or physiological parameter.

[0043] Preferably the method further includes the step of transmitting the signal to an external location.

[0044] Preferably the external location comprises a portable digital communications device.

[0045] Preferably the external location comprises a database.

[0046] Preferably the signal is a short range signal.

[0047] Preferably the signal is a Bluetooth signal.

[0048] Preferably the signal is a WiFi signal.

[0049] Preferably the signal is a long range signal.

[0050] Preferably the long range signal utilises TCP/IP protocol over a network.

[0051] Preferably the signal is a packet switched signal.

[0052] Preferably the database includes a AI Engine.

[0053] Preferably the portable digital communications device is in bidirectional communication with the communications module.

[0054] Preferably the database is in bidirectional communication with the communications module.

[0055] Preferably there is provided an audio output device whereby the method provides interactive audio guidance to a user.

[0056] Preferably the sensor comprises one or more of accelerometer, Magnetometer, GPS Unit, EGC Sensor, Blood Pressure Sensor, Temperature Sensor, Range of Motion Sensor.

[0057] Preferably the sensor is incorporated within a cuff.

[0058] Preferably the sensor is incorporated in a cover.

[0059] Preferably the sensor is incorporated in a joint cover.

[0060] Preferably the sensor is incorporated in a knee cover.

[0061] Preferably the cover includes an inner sleeve.

[0062] Preferably the apparatus incorporates a medicine dispensing capability.

[0063] Preferably the sensor is a goniometer.

[0064] Preferably the sensor is a inclinometer.

[0065] Preferably the sensor is a petrometer.

[0066] According to a further aspect of the invention there is provided an apparatus for measuring an anatomical angle of a body, the apparatus comprising aligning means for aligning an axis of the apparatus with anatomical landmarks of the body, sensing means for sensing an orientation of the axis while the axis is aligned with the landmarks, and processing means for processing the sensed orientation, wherein the processing means is able to process a sensed first orientation of the axis and a sensed second orientation of the axis to determine an angle between the axis in the sensed first orientation and the axis in the sensed second orientation.

[0067] Preferably the sensing means includes a tilt sensor for sensing the tilt of the axis, and a magnetic sensor for sensing the direction of the axis relative to a magnetic field.

[0068] Preferably the tilt sensor is able to sense the yaw, pitch and roll of the axis.

[0069] Preferably the tilt sensor is an accelerometer.

[0070] Preferably the magnetic sensor is a magnetometer.

[0071] Preferably the apparatus also comprises another aligning means for aligning another axis of the apparatus with other anatomical landmarks of the body, the aligning means are able to be pivoted relative to each other so as to vary an angle between the axes, and the processing means is able to process the sensed orientation to determine the angle between the axes.

[0072] Preferably each aligning means is a light source.

[0073] Preferably the light source is a laser.

[0074] Preferably the apparatus also comprises a display for displaying the measured angle.

[0075] Preferably the apparatus also comprises at least one switch for allowing a user to control the operation of the apparatus.

[0076] According to yet a further aspect of the invention there is provided a method for measuring an anatomical angle of a body, the method comprising the steps of:

- **[0077]** aligning an axis with a first anatomical landmarks of the body;
- **[0078]** sensing a first orientation of the axis while the axis is aligned with the landmarks;
- **[0079]** aligning the axis with a second anatomical landmaks of the body;
- **[0080]** sensing a second orientation of the axis while the axis is aligned with the landmarks; and
- **[0081]** processing the first and second orientation to determine an angle between the axis in the sensed first orientation and the axis in the sensed second orientation.

[0082] Preferably each orientation is sensed by sensing the tilt of the axis and the direction of the axis relative to a magnetic field.

[0083] Preferably the tilt of the axis is sensed by sensing the pitch and roll of the axis.

[0084] Preferably each aligning step includes aligning a light beam with the landmarks.

[0085] Preferably the light beam is a laser beam.

[0086] Preferably the method also comprises the step of displaying the measured angle.

[0087] According to yet a further aspect of the invention there is provided an apparatus for measuring an anatomical angle of a body, the apparatus comprising aligning means for aligning an axis of the apparatus with first and second anatomical landmarks of the body, sensing means for sensing an orientation of the axis while the axis is aligned with each of the first and second landmarks, and processing means for processing the sensed orientation, wherein the apparatus is adapted to be positioned at first and second anatomical landmarks of the body for alignment of the axis of the apparatus with each of the first and second anatomical landmarks of the body for sensing the orientation of the axis at the first and second anatomical landmarks; the apparatus comprising processing means for processing the sensed orientation of the axis at the first and second anatomical landmarks to determine the angle between the axis when with the first landmark of the body and the axis when aligned to the second anatomical landmark of the body.

[0088] In yet a further broad form of the invention there is provided an interactive support apparatus for measuring anatomical and physiological parameters of a body of a user and providing localised audio feedback to the user based on signals derived from measuring the anatomical and physiological parameters of the body; said apparatus providing localised audio feedback to the user; the feedback derived from local sourced information.

[0089] Preferably the feedback is additionally derived from external sourced information.

[0090] Preferably the external sourced information is determined from the local sourced information.

[0091] Preferably the external sourced information is determined from the local sourced information and from an AI Engine; the AI engine acting on signals derived from the local sourced information and the external sourced information.

[0092] In yet a further broad form of the invention there is provided an interactive support method for measuring anatomical and physiological parameters of a body of a user and providing localised audio feedback to the user based on signals derived from measuring the anatomical and physiological parameters of the body; said method providing localised audio feedback to the user; the feedback derived from local sourced information.

[0093] Preferably the feedback is additionally derived from external sourced information.

[0094] Preferably the external sourced information is determined from the local sourced information.

[0095] Preferably the external sourced information is determined from the local sourced information and from an AI Engine; the AI engine acting on signals derived from the local sourced information and the external sourced information.

[0096] In yet a further broad form of the invention there is provided interactive support apparatus for measuring anatomical and physiological parameters of a body of a user and providing localised audio feedback to the user based on signals derived from measuring the anatomical and physiological parameters of the body; said apparatus providing localised audio feedback to the user; the feedback derived from local sourced information.

