



(11)

**EP 2 675 348 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:

**06.11.2019 Bulletin 2019/45**

(21) Application number: **12747239.7**

(22) Date of filing: **17.02.2012**

(51) Int Cl.:

<b>A61B 5/02</b> <small>(2006.01)</small>	<b>A61B 5/00</b> <small>(2006.01)</small>
<b>A61B 5/0205</b> <small>(2006.01)</small>	<b>A61B 5/024</b> <small>(2006.01)</small>
<b>A61B 5/029</b> <small>(2006.01)</small>	<b>A61B 5/0404</b> <small>(2006.01)</small>
<b>G06F 1/16</b> <small>(2006.01)</small>	<b>A61B 5/021</b> <small>(2006.01)</small>
<b>A61B 5/053</b> <small>(2006.01)</small>	<b>A61B 5/08</b> <small>(2006.01)</small>
<b>A61B 5/11</b> <small>(2006.01)</small>	<b>A61B 5/145</b> <small>(2006.01)</small>

(86) International application number:

**PCT/US2012/025648**

(87) International publication number:

**WO 2012/112891 (23.08.2012 Gazette 2012/34)**

(54) **MODULAR WRIST-WORN PROCESSOR FOR PATIENT MONITORING**

MODULARER ARMBAND-PROZESSOR ZUR PATIENTENÜBERWACHUNG

PROCESSEUR PORTÉ AU POIGNET MODULAIRE POUR LA SURVEILLANCE DE PATIENT

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB  
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO  
PL PT RO RS SE SI SK SM TR**

(30) Priority: **18.02.2011 US 201161444285 P**

(43) Date of publication of application:

**25.12.2013 Bulletin 2013/52**

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## Description

### BACKGROUND OF THE INVENTION

**[0001]** The following discussion of the background of the invention is merely provided to aid the reader in understanding the invention and is not admitted to describe or constitute prior art to the present invention.

**[0002]** Blood pressure is a vital sign often considered to be a good indicator of a patient's health. In critical care environments like the ICU and OR, blood pressure can be continuously monitored with an arterial catheter inserted in the patient's radial or femoral artery. Alternatively, blood pressure can be measured intermittently with a cuff using oscillometry, or manually by a medical professional using auscultation. Many patient monitors perform both the catheter and cuff-based measurements of blood pressure.

**[0003]** Blood pressure can also be monitored continuously with a technique called pulse transit time (PTT), defined as the transit time for a pressure pulse launched by a heartbeat in a patient's arterial system. Typical PTT measurements determine the time separating a maximum point on the QRS complex (indicating the peak of ventricular depolarization) and a foot of the PPG waveform (indicating the arriving pressure pulse). PTT depends primarily on arterial compliance, the propagation distance of the pressure pulse (which is closely approximated by the patient's arm length), and blood pressure.

**[0004]** PTT has been shown in a number of studies to correlate to systolic (SYS), diastolic (DIA), and mean (MAP) blood pressures. PTT can be measured with a patient monitor that includes separate modules to determine both an electrocardiogram (ECG) and SpO<sub>2</sub>. During a PTT measurement, multiple electrodes typically attach to a patient's chest to determine a time-dependent ECG component characterized by a sharp spike called the 'QRS complex'. The QRS complex indicates an initial depolarization of ventricles within the heart and, informally, marks the beginning of the heartbeat and a pressure pulse that follows. International Patent Application No. PCT/US2010/048866, describes a body-worn monitor that continuously measures a plurality of vital signs from a patient. The body-worn monitor features a series of sensors that attach to the patient to measure time-dependent PPG, ECG, accelerometer-based motion (ACC), oscillometric (OSC), respiratory rate (RR), and impedance pneumography (IP) waveforms. A wrist-worn microprocessor (CPU) continuously processes these waveforms to determine the patient's vital signs, degree of motion, posture and activity level. Sensors that measure these signals typically send digitized information to a wrist-worn transceiver through a serial interface, or bus, operating on a controlled area network (CAN) protocol. The CAN bus is typically used in the automotive industry, which allows different electronic systems to effectively and robustly communicate with each other with a small number of dropped packets, even in the presence of elec-

trically noisy environments. This is particularly advantageous for ambulatory patients that may generate signals with large amounts of motion-induced noise.

**[0005]** US patent application US 2010/0168589 A1 discloses a technique for continuous measurement of blood pressure based on pulse transit time and which does not require any external calibration. This technique is carried out with a body-worn monitor that measures blood pressure and other vital signs, and wirelessly transmits them to a remote monitor. A network of body-worn sensors placed on the patient's body connects to the body-worn monitor and measure time-dependent ECG, PPG, accelerometer, and pressure waveforms.

**[0006]** It is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of embodiments in addition to those described and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein, as well as the abstract, are for the purpose of description and should not be regarded as limiting.

**[0007]** As such, those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other structures, methods and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they fall within the scope of the claims.

### SUMMARY OF THE INVENTION

**[0008]** It is an object of the present invention to provide a body-worn data processing system for determining/monitoring physiological properties of the wearer. The system comprises a housing which contains the processor module, and a separate plastic casing which receives the housing. The processor module is sealed in a water-proof plastic fashion within the housing, which provides openings to access electrical interconnects operably connected to the processor module. During operation, the housing snaps into a separate plastic base (or "cradle"). Upon mating of the housing and the base, interface cavities, or "ports," are formed for receiving the terminal ends of data cables leading to and/or from one or more sensors which collect data related to the physiological properties of interest. The ports may also provide connection to one or more peripheral devices such as blood pressure cuffs, wireless communication hardware, etc. Insertion of a terminal end into such a port establishes electrical communication between the port's corresponding electrical interconnects and the cable, thereby permitting electrical communication between the processor module and the corresponding sensor or peripheral device. In certain embodiments, the communications between the processor, sensors, and any peripherals con-

nected through the ports are configured as a peer-to-peer network such that each device on the network is an equally privileged, equipotent participant node which can simultaneously function as both "clients" and "servers" to the other nodes on the network.

**[0009]** The design described herein facilitates activities such as cleaning and disinfection of the processor module, as housing contains no openings for fluids common in the hospital, such as water and blood, to flow inside. During a cleaning process the housing may simply be detached from the cradle and then cleaned. In addition, wear components, such as the tabs described above, can be provided on the cradle such that the majority of wear components are located on an inexpensive disposable unit while the relatively more expensive electronic components provide for multiple uses. Finally, the peer-to-peer architecture permits each node to communicate with, and so synchronize as necessary, with the other nodes available on the system.

**[0010]** In a first aspect, the invention provides a body-worn physiological data processing system, comprising:

a housing supporting electronic circuitry, the housing providing a waterproof enclosure for the electronic circuitry, the electronic circuitry comprising: one or more processors configured to receive data from, and export data to, one or more peripheral devices external to the housing, and to use data received from one or more of the peripheral devices in deriving a measurement of at least one physiological property of the wearer,

a display operably connected to the processor to display data received by the processor from one or more of the peripheral device(s), or a processed form thereof,  
 a power supply operably connected to the processor and display, and  
 one or more electrical contacts proximate to one or more openings in the housing and operably connected to the processor to provide one or more connections through which the processor receives data from, and exports data to, the one or more peripheral devices; and

(b) a base, or "cradle," configured to releasably receive the housing, wherein when the housing is inserted into the base, one or more interface cavities are formed between the base and the housing.

wherein each interface cavity is adapted to establish an operable connection between one of the peripheral device(s) and the processor through a data cable connected to the peripheral device by insertion of a connector on the data cable into the interface cavity such that electrical contacts on the connector interconnect with a corresponding electrical contact on the housing,

**[0011]** The base and housing can be mated with a pos-

itive latch, or may be mated by a simple friction fit, or by a combination of these. In the case of a friction fit, the friction fit is preferably strong enough to prevent separation of the base and housing under the force of gravity.

5 In certain embodiments, at least one interface cavity formed by mating of the housing and the base comprises a latch mechanism which acts to prevent separation of the base from the housing when a connector is inserted fully into the cavity. In preferred embodiments, this latch mechanism comprises at least one first recess in a wall of the interface cavity provided by the base, and at least one second recess in a wall of the interface cavity provided by the housing. The first and second recesses are configured to receive a portion of the connector when it is inserted which acts similarly to a latch bolt on a conventional lock to physically restrain separation of the base and housing until the connector is removed.

**[0012]** In certain embodiments, the base comprises a reclosable tape or retaining strap for reversibly fixing the data processing system to the wearer. In these embodiments, openings may be provided in the base through which such a strap can thread. Other alternatives for affixing the strap include bonding materials such as adhesives, ultrasonic welds, etc. The strap may comprise mated hook-and-loop patches or similar fastening elements such as tapes, snaps, buckles, etc., to secure the system to the wearer's body during use.

**[0013]** Preferably, the base is designed as a disposable component which receives an electronics housing preferably designed for multiple uses. As used herein, the term "disposable" with regard to the base refers to the characteristic that the base may be disengaged from housing in the course of normal use by the user of the system such that the electronics may be easily separated from, and need not be discarded with, the base. This can serve to place the device components of the system most susceptible to wear and cleanability issues on a disposable unit, while retaining the more expensive electronic components on an easily cleanable and reusable unit.

**[0014]** As noted above, the housing provides a waterproof enclosure for the electronic circuitry contained within the housing. The IP Code system defined in international standard IEC 60529 classifies the degrees of protection provided against the intrusion of solid objects (including body parts like hands and fingers), dust, accidental contact, and water in electrical enclosures. Preferably, the housing meets IEC 60529-2004 IPX7 standards, which provides that ingress of water in harmful quantity shall not be possible when the enclosure is immersed in water under up to 1 m of submersion for up to 30 minutes.

**[0015]** The connector may be held in the port by a friction fit, or may utilize a locking mechanism such as that of a standard RJ-45 modular connector which comprises a resilient tab which snap-fits into a recess on the housing. Removal of the connector is accomplished by simply pulling on the connector with sufficient force, or by disengaging the resilient tab from the recess prior to pulling. In preferred embodiments, a port can comprise a tab

which exhibits a spring force and which flexes during insertion of a terminal end, and springs back when the terminal end is fully inserted for receiving and holding the cable in its proper orientation to establish data communication.

**[0016]** In certain embodiments, the processor is configured to derive a measurement of at least one physiological property of the wearer selected from the group consisting of heart rate, electrical activity of the heart, temperature, SpO<sub>2</sub>, blood pressure, cardiac stroke volume, cardiac output, motion, activity, posture, pulse rate, and respiration rate. Peripheral devices such as sensors to be connected to the system are selected appropriately for the physiological properties of interest. The peripheral devices which may be pluggably connected to the physiological data processing system may be selected from the group consisting of a body-worn optical probe adapted to measure at least one optical signal detected after interaction with the wearer's tissue, an accelerometer, a pump module configured to inflate a blood pressure cuff, an ECG sensor, an ICG sensor, and a temperature sensor. As noted, each peripheral device is adapted to establish an operable connection with the processor through a data cable connected to the peripheral device by insertion of a connector on the data cable into the interface cavity. This data cable can carry I/O signals to and from the peripheral, and preferably also provides power to one or more peripherals from a power supply contained within the housing. By powering a peripheral from the body worn housing, the peripheral may be made lighter, less expensive, and more readily disposable. It is not necessary that each peripheral be so powered; for example a first peripheral may be controlled and powered by the physiological data processing system, while a second peripheral may be controlled by the physiological data processing system but powered by its own on-board battery.

**[0017]** As noted above, the communications between the processor, sensors, and any other peripherals connected through the ports are configured as a peer-to-peer network such that each device on the network is an equally privileged, equipotent participant node which can simultaneously function as both "clients" and "servers" to the other nodes on the network. In preferred embodiments, the nodes communicate through a serial interface, or bus, operating on a controlled area network (CAN) protocol. The CAN bus, which is typically used in the automotive industry, allows different electronic systems to effectively and robustly communicate with each other with a small number of dropped packets, even in the presence of electrically noisy environments. This is particularly advantageous for ambulatory patients that may generate signals with large amounts of motion-induced noise.

**[0018]** In certain embodiments, the physiological data processing system comprises a transceiver for wirelessly communicating with a data acquisition system external to the body-worn physiological data processing system.

In these embodiments, the necessary communications hardware may be provided within the housing, or may be external, e.g., provided as a "dongle" which pluggably inserts into one of the interface cavities formed by the housing and the base, or may be provided partially within the housing and partially externally. Provision of the communications hardware as an external pluggable component can provide additional flexibility in configuration for the end user.

**[0019]** The system may utilize one or more electronic connectors adapted to insert into an interface cavity and which act as "keys" to unlock menus within the processing system which are not otherwise available to the user. Examples of such key connectors include "mode connectors" which enable certain special modes including, but not limited to a sleep mode (disabling the system, for example during shipping), a manufacturer mode (permitting a manufacturer to interact with the system for calibration, servicing, etc.), a demo mode (permitting the unit to display a pre-programmed demonstration), and a biomedical mode (permitting a hospital or other care site access to settings generally not available to a patient).

**[0020]** Advantageously, the system may also utilize one or more non-electronic "dummy" connectors adapted to insert into an interface cavity which is not in operable use. These plugs can serve to protect the structures within an interface cavity and, in the case of a system utilizing connectors to provide a latch between the base and the housing, can serve as a latch when no electrically active connector is being employed by the user.