[0097] Preferably, the feedback is additionally derived from external sourced information.

[0098] Preferably, the external sourced information is determined from the local sourced information.

[0099] Preferably, the external sourced information is determined from the local sourced information and from an AI Engine; the AI engine acting on signals derived from the local sourced information and the external sourced information.

[0100] In yet a further broad form of the invention there is provided an interactive support method for measuring anatomical and physiological parameters of a body of a user and providing localised audio feedback to the user based on signals derived from measuring the anatomical and physiological parameters of the body; said method providing localised audio feedback to the user; the feedback derived from local sourced information.

[0101] Preferably, the feedback is additionally derived from external sourced information.

[0102] Preferably, the external sourced information is determined from the local sourced information.

[0103] Preferably, the external sourced information is determined from the local sourced information and from an AI Engine; the AI engine acting on signals derived from the local sourced information and the external sourced information.

BRIEF DESCRIPTION OF THE DRAWINGS

[0104] In order that the invention may be more fully understood and put into practice, preferred embodiments thereof will now be described with reference to the accompanying drawings, in which:

[0105] FIG. **1** is a schematic block diagram of an apparatus according to a first preferred embodiment of the present invention when a battery for powering the apparatus is being charged from an external supply of electricity;

[0106] FIG. **2** is a front perspective view of the apparatus according to the first preferred embodiment of the present invention;

[0107] FIG. **3** is a rear elevation of the apparatus illustrated in FIG. **2**;

[0108] FIG. **4** depicts the printed circuit board and display of the apparatus illustrated in FIG. **2** after pressing both switches of the apparatus;

[0109] FIG. **5** depicts the printed circuit board and display after both switches are pressed again;

[0110] FIG. **6** depicts the printed circuit board and display after rotating the apparatus and then pressing both switches again;

[0111] FIG. **7** depicts the printed circuit board and display after again pressing both switches;

[0112] FIG. **8** is a flowchart of a method of operating the apparatus illustrated in FIGS. **1** to **7**;

[0113] FIG. **9** depicts an apparatus according to a second preferred embodiment of the present invention being used to measure an anatomical angle at a person's knee joint;

[0114] FIG. **10** depicts an apparatus according to a third preferred embodiment of the present invention when the lasers of the apparatus are activated;

[0115] FIG. **11** depicts the three main steps in operating the apparatus illustrated in FIG. **10** to measure an anatomical angle at a person's knee joint;

[0116] FIG. **12** is a schematic block diagram of an apparatus according to a fourth preferred embodiment of the present invention;

[0117] FIG. **13** is a front elevation of the apparatus according to the fourth preferred embodiment of the present invention;

[0118] FIG. **14** is a flowchart of a method of operating the apparatus illustrated in FIGS. **12** and **13**.

[0119] FIG. **15** is a block schematic diagram of a further embodiment.

[0120] FIG. **16** is a block schematic diagram of yet a further embodiment.

BEST MODE(S) FOR CARRYING OUT THE INVENTION

[0121] In the figures, like features of the described preferred embodiments of the present invention have been referenced with like reference numerals.

[0122] Referring to FIGS. **1** to **4**, there is depicted an apparatus **20** according to a first preferred embodiment of the present invention. Apparatus **20** is for measuring an anatomical angle of a body such as a human body. Apparatus which are used for this purpose are usually referred to as goniometers by physiotherapists and the like.

[0123] Apparatus **20** includes a pair of aligning or alignment means that are each in the form of a solid-state laser **23**. Lasers **23**, which are diametrically opposite each other, are for aligning an axis **22** of the apparatus **20** with anatomical landmarks of a body. Each Laser **23** is able to emit a respective focused or collimated light beam in the form of a laser beam. The lasers **23** emit the laser beams outwardly from the apparatus **20** such that the laser beams are co-linear with each other and the axis **22** of the apparatus **20**. Lasers **23** are preferably low-power lasers so that they do not pose a health risk.

[0124] A sensing means **30** of the apparatus **20** is a three-dimensional orientation sensor which is able to sense a first orientation of the apparatus **20** and, hence, the axis **22** in three dimensions, while the axis **22** is aligned with first anatomical landmarks of the body, and is also able to sense a second orientation of the apparatus **20** and, hence, the axis **22** in three dimensions, while the axis **22** is aligned with second anatomical landmarks of the body. Sensing means **30** includes a tilt sensor which is in the form of an accelerometer **31**, and a magnetic sensor which is in the form of a magnetometer **32**. Sensing means **30** is able to provide stable measurement/sensing of the three-dimensional orientation of an object in space, regardless of the object's orientation.

[0125] Accelerometer **31** is able to sense the tilt of the apparatus **20** and, hence, the axis **22**. In particular, accelerometer **31** is able to sense the pitch (i.e. up/down position) and roll (i.e. side to side rocking position) of the apparatus **20** and, hence, the axis **22**.

[0126] Magnetometer **32** is able to sense the yaw (rotational position about a vertical axis) of the apparatus **20** and, hence, the axis **22** relative to a magnetic field such as the earth's magnetic field.

[0127] The three-dimensional orientation of the apparatus **20** and axis **22**, including the pitch, roll and yaw of the apparatus **20** and axis **22**, which is sensed by the sensing means **30** is able to be output by the sensing means **30** to a processing means which is in the form of a microprocessor **40**. The sensed three-dimensional orientation is output by the sensing means **30** in the form of three-dimensional coordinates. In addition to the accelerometer **31** and magnetometer **32**, sensing means **30** includes interfacing circuitry (not depicted) for interfacing the accelerometer **31** and the magnetometer **32** with the microprocessor. Microprocessor **40** is able to determine an angle between the axis **22** in the sensed first orientation and the axis **22** in the sensed second orientation by processing the output of the sensing means **30** in accordance with computer-readable instructions which are able to be read by the microprocessor **40** and which are stored on storage means which is in the form of a non-volatile memory **41**. Microprocessor **40** is able to output the determined angle to a liquid-crystal display (LCD) **42** which is then able to display the angle numerically in units of degrees. LCD **42** has a height of 32.41 mm, and a width of 61.82 mm.

[0128] Suitably pressing a pair of pushbutton switches **43** enables a user to control the operation of the microprocessor **40** and, hence, the apparatus **20**.

[0129] Apparatus **20** is powered by a battery **44**. The battery **44** may for example be a long-life lithium battery. The battery **44** can be charged by a battery charger such as a Universal Serial Bus (USB) charger **45** which is connected to an external charging supply of electricity **46**.

[0130] Lasers **23**, sensing means **30** including the accelerometer **31** and magnetometer **32**, microprocessor **40**, non-volatile memory **41**, LCD **42**, and switches **43** are all mounted on a printed circuit board (PCB) **47**. PCB **47** is generally circular and has a radius of curvature of 30 mm. PCB **47** includes a pair of diametrically opposite recesses **48** for receiving the lasers **23**. A respective pair of contact prongs **49** is secured to the PCB **47** and extends into each recess **48** from the PCB **47**. Each pair of contact prongs **49** plugs into a respective slot (not depicted) in a socket (not depicted) of each laser **23**.

[0131] PCB **47** is housed within a hollow disc-shaped housing **51**. Housing **51** includes an opening or window **52** through which the measured angle which is displayed by LCD **42** can be viewed. It also includes a pair of buttons **53** which are located on diametrically opposite sides of the housing **51**. Each button **53** operatively engages with a respective switch **43** such that the switch **43** is able to be operated by pressing the button **53**. Each laser **23** is located in the housing **51** such that the lasers **23** do not protrude from the housing **51**. Also, each laser **23** is located adjacent to a respective recess **54** in the housing **51** such that the housing **51** does not obstruct the laser beams which are emitted by the lasers **23**.

[0132] With reference to FIGS. **4** to **7**, and FIG. **8** which depicts a flowchart of a method **60** of operating the apparatus **20**, the apparatus **20** may be used to measure an anatomical angle of a body joint by firstly performing an activation step **61**. The activation step **61** involves a user pressing both buttons **53** simultaneously with to activate (i.e. turn on) the apparatus **20**. Once the buttons **53** have been pressed, both of the lasers **23** emit a laser beam, and the LCD **42** displays a numeric value in the range of 0-180 degrees. The value which is displayed by the LCD **42** depends on the orientation of the apparatus **20** and axis **22** at the time, and will change dynamically in response to a change in the orientation of the apparatus **20** and axis **22**. FIG. **4** depicts the LCD **42** displaying a value of 20.0 degrees shortly after activation of the apparatus **20**.

[0133] The next step of the method **60** is step **62** which is to align the laser beams which are emitted by the lasers **23** with first anatomical landmarks of the body which the joint forms part of. The laser beams are aligned with the first anatomical landmarks such that each laser beam intersects a respective one of the first anatomical landmarks. If the apparatus **20** is being used to measure a range of angular motion of a joint of a limb, the laser beams are initially aligned with landmarks at a distal end or part of the limb i.e. below the joint. For example, when measuring shoulder flexion when the patient is in supine, the apparatus **20** is positioned so that the laser beams align with the landmarks of the greater trochanter of the hip, along the line of the trunk to the mid axilla.

[0134] The landmarks which the laser beams are aligned with may be non-joint landmarks and/or joint landmarks (e.g. landmarks indicating the axis of a joint). The particular landmarks which are used by physiotherapists and the like to measure anatomical angles are well-known in the art and will not be described at length here.

[0135] Step **63**, which follows step **62**, involves sensing a first orientation of the apparatus **20** and axis **22** with the sensing means **30**, and then capturing that information with the microprocessor **40**. The first orientation of the apparatus **20** and axis **22** is the orientation that the apparatus **20** and axis **22** have when the laser beams emitted by the lasers **23** are aligned with the first anatomical landmarks of the body. Pressing both buttons **53** simultaneously while the laser beams emitted by the lasers **23** are aligned with the first anatomical landmarks causes the first orientation which is sensed by the sensing means **30** to be captured by the microprocessor **40**.

[0136] Following step **63**, the apparatus **20** automatically performs step **64** which is to zero the numeric value which is displayed by the LCD **42** so that the LCD will display a value of 0.0 degrees while the apparatus **20** and axis **22** are in the first orientation. FIG. **5** depicts the LCD **42** displaying a value of 0.0 degrees after the first orientation of the apparatus **20** and axis **22** have been detected, and after the numeric value displayed by the LCD **42** has been zeroed.

[0137] In other embodiments, the numeric value which is displayed by the LCD **42** may be set to zero at the time that the apparatus **20** is activated.

[0138] The next step of the method **60** is step **65** which is to align the laser beams which are emitted by the lasers **23** with second anatomical landmarks of the body which the joint forms part of. The laser beams are aligned with the second anatomical landmarks such that each laser beam intersects a respective one of the second anatomical landmarks. If the apparatus **20** is being used to measure a range of angular motion of a joint of a limb, the laser beams are aligned with landmarks at a proximal end or part of the limb (i.e. above the joint) after movement of the joint. For example, when measuring shoulder flexion, the apparatus **20** is positioned so that the laser beams align with the landmarks of the mid axilla to the medial epicondyle on the humerus.

[0139] Step **66**, which follows step **63** involves sensing a second orientation of the apparatus **20** and axis **22**, and capturing that information. The second orientation of the apparatus **20** and axis **22** is the orientation that the apparatus **20** and axis **22** have when the laser beams emitted by the lasers **23** are aligned with the second anatomical landmarks of the body. Pressing both buttons simultaneously while the laser beams emitted by the lasers **23** are aligned with the second anatomical landmarks causes the second orientation to be captured from the sensing means **30** by the microprocessor **40**.

[0140] Step **67** of the method **60** occurs automatically after step **66**. In step **67**, the microprocessor **40** processes the sensed first orientation and the sensed second orientation to determine what the measured anatomical angle of the joint is.