**[0021]** A number of additional features may be incorporated into the electronics contained within the housing. By way of non-limiting example, the display may provide a touch-screen interface for data entry to the processor; a microphone and speaker configured for two-way voice communication may be provided; a voice over Internet protocol (VOIP) communication protocol may be provided; etc.

**[0022]** Mis-connection of medical devices by medical workers due to the use of common connectors across different device types is increasingly understood as both a source of patient injury and damage to equipment. Thus, in certain embodiments, the interface cavity comprises a "key" structure, and the corresponding connector is adapted to match the key structure to reduce the risk of insertion of an incompatible connector into an interface cavity. For example, the base may comprise a raised element in the wall of the interface cavity which is matched by a recess in the appropriate connector. Incompatible connectors lacking the appropriate recess and interface dimension would be physically prevented from insertion. This description is by way of example only and is non-limiting on the types of lock-and-key structures which may be used.

**[0023]** In related aspects, the present invention provides a base configured to releasably receive a housing supporting a processor, wherein when the housing is inserted into the base, one or more interface cavities are

formed between the base and the housing, each interface cavity comprising one or more electrical contacts on the housing operably connected to the processor, and each interface cavity adapted to receive an electrical connector which makes sliding contact with the electrical contacts within the interface cavity to establish an operable connection between a peripheral device and the processor, the base comprising:

a latch mechanism at a first end of the base, the latch mechanism comprising at least one recess in a portion of the base which forms part of a first interface cavity,

said first recesses configured to receive a portion of the electrical connector when inserted;

a tab on a portion of the base which forms part of the first interface cavity, the tab configured to insert into a recess on the electrical connector when inserted and

thereby position the connector into a recess on a portion of the housing which forms part of the first interface cavity;

a tab at a second end of the base which is configured to insert into a corresponding opening in the housing when mated thereto;

wherein insertion of the electrical connector into the first interface cavity so that the connector is positioned into the recess on the housing prevents separation of the base from the housing until the connector is removed.

**[0024]** Still other embodiments are found in the following detailed description of the invention, and in the claims.

#### BRIEF DESCRIPTION OF THE DRAWINGS

##### **[0025]**

Fig. 1 shows a three-dimensional mechanical drawing of an exemplary processor module housing and base module of the present invention, depicting a mode of mating the processor module housing to the base module.

Fig. 2 shows an alternative view of a three-dimensional mechanical drawing of an exemplary processor module housing and base module of the present invention.

Fig. 3 shows a detailed view of a base module of the present invention.

Fig. 4 shows a series of sectional views of the base module shown in Fig. 3.

Fig. 5 shows a three-dimensional mechanical drawing depicting the top and bottom halves of an exem-

plary connector shell for use in the present invention. Fig. 5 shows a three-dimensional mechanical drawing of a completed connector for use in the present invention.

Fig. 7 shows a three-dimensional mechanical drawing depicting the bottom half of an exemplary processor module housing of the present invention.

Fig. 8 shows a three-dimensional mechanical drawing depicting one view of a completed processor module housing of the present invention.

Fig. 9 shows a pair of three-dimensional mechanical drawings depicting the mode of insertion of a connector as shown in Fig. 5 into the mated processor module housing and base module as shown in Fig. 1.

#### DETAILED DESCRIPTION OF THE INVENTION

**[0026]** Figs. 1 and 2 depict a top and bottom view of a base 100, and housing 101 which releasably attaches thereto, for use in the body-worn data processing system of the present invention. The housing provides a waterproof plastic casing housing a processor (the "system processor") and associated electronics (collectively the housing and the associated electronics being referred to herein as a "processing module"), and features openings on the underside that provide access to electrical interconnects that interface to connectors at the terminal ends of cables leading to the system's various sensors and other peripherals. In addition to being waterproof, this design facilitates activities such as cleaning and disinfection, as the housing contains no openings for fluids common in the hospital, such as water and blood, to flow inside.

**[0027]** The base is preferably designed as a disposable component which receives an electronics housing preferably designed for multiple uses. As used herein, the term "disposable" with regard to the base refers to the characteristic that the base may be disengaged from the housing in the course of normal use by the user of the body-worn data processing system such that the housing may be easily separated from, and need not be discarded with, the base. This can serve to place the system components most susceptible to wear and cleanliness issues on a disposable unit, while retaining the more expensive electronic components in an easily cleanable and reusable unit.

**[0028]** During use, the housing reversibly snaps into the plastic base. Upon mating of the housing and the base, interface cavities, or "ports," are formed for receiving the terminal connectors of data cables leading to and/or from one or more peripheral devices such as sensors which collect data related to the physiological properties of interest. Insertion of a terminal connectors into such a port establishes electrical communication between the port's corresponding electrical interconnects and the cable, thereby permitting electrical communication between the system processor and the corresponding sensor or peripheral device. When mated, the hous-

ing and base are releasably attached; likewise, when a connector is inserted into a port, the connector and the port are releasably attached. As used herein, the terms "releasably attached" and "releasably receive" refers to two separate modules which may be engaged with and disengaged from one another in the course of normal use.

**[0029]** Figs. 3 and 4 depict base 100 in more detail. Openings 302 a, b and c positioned at a first end of the base, and a larger opening 303 positioned at a second end of the base, are configured to receive appropriately constructed terminal connectors, which are described in more detail below. The base provides a bottom wall and side walls for each interface cavity which receives a connector, while the waterproof electronics housing, when mated to the base, provides a top wall which includes electrical interconnects which are in sliding contact with the conductors of the terminal connector.

**[0030]** A tab 312 (also shown in cross section in Fig. 4, 402) fits into a groove in the housing to secure the first end of the base in the housing. Raised areas 313 and 314 at the second end of the base provide a friction fit for the housing; the tightness of this friction fit may be controlled by the thickness and flexibility of these raised areas. Preferably, the friction fit is sufficiently tight that the base can be inverted with the housing in place without the housing disengaging from the base.

**[0031]** Opening 303 (which in this example accommodates a terminal connector having 8 electrical interconnects) is capable of receiving a larger terminal connector than are openings 302 a, b and c (which each accommodate a terminal connector having 4 electrical interconnects). Opening 303 includes in its lateral walls recesses 304 and 305 (also shown in cross section in Fig. 4, 404 and 405). These recesses are configured to receive extensions (Fig. 6, 603 and 605) at the edge of the terminal connector when it is inserted into the interface cavity. A tab 311 that exhibits a spring force due to its material composition (thickness and stiffness of the material forming the tab) flexes during insertion of the terminal connector, and springs back when the terminal connector is fully inserted into the interface cavity.