[0141] The sensed first orientation includes a vector A (i.e. Axyz) which is an initial reference position. Vector A is sensed by the magnetometer **32**, and includes pitch and roll angles which are sensed by the accelerometer **31**. The sensed second orientation includes a vector B (i.e. Bxyz) which is a final reference position. Vector B is sensed by the magnetometer **32**, and includes pitch and roll angles for vector B which are sensed by the accelerometer **31**. Microprocessor **40** processes the sensed first orientation and the sensed second orientation by transposing vector A and Vector B to the horizontal plane so that vector A (i.e. Axyz) becomes vector A'xy, and so that vector B (i.e. Bxyz) becomes vector B'xy. The microprocessor **40** then determines the angle between transposed vector A'xy and transposed vector B'xy, and this is the angle which is displayed by the LCD **42** at step **68**. A similar method is used by a compass system disclosed in a published article which is entitled "Applications of Magnetic Sensors for Low Cost Compass Systems", by Michal J. Caruso of Honeywell, SSEC, and which is incorporated herein it its entirety by reference.

[0142] After determining the anatomical angle of the joint, the next step which is performed is step **68** which involves the microprocessor **40** controlling the LCD **42** to display this information numerically and in units of degrees. The measured anatomical angle is displayed to an accuracy of a single decimal place. This information remains display by the LCD **42** irrespective of whether or not the apparatus **20** is subsequently moved. In addition, the lasers **23** are turned off so that they no longer emit laser beams. FIG. **6** depicts the LCD **42** displaying a measured angle of 65.0 degrees.

[0143] The next step in the method is step **69** which involves the user pressing both buttons **53** so that the apparatus **20** is deactivated (i.e. turned off). FIG. **7** depicts the blank display **42** of the apparatus **20** after it has been turned off.

[0144] It will be appreciated that the sensing means **30** is not limited to including the accelerometer **31** and magnetometer **32** to sense the orientation of the axis **22** in three-dimensions, and that the sensing means **30** could use other devices/instruments to sense the three-dimensional orientation of the axis **22**. For example, the sensing means **30** could use electrolytic (fluid) based tilt sensors, gimbaled mechanical structures, gyroscopes, magnetic compasses to sense the orientation of the axis **22**.

[0145] The apparatus **20** may be used to measure the anatomical angle of small joints (e.g. finger joints) or the small joints of infants and the like in pediatric settings by selecting a small joint mode of operation of the apparatus by suitably pressing the buttons **53**. In the small joint mode, only one of the lasers **23** is activated.

[0146] Referring to FIG. **9**, an apparatus **80** according to a second preferred embodiment of the present invention is being used by a user **81** to measure an anatomical angle of a patient's right knee joint **82**. Apart from some minor cosmetic differences, apparatus **80** is identical to the apparatus **20**. User **81** is shown aligning laser beams **83** which are emitted by the lasers (not depicted) of the apparatus **80** with anatomical landmarks **84**, **85** of the patient's right leg **86** while holding the apparatus **80** in their right hand **87** adjacent to the patient's lower right leg **88**. The apparatus **80** is initially placed on the anatomical bone of the lower right leg **88** to allow intersection of the laser beams **83** with the knee joint **82** and the proximal landmark **84** of the knee **82**. Laser beams **83** are co-linear with an axis **22** of the apparatus **80**.

[0147] FIG. **10** depicts an apparatus **90** according to a third preferred embodiment of the present invention which is also identical to the apparatus **20** apart from some minor cosmetic differences. The lasers **23** of the apparatus **90** are shown emitting laser beams **83**, and the LCD **42** of the apparatus **90** is shown displaying an angular reading of 126.0 degrees. A degrees symbol '°' is displayed on the LCD **42** at the right-side of the angular reading to make it clear to a person reading the LCD **42** that the angular reading displayed thereon is in units of degrees. Laser beams **83** are co-linear with an axis **22** of the apparatus **90**.

[0148] FIG. **11** depicts the three main steps in operating the apparatus **90** to measure an anatomical angle at a person's knee joint. Those steps are:

[0149] Activate;

[0150] Calibrate; and

[0151] Calculate.

[0152] In the Activate step, the apparatus **90** is activated (i.e. turned on) by pressing the buttons **53**. When the apparatus **90** is activated, the LCD **42** and the lasers **23** are activated.

[0153] In the Calibrate step, the laser beams **83** are aligned with landmarks of the lower part of the leg, and then buttons **53** are pressed again to zero the reading which is displayed by the LCD **42**.

[0154] In the Calculate step, the laser beams **83** are aligned with landmarks of the upper part of the leg, and then buttons **53** are pressed again so that the apparatus **90** calculates the angle between the laser beams **83** when they are aligned with the landmarks of the lower part of the leg and the laser beams **83** when they are aligned with the landmarks of the upper part of the leg.

[0155] If a user holds down the two buttons **53** for at least 5 seconds, a menu (not depicted) is displayed by the LCD **42**. The menu includes a heading "Instructions for application 1, 2, 3 use", and includes the following items:

[0156] Landmark review

[0157] Small joint mode

[0158] The menu items can be scrolled through by pressing the buttons **53**. To scroll up through the menu items, the topmost button **53** is pressed. To scroll down through the menu items, the bottommost button **53** is pressed. To select a menu item, the both buttons **53** are held down for at least 5 seconds.

[0159] Selecting menu item 1—Landmark review causes a submenu to be displayed by the LCD **42**. The submenu includes a list of joints (e.g. shoulder, elbow, wrist, etc.) which can be measured and whose angular measurements can be reviewed.

[0160] Selecting menu item 2—Small joint mode results in only one of the lasers **23** being activated. This means that the lasers **23** can work independently of each other. Small joint mode is used when measuring an anatomical angle of a small joint. When measuring an anatomical angle of a small joint (e.g. a finger joint), both lasers **23** are unable to be used in the manner described previously because the apparatus **90** is too large and would cover the landmarks which the laser beams **83** need to be aligned with. In the small joint mode, only one of the lasers **23** is activated, and the laser beam **83** which it emits is aligned with the landmarks.

[0161] Referring to FIGS. **12** and **13**, there is depicted an apparatus **100** according to a fourth preferred embodiment of the present invention. Apparatus **100** is for measuring an anatomical angle of a body such as a human body. Apparatus which are used for this purpose are usually referred to as goniometers by physiotherapists and the like.

[0162] Apparatus **100** includes an aligning or alignment means that are each in the form of a solid-state laser **23**. Lasers **23** are for aligning a first axis **101** of the apparatus **100** with first anatomical landmarks of a human body, and for aligning a second axis **22** of the apparatus **100** with second anatomical landmarks of the body. Lasers **23** are each able to emit a respective focused or collimated light beam in the form of a laser beam **83**. The lasers **23** emit the laser beams **83** outwardly from the apparatus **100** such that one of the laser beams **83** is co-linear with the first axis **101**, and such that the other laser beam **83** is co-linear with the second axis **22**. Lasers **23** are preferably low-power lasers so that they do not pose a health risk.

[0163] Apparatus **100** also includes a hollow disc-shaped housing **51** which is approximately 50 mm in diameter and which includes an inner circular part **102** which one of the lasers **23** is fixed relative to, and an outer circular part **103** which the other laser **23** is fixed relative to. The outer part

103 is able to rotate relative to the inner part **102** in either a clockwise or an anticlockwise direction as indicated by the arrow 'A' in FIG. **13**. The laser **23** which is fixed relative to the inner part **102** is the laser **23** which is for aligning the first axis **101** with first anatomical landmarks of the body, and the laser **23** which is fixed relative to the outer part **103** is the laser **23** which is for aligning the second axis **22** with second anatomical landmarks of the body. The angle between the lasers **23** and, hence, the axes **22** and **101** can be varied by rotating the outer part **103** relative to the inner part **102**. The outer part **103** can be rotated relative to the inner part through 360 degrees.

[0164] A sensing means **30** of the apparatus **100** is able to sense an orientation of the second axis **22** relative to the first axis **101**. In particular, sensing means **30** is able to determine the angular orientation of the second axis **22** relative to the first axis **101**.

[0165] The sensed orientation is able to be output by the sensing means **30** to a processing means **40** which is in the form of a microprocessor **40**. Microprocessor **40** is able to determine the angle between the first axis **101** and the second axis **22** by processing the sensed orientation which is output by the sensing means **30** in accordance with computer-readable instructions which are able to be read by the microprocessor **40** and which are stored on storage means which is in the form of a non-volatile memory **41**. Microprocessor **40** is able to output the determined angle to a liquid-crystal display (LCD) **42** which is then able to display the angle numerically in units of degrees. The angle is displayed to the nearest degree. LCD **42** can display a maximum angle of 360 degrees and a minimum angle of 0 degrees.

[0166] A pushbutton switch **43** enables a user to control the operation of the microprocessor **40** and, hence, the apparatus **100**.

[0167] Apparatus **100** is powered by a battery **44**. The battery **44** may for example be a long-life lithium battery. The battery **44** can be charged by a battery charger such as a Universal Serial Bus (USB) charger **45** which is connected to an external charging supply of electricity **46**.

[0168] Lasers **23**, sensing means **30**, microprocessor **40**, non-volatile memory **41**, LCD **42**, and switch **43** are all housed within the housing **51**. Housing **51** includes an opening or window **52** through which the measured angle which is displayed by LCD **42** can be viewed. It also includes a button **53** which is located on the front of the housing **51** adjacent to the LCD **42**. Button **53** operatively engages with the switch **43** of the apparatus **100** such that the switch **43** is able to be operated by pressing the button **53**. Although, for clarity, the lasers **23** are shown protruding from the housing **51**, they may alternatively be located in the housing **51** such that they do not protrude from the housing **51** and such that the housing **51** does not obstruct the laser beams **83** which are emitted by the lasers **23**.

[0169] With reference to FIGS. **12** and **13**, and also FIG. **14** which depicts a flowchart of a method **120** of operating the apparatus **100**, the apparatus **100** may be used to measure an anatomical angle of a body joint by firstly performing an activation step **121**. The activation step **121** involves a user pressing the button **53** to activate (i.e. turn on) the apparatus **100**. Once the button **53** has been pressed, the lasers **23** emit laser beams **83**, and the LCD **42** displays a numeric value in the range of 0-360 degrees. The value which is displayed by the LCD **42** depends on the orientation of the axis **22** relative to the axis **101** at the time, and will change dynamically if the orientation of the axis **22** relative to the axis **101** is altered by rotating the outer part **103** of the housing **51** relative to the inner part **102** of the housing. Rotating the outer part **103** relative to the inner part **102** changes the orientation of the axis **22** relative to the axis **101** by changing the angle between the axes **22**, **101**.

[0170] The next step of the method **120** is step **122** which is to position the housing **51** over the joint so that the laser beams **83** can be aligned with predetermined anatomical landmarks which are located above and below the joint.

[0171] At step **123** the laser beam **83** which is co-linear with the first axis **101** is aligned with first anatomical landmarks. The laser beam **83** is aligned with the first anatomical landmarks such that the laser beam **83** intersects each one of the first anatomical landmarks.

[0172] At step **124**, the laser beam **83** which is co-linear with the second axis **22** is aligned with second anatomical landmarks. The laser beam **83** is aligned with the second anatomical landmarks such that the laser beam **83** intersects each one of the second anatomical landmarks.

[0173] Aligning the laser beams **83** with the first and second anatomical landmarks may require adjustment of the angle between the axes **22**, **101** by suitably rotating the outer part **103** of the housing **51** relative to the inner part **102** of the housing **51**.

[0174] At step **125**, the sensing means **30** senses the orientation of the second axis **22** relative to the first axis **101** while those axes **22**, **101** are aligned with the second and first anatomical landmarks, respectively. At step **126**, the microprocessor **40** processes the sensed orientation to determine the angle between the first axis **101** and the second axis **22** and controls the LCD **42** to display the angle between the first axis **101** and the second axis **22**.

[0175] At step **128**, the apparatus **100** is deactivated (i.e. turned off) by pressing the button **53**.

[0176] By employing lasers **23** instead of arms or the like as aligning means assists to make the apparatus described above more compact compared to existing goniometers which have long arms for alignment purposes.

[0177] The various apparatus described above may be used to measure the range of motion of an anatomical joint.