**[0032]** A raised portion of this tab (shown in cross-section in Fig. 4, 401) inserts into a depression in the bottom surface of the terminal connector (Fig. 6, 602), thereby forming a detent to provide positive location of the terminal connector when in its proper position. In this position, the electrical conductors of the terminal connector are in sliding contact with the corresponding electrical interconnects on the housing, and the distal end of the terminal connector (Fig 6, 606) is inserted into a recess in the housing (Fig 8, 801). So inserted, the housing is secured at one end by tab 312, while at the other end the terminal connector 600 forms a "deadbolt" lock due to insertion of its distal end 606 into recess 801 and insertion of extensions 603 and 605 into lateral walls recesses 304 and 305. This "latch" prevents removal of the housing from the base until the terminal connector 600 is removed. Once the terminal connector is removed, the base and

housing may be separated by simply lifting the housing from the base.

**[0033]** Like opening 303, each of openings 302 a, b, and c also contain a tab that flexes during insertion of the terminal connector, and springs back when the terminal connector is fully inserted into the interface cavity. A raised portion of this tab (shown in cross-section in Fig. 4, 401) inserts into a depression in the bottom surface of the terminal connector (Fig. 5, 504) to form a detent to provide positive location of the terminal connector when in its proper position. In this position, the electrical conductors of the terminal connector are in sliding contact with the corresponding electrical interconnects on the housing. These connectors, however, do not participate in the "latch" mechanism.

**[0034]** Raised posts 306, 307, 308, and 309 in each interface cavity provide a keying mechanism to prevent inadvertent insertion of an incompatible terminal connector. Each terminal connector has a corresponding slot (Fig. 5, 503; Fig 6, 604) which is adapted to receive the raised post. A similarly sized connector lacking this slot would be prevented from insertion. It is preferred that this keying mechanism be unique as compared to other electrical cable connectors used in the particular care setting to limit chances for inadvertent insertion of an incorrect cable connector.

**[0035]** To affix the base to a wearer, slots (Fig. 3, 310; Fig. 4, 403) are provided through which a strap may be threaded. This strap may be sized according to the body location to which the base is to be affixed. A preferred site is the wrist of the wearer.

**[0036]** Figs. 5A and B show the top and bottom halves of a data cable connector 500 configured to insert into one of openings 302 a, b, and c without the associated cable hardware. An opening 501 allows the cable leads to pass into the connector, and spring-tension "sliding" or "wiping" electrical contacts (similar to those of a standard modular RJ-45 cable) are positioned in opening 502. The connector is conveniently made as a 2-piece component for ease of cable attachment. As noted above, slot 503 and detent recess 504 serve to position the connector in its proper orientation and in a compatible interface recess.

**[0037]** Fig. 6 shows the bottom surface of a completed data cable connector 600 configured to fit larger opening 303. Cable 601 extending from a peripheral (not shown) enters the connector at its proximal end, relative to distal end 606 which forms part of the latch mechanism described above. Spring-tension "sliding" or "wiping" electrical contacts are positioned on the top surface of the connector (not shown). In some cases, it may be desirable to latch the housing and base together without the use of a data cable. In this case, a "dummy" connector lacking cable 601 and the associated wiring and electrical contacts may be provided. This dummy connector will comprise slot 604, detent recess 602, distal end 606, and extensions 605 and 603 to support insertion into opening 303. As in the case of connector 600, the dummy con-

nectors will provide a latch preventing removal of the housing from the base until the dummy connector is removed.

**[0038]** Figs. 7 and 8 show the underside of bottom portion of the housing. When mated to the base, contact pads 701 a and b and 702 overlay openings 302 a, b, and c in the base, thus forming the electrical interconnects that interface to the terminal connector at the end of cables. As noted above, openings 302 a, b, and c are sized to accommodate a connector having four electrical contacts, and contact pads 701 a and b contain a corresponding number of electrical interconnects. In contrast, contact pad 702 contains 8 electrical interconnects. The central four interconnects interface to the terminal end of a cable inserted into opening 302 b, and when the housing is mated to the base, the other four electrical connectors are unavailable. However, when the housing is separated from the base, these additional four contacts can provide for additional electrical access to the electronics within the housing. These additional four contacts can be used, for example, for battery charging, and a separate battery charging station which is adapted to receive the housing can be provided for this purpose.

**[0039]** Similarly, contact pad 802 overlays opening 303 in the base, thus forming the electrical interconnects that interface to the terminal connector of the larger cable. As discussed, opening 303 is sized to accommodate a connector having eight electrical contacts, and contact pad 802 contains a corresponding number of electrical interconnects. Fig. 9 depicts the releasable insertion of connector 902 into the interface cavity formed between opening 303 and contact pad 802 when the housing is mated to the base. Connector 902 is inserted until the detent depression 904 snaps into the ridge on tab 903. At this point, the distal end of the connector is inserted into recess 801, forming the latch which retains the housing in the base until the connector is removed.

**[0040]** Suitable electronics to be provided within the housing is described in detail in International Patent Application No. PCT/US2010/048866, International publication WO2010/135518, U.S. publication US20090018453A1, and U.S. publication US20100168589A1. The electronics preferably support serial communication through the CAN protocol. This allows the system processor to easily interpret signals that arrive from the various sensors, and means that the interface cavities need not be associated with a specific cable; any cable can be plugged into any compatible port. Furthermore, because the CAN protocol supports peer-to-peer connection of the peripherals, these peripherals may communicate directly with one another, for example for purposes of synchronization. Digital information generated by the attached peripherals can include a header that indicates the identity or origin of the signals so that the system processor can process them accordingly.

**[0041]** A variety of peripheral devices may communicate with the processing module. For example, a cable may transport I/O signals to/from an ECG circuit and electrodes; accelerometers; a cuff-based system for deter-

mining blood pressure values; a glucometer; an infusion pump, a body-worn insulin pump; a ventilator; an end-tidal CO<sub>2</sub> monitoring system; a pulse oximeter or other optical physiological probe; and a thermometer. This list is not meant to be limiting. Using one or more of these inputs, the processing system can determine one or more physiological properties associated with the wearer, such as heart rate, electrical activity of the heart, temperature, SpO<sub>2</sub>, blood pressure, cardiac stroke volume, cardiac output, medication dosage, patient weight, blood glucose levels, end tidal CO<sub>2</sub>, motion, activity, posture, pulse rate, and respiration rate.

**[0042]** The processing module can include a speaker and/or microphone that allows a medical professional to communicate with the patient, using an appropriate protocol such as a voice over Internet protocol (VOIP). For example, the medical professional can query the patient from a central nursing station; the electronics carried within the housing may function much like a conventional cellular telephone or 'walkie talkie': the processing module can be used for voice communications with a medical professional and can additionally relay information describing the patient's vital signs and motion. The processing module can be configured via software to support speech-to-text annotations. By this is meant that speech generated externally can be converted into text for display on the processing module, and/or speech generated at the processing module can be converted into text at an external computer.