[0178] A user may operate the various apparatus described above using only one of their hands. This enables the user to use their free hand to assist a patient if need be, or to record the angular measurement which is obtained using the apparatus.

[0179] The lasers **23** allow the various axes of the apparatus described above to be accurately aligned with anatomical landmarks. This together with the automatic and accurate sensing, processing and display of the orientation of the various axes enables the apparatus to provide an accurate angular measurement which is more likely to be replicated between multiple measurements by the same user or measurements by different users. Consequently, the apparatus has an improved inter rater/therapist reliability and improved intra rater/therapist reliability compared to prior art devices.

[0180] In addition to being able to take accurate measurements which can be repeated by the same or different users, the apparatus are fast and easy to use.

[0181] The apparatus are able to measure anatomical angles irrespective of the orientation of the angle which is to be measured. Thus, it does not matter whether the angle to be measured lies in a horizontal plane, a vertical plane, or something in between. Consequently, the apparatus are able to be used to measure an anatomical angle of a person irrespective of the position of the person or the part of their body being measured.

[0182] The LCDs of the apparatus are sufficiently large to clearly display the angular measurement which is obtained using the apparatus.

[0183] The buttons **53** may be used to scroll through and select items from a menu which may be displayed by the LCD **42**. The menu items may relate to configuring or selecting functions that the apparatus is able to perform. For example, the buttons **53** may be used to put the apparatus in to a normal measuring mode where laser beams **83** are emitted by both lasers **23**, the small joint mode discussed earlier, or to select a landmark revision function. The LCD **42** may display instructions for to assist in operating the apparatus.

[0184] The housing **51** of the apparatus is preferably made from a material such as polycarbonate and aluminium for comfort and migration to the user, as well as for aesthetics and durability of the apparatus.

[0185] The battery charger **45** is not limited to being a USB battery charger and may be any sort of battery charger.

[0186] The display **42** may be a touch screen which can be used by a user to operate the apparatus. For example, the touch screen may display various options related to the operation of the apparatus, and the user may select any of those options by appropriately touching the touch screen.

Further Embodiments

Remote Communication Capability (H2)

[0187] With reference to FIG. **15**, there is illustrated apparatus **200** in accordance with a further embodiment of the present invention wherein like components are numbered as for earlier embodiments except in the **200** series.

[0188] In one form the apparatus **200** may perform the function of one or more of a goniometer, petrometer and inclinometer.

[0189] A petrometer is utilised to measure vertical and horizontal body and extremity range of movement (ROM) movements.

[0190] In this instance the apparatus **200** includes components as previously described in communication with micro-processor **240**.

[0191] Sensor **230** may take one of a multitude of forms.

[0192] The sensor **230** may comprise one or more of:

[0193] Accelerometer

[0194] Magnetometer

[0195] GPS Unit

[0196] EGC Sensor

[0197] Blood Pressure Sensor

[0198] Temperature Sensor

[0199] Range of Motion Sensor

[0200] By way of the communications module **260**, signals from any one or more of the above described sensors or results processed from the signals by the micro-processor **240** may be communicated to other devices.

[0201] In one form, the other devices may include a portable digital communications device **261** or a data base **262**.

[0202] In one form, the communications may comprise a signal in the form of a short range radio signal **263**. The short range signal may be based on packet switched technology and may include Bluetooth and WiFi.

[0203] In other forms, the communications may comprise a signal in the form of a long range signal **264**. The long range signal may be based on packet switched technology and may include cable based technologies such as TCP/IP which permit transmission over internet **265**.

Bidirectional Remote Communication Capability (H3)

[0204] With reference to FIG. **16**, there is illustrated apparatus **300** in accordance with a further embodiment of the present invention wherein like components are numbered as for earlier embodiments except in the **300** series.

[0205] In this instance communication from external sources such as database **362** or portable digital communications device **361** may proceed to communications device **360** by way of bidirectional long range signal **364** and/or bidirectional short range signal **363**.

[0206] With the topology of apparatus **300**, the system permits transmission of local sourced information **366** from sensor **330** out to portable digital communications device **361** or database **362**.

[0207] The system also permits transmission of external sourced information **367** from database **362** and/or portable digital communications device **361** to processor **340**. This external sourced information **367** may be used to enhance functionality of the apparatus **300**. In a further form, the local sourced information **366** and the external sourced information **367** may also be used to enhance the functionality of apparatus **300**.

[0208] In one form the functionality of apparatus **300** may be enhanced by incorporation of audio output **368** whereby audio instructions may be passed to a user of apparatus **300**. In one form the constructions may derive from processing the local sourced information **366** through an Artificial Intelligence (AI) engine **369**. In preferred forms the AI Engine **369** is associated with database **362** and makes use of local sourced information **366** and the external sourced information **367** thereby to provide intuitive and anticipatory commands and data to a user of apparatus **300**.

EXAMPLE 1

[0209] With further reference to FIG. **16**, a particular form of sensor **330** in this instance in the form of a knee cover **370** is utilised by way of a first example of an application of an apparatus and method for measuring anatomical and physiological parameters of a body in accordance with an embodiment of the invention.

[0210] In this instance, the knee cover **370** has sensors in it. The knee cover **370** glides on over the knee **371**, in a breathable, flexible, soft and washable material. The knee cover may consist of double layered material where by additional rehabilitation aids such as ice may be inserted in order to reduce the joint inflammation.

[0211] The double sleeve provides as inner sleeve which may also hold functions such as analgesic delivery to the joint or body part directly underneath the cover.

[0212] The inner sleeve may be made from a reusable material or disposable material, as part of a consumable part of the knee cover **370**.

[0213] In preferred forms the knee cover **370** includes the apparatus **300** within it. The apparatus **300** communicates with portable digital communications device **361**.

[0214] An application **372** stored in memory **373** processes the local sourced information **366** and the external sourced information **367** and also output from the AI engine **369** by way of processor **374** thereby to provide interactive guidance to a user of the knee cover **370**.

[0215] The AI engine **369** will communicate with the knee cover **370** on a continuous basis and be interpreting and acting of the information from the sensors. The information may be stored and tracked within the portable digital communications device **361**. The information may also be stored within a memory within the actual knee cover **370**.

[0216] The application **372** permits the portable digital communications device **361** to operate as an intelligent, reactive assistant. It provides audio prompting by way of the audio output **368** and/or via audio output on the portable digital communications device **361**.

[0217] Audio output **368** may also be transmitted through the knee cover **370** to be heard to come from the knee cover **370**.

[0218] In a further form, sound may come from both the portable digital communications device **361** and knee cover **370** so both will have audible hardware available.

[0219] In a particular form the knee cover **370** may also include an inner sleeve **375** in the knee cover **370** that has the ability to release pain medication to the joint and deliver other therapies on instruction from and under the control of application **372**.

[0220] The inner sleeve **375** of the knee cover **370** may have the ability to receive an ice pack therewithin for reacting to temperature variations as indicated by the sensors. In one form, the user may be signalled to obtain and insert an ice pack into the inner sleeve **375** of the knee cover **370**.

[0221] In this instance the application **372** may be given a convenient name in order to assist the user to relate to the apparatus—for example 'Halo Buddy'.

[0222] The knee cover **370**, will interface with a portable digital communications device **361** associated with the user. In one form, the Halo buddy may be on continuously and ready to answer questions or ask questions based on the Biometric data it is receiving from the knee cover **370**.

[0223] In one form the apparatus may be considered as an audible rehabilitation system. In one form, the system does not show exercises. Rather the system (termed HALO buddy) guides the user by means of audio prompts from the audio output **368** based on the movement it detects the user is doing, correcting and encouraging the user. The audible reactive technology acts like a personal physical therapist, nurse and surgeon.

[0224] In one form, the apparatus **300** or the portable digital communications device **361** may be implemented by way of a third party interactive assistant combined with an application. In this instance, this application may reside on a server or related device provided for use in association with the third party interactive assistant.

[0225] Audible two way feedback that is reactive to sensor information is a distinguishing characteristic of at least some forms of the present invention.

[0226] It may be thought of as Siri or Google Home for pre, peri and post-operative recovery.

[0227] In one form, the third party interactive assistant may be the 'Google Home' device marketed by Alphabet Corporation of the USA.

[0228] In an alternative form, the third party interactive assistant may be the 'Siri Assistant' device marketed by Apple Corporation in the USA.

[0229] In the case of the audio interactive assistant capability of example 1 an advantage is that it supports a user more in the capacity of a friend. Screen prompts or visual indications do not exhibit this capacity. The process of rehabilitation is thereby humanized and connects the professional to the user.

[0230] In a further form, the device is in the form of a cuff or cover that goes over or around a body part that is required to be supported and cared for post operatively. This can be for example a cover over the knee that fits the knee joint, filled with sensors that 'subconsciously" monitor the patient. It is only when there is a requirement to interact, for example: An abnormal temperature or an exercise to be done that the Halo Buddy will ask the user a question to get more detail to interpret this. The Halo buddy can be asked any recovery based questions at any time by the user.

[0231] Stated another way in one form there is provided a device in the form of a simple knee brace that is filled with sensors.

[0232] Temperature

[0233] Motion

[0234] Pressure

[0235] Time

[0236] Pain

[0237] Device+Ai=Halo Buddy

The Ai is the buddy: an all knowing, all monitoring source for the user pre operative, peri operative and post operative.

- **[0238]** 1. Ai talks to the person in the tone and mannerism of a friend
- **[0239]** 2. English speaking first (multi-lingugal in the future)
- **[0240]** 3. Takes on Hospital and Surgeon specific information
- **[0241]** 4. Feeds back into a monitoring system. Ie. Temp control, pain monitoring, exercise so it can feedback to the patient as a Physio or Health professional would. Ie. You have done 1 km of walking today, so tomorrow your knee may be a little sore and even slightly swollen. Ai platform feeds back and reassures the patient, says to ice the knee, times the ice and subconsciously runs health checks on the knee for the next 24, 48, 72 hrs. Any detected abnormal ranges, which are prolonged, would require a first check via Ai, then if persistent the Ai device would ring a health professional and give the monitored information. If requested they would schedule an appointment and then ask the patient to go in to see the health professional for a review.
- **[0242]** 5. We get the professional involved, only when there is a problem. Until then you are monitored by a feedback system that detects and checks, sometimes through asking you a question, sometimes through using the monitors in the knee brace.
- **[0243]** 6. Ai that learns when the patient likes to exercise, when they need a day off, when they need to be motivated to do their exercises.
- **[0244]** 7. A system that moves with the patient, ie. Exercise anywhere, no restrictions to sensors in the home, standing in front of the tv ect.
- **[0245]** 8. Ios and Android

[0246] In Use

[0247] A user may use the apparatus **300** as referenced under Example 1 above as follows:

[0248] a) In the case of wishing to provide use of the system in relation to the knee, a knee cover **370** will be provided and the user will slide the knee cover over the knee.

[0249] b) The knee cover **370** will include the apparatus **300** for monitoring anatomical and physiological parameters of the body of the user (in this case, the knee).

[0250] c) The user will download an application **372** to their portable digital communications device **361**, in this case a smart phone.

[0251] d) The user will conduct an initial enrolment guided by the application **372**.

[0252] e) Thereafter the user may proceed about their daily life.

[0253] In an alternative form the application download and intimal enrolment may occur in a clinical setting. For example, a health professional may conduct the application download and initial enrolment whilst the user is in the clinical setting (for example, a patient in a hospital or the like setting). It may then require the user to conduct a subsequent enrolment session or follow up enrolment session when they return to their home environment.

[0254] The user will receive audio prompts periodically as described above either to conduct specific exercises or audio prompts in the form of enquiries or encouragement.

[0255] The audio prompts may request the user to conduct certain activities—the example given above was to obtain an ice pack for insertion into the knee cover **370** to assist with rehabilitation/recovery resulting from local sourced information **366** sensed by the apparatus **300** and transmitted as a short range signal **363** in this instance to the portable digital communications device **361** and then via the long range signal **364** to the AI engine **369** whereby the AI engine **369** instigates the audio prompt to conduct the activity by way of a return long range signal and short range signal.