**[0043]** The system processor is preferably operably connected to a data input device such as a keypad or touchscreen located at the top of the housing to permit the wearer or medical personnel to interact with the system. Openings may be provided in the top of the housing for the speaker and/or microphone, as depicted in Fig. 9, 905 and 906; in order to maintain water resistance (e.g., at an IPX-7 standard), these openings may be sealed from underneath with a waterproof but breathable material such as a GORE-TEX® membrane (W. L. Gore & Associates, Inc.).

**[0044]** The electronics within the housing preferably include a battery or other power supply. Numerous battery technologies are known in the art, including common alkaline batteries, oxyride batteries, lithium batteries, etc. There are three preferred battery technologies that could be employed: Nickel Cadmium (NiCad), Nickel Metal Hydride (NiMH) and Lithium Ion (Li-ion), and most preferred are Li-ion batteries.

**[0045]** The battery can be provided in a "hot swap" configuration so that the electronics' data, wireless connections, etc., are preserved after the battery change. For example, prior to the hot swap a battery-powered dongle operating a firmware program may be plugged into one of the interface cavities. After being plugged in, the dongle sends a packet formatted according to the CAN protocol to the system processor indicating that its battery is about to be replaced with one having a full charge. The system processor receives the packet, and

in response stores in non-volatile memory information that is normally not present when a device is initially powered on. Alternatively this information can be temporarily transferred for storage to a data buffer on an external network, or on non-volatile memory associated with the dongle. Once this is complete, the system processor can signal that the battery may be replaced. The depleted battery, located on the bottom side of the housing, can now be replaced with a charged battery. After this operation is complete the system processor can be returned to its configuration before the battery swap.

**[0046]** The "hot swap" configuration may not be suitable for IPX-7 standard waterproofing of the housing. Thus, in an alternative, the processor module itself may be swapped, rather than the battery within the module. In this scenario, a first processor module currently in use should transfer its store of data about the wearer to a second replacement processor module. Advantageously, a "bumping" action can be used to transfer this data. To initiate a transfer, a person accesses a special "data transfer" mode on the first and second processor modules. Then the first and second processor modules are brought into contact with one another using a sideways "bumping" action. Sensors (accelerometers) within each processor module sense the bump, and a matching algorithm pairs processor modules that detected the same bump (in terms of time and force). If and only if the bump is confirmed on the two processor modules will the data be exchanged. Following data exchange, the second processor module replaces the first processor module on the wrist-worn base of the wearer, and the first processor module is cleaned and recharged for later use. The matching algorithm may run locally on the processing modules themselves, or may run externally on a separate network. In the latter case, the processor modules would communicate the bump characteristics to the external network for processing.

**[0047]** Preferably, the electronics of the system support wireless transfer of data from the system to an external monitor or network. For relatively short distance RF communications, Bluetooth, Bluetooth LE, ANT+, HomeRF, IEEE 802.11x (e.g., IEEE 802.11a/b/g/n), and IEEE 802.15.4 are well known exemplary standard communications protocols that may be used. For somewhat longer range data transfers, cellular telephone protocols such as CDMA, TDMA, GSM, WAP, 3G (e.g., 3GPP, W-CDMA, TD-SCDMA, HSPA+, EVDO rev B, and CDMA2000), and 4G (e.g., LTE advanced, IEEE 802.16m) may be employed. These lists are not meant to be limiting. The electronics supporting wireless communication can be contained within the housing, or may be connected in a pluggable fashion through one of the interface cavities. Moreover, peripherals may also communicate with the system processor wirelessly rather than through a data cable connected to an interface cavity.

**[0048]** One skilled in the art readily appreciates that the present invention is well adapted to carry out the ob-

jects and obtain the ends and advantages mentioned, as well as those inherent therein. The examples provided herein are representative of preferred embodiments, are exemplary, and are not intended as limitations on the scope of the invention.

**[0049]** It will be readily apparent to a person skilled in the art that varying substitutions and modifications may be made to the invention disclosed herein and that the scope of protection is as defined in the claims.

**[0050]** All patents and publications mentioned in the specification are indicative of the levels of those of ordinary skill in the art to which the invention pertains.

**[0051]** The invention illustratively described herein suitably may be practiced in the absence of any element or elements, limitation or limitations which is not specifically disclosed herein. Thus, for example, in each instance herein any of the terms "comprising", "consisting essentially of" and "consisting of" may be replaced with either of the other two terms. The terms and expressions which have been employed are used as terms of description and not of limitation, and there is no intention that in the use of such terms and expressions of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed. Thus, it should be understood that although the present invention has been specifically disclosed by preferred embodiments and optional features, modification and variation of the concepts herein disclosed may be resorted to by those skilled in the art, and that such modifications and variations are considered to be within the scope of this invention as defined by the appended claims.

**[0052]** Other embodiments are set forth within the following claims.

## Claims

1. A body-worn physiological data processing system, comprising:

(a) a housing (101) supporting electronic circuitry, the housing (101) providing a waterproof enclosure for the electronic circuitry meeting IEC 60529-2004 IPX7 standards, the electronic circuitry comprising:

a processor configured to receive data from, and export data to, one or more peripheral devices external to the housing (101), and to use data received from one or more of the peripheral devices in deriving a measurement of at least one physiological property of the wearer,  
a display operably connected to the processor to display data received by the processor from one or more of the peripheral

devices, or a processed form thereof,  
 a power supply operably connected to the  
 processor and display,  
 one or more electrical contacts (701 a, b;  
 702; 802) proximate to one or more open-  
 5 ings (302 a, b, c; 303) in the housing (101)  
 and operably connected to the processor to  
 provide one or more connections through  
 which the processor receives data from,  
 and exports data to, the one or more periph-  
 10 eral devices;

(b) a base (100) configured to releasably receive  
 the housing (101), wherein when the housing  
 (101) is inserted into the base (100), one or more  
 15 interface cavities are formed between the base  
 (100) and the housing (101),

wherein each interface cavity is adapted to  
 releasably receive a connector (600) on a  
 20 data cable (601) connected to a peripheral  
 device, thereby establishing an operable  
 connection between the peripheral device  
 and the processor through the data cable  
 (601), wherein insertion of the connector  
 (600) on the data cable (601) into the inter-  
 25 face cavity interconnects electrical contacts  
 on the connector (600) with corresponding  
 electrical contacts (701 a, b; 702; 802) on  
 the housing (101), and  
 wherein at least one interface cavity com-  
 30 prises a latch mechanism comprising at  
 least one first recess (304; 404) in a wall  
 thereof provided by the base (100), and at  
 least one second recess (801) in a wall  
 thereof provided by the housing (101), said  
 first and second recesses (304, 305; 801)  
 configured to receive a portion of the con-  
 35 nector (600) when inserted, the insertion of  
 the connector (600) thereby preventing sep-  
 aration of the base (100) from the housing  
 (101) until the connector (600) is removed;

(c) a reclosable retaining strap for reversibly fix-  
 45 ing the data processing system to the wearer.