[0256] Other activities instigated by the AI engine **369** may include administration of pain medication as also described earlier.

How does it help the User

[0257] A user may benefit from the use of apparatus **300** as referenced under Example 1 above as follows:

[0258] Recovery

[0259] Reduce post operation complications

[0260] Support

[0261] Help when needed

[0262] Answer the questions as they come up, as and when they come up (don't have to save them up for the next surgeon check up)

[0263] Empowerment

[0264] Motivation

[0265] Knowledge to recover optimally

[0266] To feel cared for

[0267] Monitored

[0268] A friend

[0269] Reminders of post operation rules: 1 week until you can drive again.

[0270] Reminders (take out stitches, follow up needed, appointment reminder if already made in diary)

[0271] Recover is done with the patient, 24/7, monitored like never before

[0272] Base info: implant type, surgeon name that they can ask Halo buddy.

SUMMARY

[0273] The apparatus **300** associated with the knee cover **370** as described with reference to example **1** may be used for other joints or regions of the body.

[0274] The AI engine **369** and system including apparatus **300** may be applied by way of further example to the shoulder and hip and knee.

[0275] The main thing is that we are bringing to life the concept of HUMANIZING the pre-operative, peri-operative and post-operative process through use of audible Ai, which will react when spoken to by the patient and when speaks to the patient when required to clarify information from which the Ai buddy receives from input from the sensors the patent has in the knee cover/brace that they are wearing.

[0276] Importantly the concept is also that the patient does not, in any way, think or know about the measures happening from the sensors inside their knee cover/brace, they are being monitored **24/7** and do not need to worry about the readings or check and record them at all. This is the beauty of Halo buddy, it does it all for you, and standardises recovery by primarily using objective data (heat,BP, range of motion ect) input, versus taking in subjective data from the patient. We could come up with a unique term to place in the continuation around "subconscious tracking or monitoring", where by Ai is doing the monitoring versus the patient.

[0277] The reach that H**3** will have great impact. We get to reach rural patients and 3rd world patients and offer them the knowledge of a Physical Therapist, Surgeon and Nurse on hand for them, to take home within the Halo buddy Ai system to help them recover optimally and feel supported throughout their recovery. We are also de-centralising health care by using this tech at home to assist with the patients versus utilising health care workers and taking up hospital beds/space as this will reduce hospital admissions and calls to hospitals given we can calm and support the patient exactly as something happens and we can monitor things like temperature and flag easily infections to fix prior to having to go back into surgery to fix these.

[0278] It will be appreciated by those skilled in the art that variations and modifications to the invention described herein will be apparent without departing from the spirit and scope thereof. The variations and modifications as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of the invention as herein set forth.

[0279] In particular, the knee cover **370** represents just one example of use of embodiments of the invention.

[0280] Throughout the specification and claims, unless the context requires otherwise, the word "comprise" or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0281] Throughout the specification and claims, unless the context requires otherwise, the term "substantially" or "about" will be understood to not be limited to the value for the range qualified by the terms.

[0282] It will be clearly understood that, if a prior art publication is referred to herein, that reference does not constitute an admission that the publication forms part of the common general knowledge in the art in Australia or in any other country.

1. Interactive support apparatus for measuring anatomical and physiological parameters of a body of a user and providing localised audio feedback to the user based on signals derived from measuring the anatomical and physiological parameters of the body;

said apparatus providing localised audio feedback to the user;

the feedback derived from local sourced information.

2. Interactive support apparatus of claim **1** wherein the feedback is additionally derived from external sourced information.

3. The apparatus of claim **2** wherein the external sourced information is determined from the local sourced information.

4. The apparatus of claim **2** wherein the external sourced information is determined from the local sourced information and from an AI Engine;

the AI engine acting on signals derived from the local sourced information and the external sourced information.

5. An interactive support method for measuring anatomical and physiological parameters of a body of a user and providing localised audio feedback to the user based on signals derived from measuring the anatomical and physiological parameters of the body;

said method providing localised audio feedback to the user;

the feedback derived from local sourced information.

6. The method of claim **5** wherein the feedback is additionally derived from external sourced information.

7. The method of claim **5** wherein the external sourced information is determined from the local sourced information.

8. The method of claim **6** wherein the external sourced information is determined from the local sourced information and from an AI Engine;

the AI engine acting on signals derived from the local sourced information and the external sourced information.

9. A method for measuring anatomical and physiological parameters of a body; said method comprising sensing at least one anatomical or physiological parameter of a body thereby to output a signal comprising a measurement of at least one anatomical or physiological parameter; said processor further including the step of transmitting the signal to an external location' wherein the external location comprises a portable digital communications device; wherein the external location comprises a database; wherein the database includes a AI Engine; wherein the portable digital communications device is in bidirectional communication with the communications module;

wherein the database is in bidirectional communication with the communications module; said method further including an audio output device whereby the apparatus provides interactive audio guidance to a user.

10. The method of claim **9** wherein the signal is a short range signal.

11. The method of claim **9** wherein the sensor comprises one or more of accelerometer, Magnetometer, GPS Unit, EGC Sensor, Blood Pressure Sensor, Temperature Sensor, Range of Motion Sensor.

12. The method of claim **9** wherein the sensor is incorporated within a cuff.

13. The method of claim **9** wherein the sensor is incorporated in a cover.

14. The method of claim **13** wherein the sensor is incorporated in a joint cover.

15. The method of claim **13** wherein the sensor is incorporated in a knee cover.

* * * * *

专利名称(译)	用于测量身体的解剖学和生理学参数的装置和方法		
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摘要(译)

一种用于测量身体解剖角度的设备 20 ，包括用于对准轴 22 的对准装置 b>具有身体解剖学界标的装置 20 ，用于感测轴 22 的方向 30 ，而轴 22 与界标对齐，并且处理装置 40 用于处理感测到的取向。 还公开了一种交互式支持设备，用于测量用户身体的解剖学和生理学参数，并基于从测量身体的解剖学和生理学参数得到的信号向用户提供局部音频反馈;所述装置向用户提供本地化的音频反馈;来自本地来源信息的反馈。