2. The body-worn physiological data processing sys-  
 tem according to claim 1, wherein the system further  
 comprises one or more peripheral devices independ-  
 50 ently selected from the group consisting of a body-  
 worn optical probe adapted to measure at least one  
 optical signal detected after interaction with the  
 wearer's tissue, an accelerometer, an ECG sensor,  
 an ICG sensor, and a temperature sensor, wherein  
 55 each peripheral device is adapted to establish an  
 operable connection with the processor through a  
 data cable connected to the peripheral device by in-  
 sertion of a connector (600) on the data cable into

the interface cavity.

3. The body-worn data processing system according  
 to claims 1 or 2, wherein the at least one physiolog-  
 ical property is selected from the group consisting of  
 heart rate, electrical activity of the heart, tempera-  
 5 ture, SpO<sub>2</sub>, blood pressure, cardiac stroke volume,  
 cardiac output, motion, activity, posture, pulse rate,  
 and respiration rate.

4. The body-worn physiological data processing sys-  
 tem according to any of claims 1 to 3, further com-  
 10 prising a transceiver for wirelessly communicating  
 with a data acquisition system external to the body-  
 worn physiological data processing system.

5. The body-worn physiological data processing sys-  
 tem according to claim 4, wherein the transceiver  
 comprises a communications circuit which is adapt-  
 20 ed to establish an operable connection with the pro-  
 cessor by insertion into the interface cavity; or wherein  
 the electronic circuitry comprises a microphone and  
 speaker configured for two-way voice communica-  
 tion, wherein optionally the microphone and speaker  
 are operably connected to the processor for voice  
 over Internet protocol (VOIP) communication.

6. The body-worn physiological data processing sys-  
 tem according to claim 1, wherein the interface cavity  
 30 comprising a latch mechanism further comprises a  
 tab (311) on a surface of the base (100), the tab (311)  
 configured to insert into a recess (602) on the con-  
 nector (600) when inserted and thereby position the  
 connector (600) into the second recess (801).

7. The body-worn physiological data processing sys-  
 tem according to claim 1, further comprising a plug  
 adapted to insert into an interface cavity which is not  
 35 in operable use, wherein the plug is not electrically  
 active.

8. The body-worn physiological data processing sys-  
 tem according to claim 7, wherein the plug is adapted  
 to insert into an interface cavity comprising a latch  
 40 mechanism, the insertion of the plug thereby pre-  
 venting separation of the base (100) from the hous-  
 ing (101) until the plug is removed.

9. The body-worn physiological data processing sys-  
 tem according to claim 1, wherein the base (100)  
 45 comprises

(a) a tab (312) at a first end thereof, which inserts  
 into a corresponding opening in the housing  
 (101) when mated thereto, and wherein mating  
 of the base (100) and the housing (101) forms  
 an interface cavity comprising a latch mecha-  
 50 nism distal to the end comprising the tab (312);

or

(b) a key structure (306-309) configured to prevent insertion of an incompatible connector (600) into an interface cavity.

10. The body-worn physiological data processing system according to claim 1, wherein the display provides a touch-screen interface for data entry to the processor.

11. The body-worn physiological data processing system according to claim 1, wherein the base and strap are configured as a disposable unit.

12. The body-worn physiological data processing system according to claim 1, wherein the base (100) and the housing (101), when mated, engage one another by a friction fit having a strength sufficient to prevent separation of the base (100) and the housing (101) due to the force of gravity.

13. A base (100) configured to releasably receive a housing (101) supporting a processor, wherein when the housing is inserted into the base, one or more interface cavities are formed between the base (100) and the housing (101), each interface cavity comprising one or more electrical contacts (701 a, b; 702; 802) on the housing (101) operably connected to the processor, and each interface cavity adapted to receive an electrical connector (600) which makes sliding contact with the electrical contacts (802) within the interface cavity to establish an operable connection between a peripheral device and the processor, the base (100) comprising:

a latch mechanism at a first end of the base (100), the latch mechanism comprising at least one recess (304; 404) in a portion of the base (100) which forms part of a first interface cavity, said first recesses (304; 404) configured to receive a portion of the electrical connector (600) when inserted;

a tab (311) on a portion of the base (100) which forms part of the first interface cavity, the tab (311) configured to insert into a recess (602) on the electrical connector (600) when inserted and thereby position the connector (600) into a recess (801) on a portion of the housing (101) which forms part of the first interface cavity;

a tab (312) at a second end of the base (100) which is configured to insert into a corresponding opening in the housing (101) when mated thereto;

wherein insertion of the electrical connector (600) into the first interface cavity so that the connector (600) is positioned into the recess (801) on the housing (101) prevents separation of the base (100) from the housing (101) until

the connector (600) is removed.

14. The base (100) according to claim 13, wherein the base (100) comprises

(i) openings for attaching a reclosable retaining strap; or

(ii) a key structure (306-309) configured to prevent insertion of an incompatible connector (600) into an interface cavity; or

(iii) one or more projections (313, 314) configured to contact the housing (101) when mated thereto, wherein the one or more projections (313, 314) establish a friction fit having a strength sufficient to prevent separation of the base (100) and the housing (101) due to the force of gravity.

15. The base according to claim 13 or the body-worn physiological data processing system according to claim 1, wherein the base (100) is configured as a disposable unit.

## Patentansprüche

1. Körpergetragenes physiologisches Datenverarbeitungssystem, umfassend:

(a) ein Gehäuse (101), das eine elektronische Schaltung trägt, wobei das Gehäuse (101) ein wasserdichtes Gehäuse für die elektronische Schaltung bereitstellt, welches den Normen IEC 60529-2004 IPX7 genügt, wobei die elektronische Schaltung umfasst:

einen Prozessor, der konfiguriert ist, Daten von einer oder mehreren Peripherievorrichtungen außerhalb des Gehäuses (101) zu empfangen und Daten an diese zu exportieren, und um Daten, die von einer oder mehreren der Peripherievorrichtungen empfangen wurden, zur Ableitung einer Messung von mindestens einer physiologischen Eigenschaft des Trägers zu verwenden,

eine Anzeige, die betriebswirksam mit dem Prozessor verbunden ist, um Daten, die der Prozessor von einer oder mehreren der Peripherievorrichtungen empfangen hat, oder eine verarbeitete Form derselben anzuzeigen,

eine Stromversorgung, die betriebswirksam mit dem Prozessor und der Anzeige verbunden ist,

einen oder mehrere elektrische Kontakte (701 a, b; 702; 802) in der Nähe einer oder mehrerer Öffnungen (302 a, b, c; 303) im

Gehäuse (101) und funktionsfähig mit dem Prozessor verbunden, um eine oder mehrere Verbindungen bereitzustellen, über die der Prozessor Daten von der einen oder den mehreren Peripherievorrichtungen empfängt und Daten an diese exportiert;

(b) eine Basis (100), die konfiguriert ist, das Gehäuse (101) lösbar aufzunehmen, wobei, wenn das Gehäuse (101) in die Basis (100) eingesetzt wird, ein oder mehrere Schnittstellenhöhlräume zwischen der Basis (100) und dem Gehäuse (101) ausgebildet sind,

wobei jeder Schnittstellenhohlraum angepasst ist, um einen Verbinder (600) auf einem Datenkabel (601) lösbar aufzunehmen, das mit einer Peripherievorrichtung verbunden ist, wodurch eine betriebswirksame Verbindung zwischen der Peripherievorrichtung und dem Prozessor über das Datenkabel (601) hergestellt wird, wobei das Einsetzen des Verbinders (600) auf dem Datenkabel (601) in den Schnittstellenhohlraum elektrische Kontakte auf dem Verbinder (600) mit entsprechenden elektrischen Kontakten (701 a, b; 702; 802) auf dem Gehäuse (101) verbindet, und wobei mindestens ein Schnittstellenhohlraum einen Verriegelungsmechanismus aufweist, der mindestens eine erste Aussparung (304; 404) in einer Wand davon, die von der Basis (100) bereitgestellt wird, und mindestens eine zweite Aussparung (801) in einer Wand davon, die von dem Gehäuse (101) bereitgestellt wird, aufweist, wobei die erste und zweite Aussparung (304, 305; 801) konfiguriert sind, einen Abschnitt des Verbinders (600) aufzunehmen, wenn er eingesetzt wird, wobei das Einsetzen des Verbinders (600) das Trennen der Basis (100) vom Gehäuse (101) verhindert, bis der Verbinder (600) entfernt wird;

(c) ein wiederverschließbares Halteband zur reversiblen Befestigung des Datenverarbeitungssystems am Träger.

2. Das körpergetragene physiologische Datenverarbeitungssystem nach Anspruch 1, wobei das System ferner eine oder mehrere Peripherievorrichtungen umfasst, die unabhängig voneinander aus der Gruppe ausgewählt sind, die aus einer körpergetragenen optischen Sonde, die zum Messen mindestens eines optischen Signals, das nach der Interaktion mit dem Gewebe des Trägers erfasst wurde, einem Beschleunigungssensor, einem EKG-Sensor, einem IKG-Sensor und einem Temperatursen-

sor besteht, wobei jede Peripherievorrichtung zum Herstellen einer betriebswirksamen Verbindung mit dem Prozessor über ein Datenkabel ausgebildet ist, das mit der Peripherievorrichtung durch Einstecken eines Verbinders (600) auf dem Datenkabel in den Schnittstellenhohlraum verbunden ist.

3. Das körpergetragene physiologische Datenverarbeitungssystem nach Anspruch 1 oder 2, wobei die mindestens eine physiologische Eigenschaft ausgewählt ist aus der Gruppe bestehend aus Herzfrequenz, elektrischer Aktivität des Herzens, Temperatur, SpO<sub>2</sub>, Blutdruck, Herzschlagvolumen, Herzleistung, Bewegung, Aktivität, Haltung, Pulsfrequenz und Atemfrequenz.

4. Das körpergetragene physiologische Datenverarbeitungssystem nach einem der Ansprüche 1 bis 3, ferner umfassend einen Sender-Empfänger zur drahtlosen Kommunikation mit einem Datenerfassungssystem außerhalb des körpergetragenen physiologischen Datenverarbeitungssystems.

5. Das körpergetragene physiologische Datenverarbeitungssystem nach Anspruch 4, wobei der Sender-Empfänger eine Kommunikationsschaltung aufweist, die angepasst ist, eine betriebswirksame Verbindung mit dem Prozessor durch Einsetzen in den Schnittstellenhohlraum herzustellen; oder wobei die elektronische Schaltung ein Mikrofon und einen Lautsprecher aufweist, die für die Zweirichtungssprachkommunikation konfiguriert sind, wobei optional das Mikrofon und der Lautsprecher betriebswirksam mit dem Prozessor für die Sprachübertragung über das Internetprotokoll (VOIP) verbunden sind.

6. Das körpergetragene physiologische Datenverarbeitungssystem nach Anspruch 1, wobei der Schnittstellenhohlraum, der einen Verriegelungsmechanismus umfasst, ferner eine Lasche (311) auf einer Oberfläche der Basis (100) aufweist, wobei die Lasche (311) so konfiguriert ist, dass sie in eine Aussparung (602) auf dem Verbinder (600) eingeführt wird beim Einsetzen und dadurch den Verbinder (600) in die zweite Aussparung (801) positioniert.

7. Das körpergetragene physiologische Datenverarbeitungssystem nach Anspruch 1, ferner aufweisend einen Stecker, der zum Einsetzen in einen Schnittstellenhohlraum geeignet ist, der nicht in betriebswirksamen Zustand ist, wobei der Stecker nicht elektrisch aktiv ist.

8. Das körpergetragene physiologische Datenverarbeitungssystem nach Anspruch 7, wobei der Stecker angepasst ist, in einen Schnittstellenhohlraum eingeführt zu werden, der einen Verriegelungsmecha-

nismus aufweist, wobei das Einsetzen des Steckers das Trennen der Basis (100) vom Gehäuse (101) verhindert, bis der Stecker entfernt wird.

9. Das körpergetragene physiologische Datenverarbeitungssystem nach Anspruch 1, wobei die Basis (100) aufweist
- (a) eine Lasche (312) an einem ersten Ende davon, die in eine entsprechende Öffnung in dem Gehäuse (101) eingesetzt wird, wenn sie mit dieser verbunden ist, und wobei das Verbinden der Basis (100) und des Gehäuses (101) einen Schnittstellenhohlraum bildet, der einen Verriegelungsmechanismus distal zu dem Ende umfasst, das die Lasche (312) umfasst; oder
- (b) eine Schlüsselstruktur (306-309), die konfiguriert ist, das Einsetzen eines inkompatiblen Verbinders (600) in einen Schnittstellenhohlraum zu verhindern.
10. Das körpergetragene physiologische Datenverarbeitungssystem nach Anspruch 1, wobei die Anzeige eine Touchscreen-Schnittstelle zur Dateneingabe in den Prozessor bereitstellt.
11. Das körpergetragene physiologische Datenverarbeitungssystem nach Anspruch 1, wobei die Basis und ein Gurt als Einweg-Einheit konfiguriert sind.
12. Körpergetragenes physiologisches Datenverarbeitungssystem nach Anspruch 1, wobei die Basis (100) und das Gehäuse (101) im zusammengesteckten Zustand durch eine Presspassung mit ausreichender Festigkeit miteinander in Eingriff stehen, um eine Trennung der Basis (100) und des Gehäuses (101) aufgrund der Schwerkraft zu verhindern.
13. Eine Basis (100), die konfiguriert ist, ein Gehäuse (101), das einen Prozessor stützt, lösbar aufzunehmen, wobei, wenn das Gehäuse in die Basis eingesetzt wird, ein oder mehrere Schnittstellenhöhlräume zwischen der Basis (100) und dem Gehäuse (101) gebildet werden, wobei jeder Schnittstellenhohlraum einen oder mehrere elektrische Kontakte (701 a, b; 702; 802) auf dem Gehäuse (101) aufweist, die betriebswirksam mit dem Prozessor verbunden ist, und wobei jeder Schnittstellenhohlraum angepasst ist, einen elektrischen Verbinder (600) aufzunehmen, der einen Gleitkontakt mit den elektrischen Kontakten (802) innerhalb des Schnittstellenhohlraums herstellt, um eine betriebswirksame Verbindung zwischen einer Peripherievorrichtung und dem Prozessor herzustellen, wobei die Basis (100) aufweist:

einen Verriegelungsmechanismus an einem ersten Ende der Basis (100), wobei der Verrie-

gelungsmechanismus mindestens eine Aussparung (304; 404) in einem Abschnitt der Basis (100) umfasst, die Teil eines ersten Schnittstellenhohlraums ist, wobei die ersten Aussparungen (304; 404) konfiguriert sind, einen Abschnitt des elektrischen Verbinders (600) aufzunehmen, wenn er eingesetzt wird; eine Lasche (311) auf einem Abschnitt der Basis (100), der Teil des ersten Schnittstellenhohlraums ist, wobei die Lasche (311) konfiguriert ist, in eine Aussparung (602) auf dem elektrischen Verbinder (600) eingeführt zu werden beim Einsetzen und dadurch den Verbinder (600) in eine Aussparung (801) auf einem Abschnitt des Gehäuses (101) zu positionieren, der Teil des ersten Schnittstellenhohlraums ist; eine Lasche (312) an einem zweiten Ende der Basis (100), die konfiguriert ist, in eine entsprechende Öffnung in dem Gehäuse (101) eingesetzt zu werden, wenn sie damit verbunden ist; wobei das Einsetzen des elektrischen Verbinders (600) in den ersten Schnittstellenhohlraum so, dass der Verbinder (600) in die Aussparung (801) am Gehäuse (101) positioniert ist, das Trennen der Basis (100) vom Gehäuse (101) verhindert, bis der Verbinder (600) entfernt ist.

14. Die Basis (100) nach Anspruch 13, wobei die Basis (100) aufweist
- (i) Öffnungen zur Befestigung eines wiederverschließbaren Haltebandes; oder
- (ii) eine Schlüsselstruktur (306-309), die konfiguriert ist, das Einsetzen eines inkompatiblen Verbinders (600) in einen Schnittstellenhohlraum zu verhindern; oder
- (iii) einen oder mehrere Vorsprünge (313, 314), die konfiguriert sind, um das Gehäuse (101) zu kontaktieren, wenn sie damit verbunden sind, wobei der eine oder die mehreren Vorsprünge (313, 314) eine Presspassung mit einer ausreichenden Festigkeit herstellen, um eine Trennung der Basis (100) und des Gehäuses (101) aufgrund der Schwerkraft zu verhindern.

15. Die Basis nach Anspruch 13 oder das körpergetragene physiologische Datenverarbeitungssystem nach Anspruch 1, wobei die Basis (100) als Einweg-Einheit konfiguriert ist.

## Revendications

1. Système de traitement de données physiologiques porté sur le corps comportant:
- (a) un boîtier (101) supportant des circuits électroniques, le boîtier (101) fournissant une en-

ceinte étanche à l'eau pour les circuits électroniques respectant les normes IEC 60529-2004 IPX7, les circuits électroniques comportant:

un processeur configuré pour recevoir des données de et exporter des données vers une ou plusieurs unités périphériques externe(s) au boîtier (101), et pour utiliser des données reçues de l'une ou plusieurs des unités périphériques pour dériver une mesure d'au moins une propriété physiologique du porteur,  
 un affichage relié fonctionnellement au processeur pour afficher des données reçues par le processeur de l'une ou plusieurs des unités périphériques, ou une forme traitée de celles-ci,  
 une alimentation électrique relié fonctionnellement au processeur et à l'affichage, un ou plusieurs contact(s) électrique(s) (701 a, b; 702; 802) à proximité de l'une ou plusieurs ouverture(s) (302 a, b, c; 303) dans le boîtier (101) et relié fonctionnellement au processeur pour fournir une ou plusieurs connexion(s) à travers lesquelles le processeur reçoit des données de et exporte des données vers une ou plusieurs unité(s) périphérique(s);

(b) une base (100) configurée pour recevoir de manière amovible le boîtier (101), dans lequel lorsque le boîtier (101) est inséré dans la base (100), une ou plusieurs cavité(s) d'interface sont formées entre la base (100) et le boîtier (101),

chaque cavité d'interface étant adaptée pour recevoir de manière amovible un connecteur (600) sur un câble de données (601) relié à une unité périphérique établissant ainsi une connexion fonctionnelle entre l'unité périphérique et le processeur à travers le câble de données (601), l'insertion du connecteur (600) sur le câble de données (601) dans la cavité d'interface raccordant des contacts électriques sur le connecteur (600) avec des contacts électriques correspondants (701 a, b; 702; 802) sur le boîtier (101), et

au moins une cavité d'interface comportant un mécanisme de verrouillage comprenant au moins un premier évidement (304; 404) dans une paroi de celle-ci fournie par la base (100), et au moins un deuxième évidement (801) dans une paroi de celle-ci fournie par le boîtier (101), lesdits premier et deuxième évidements (304, 305; 801) sont configurés pour recevoir une partie du connecteur (600) lorsqu'il est inséré, l'insertion

du connecteur (600) empêchant ainsi la séparation de la base (100) du boîtier (101) jusqu'à ce que le connecteur (600) est enlevé;

5 (c) une sangle de retenue refermable pour fixer de manière réversible le système de traitement de données au porteur.

10 **2.** Système de traitement de données physiologiques porté sur le corps selon la revendication 1, le système comportant en outre une ou plusieurs unité(s) périphérique(s) choisies indépendamment parmi le groupe constitué d'une sonde optique porté sur le corps adaptée pour mesurer au moins un signal optique détecté après interaction avec le tissu du porteur, d'un accéléromètre, d'un capteur ECG, d'un capteur CGI et d'un capteur de température, chaque unité périphérique étant adaptée pour établir une connexion fonctionnelle avec le processeur à travers un câble de données relié à l'unité périphérique par insertion d'un connecteur (600) sur le câble de données (601) dans la cavité d'interface.

15 **3.** Système de traitement de données porté sur le corps selon les revendications 1 ou 2, l'au moins une propriété physiologique étant choisie parmi le groupe constitué de la fréquence cardiaque, de l'activité électrique du cœur, de la température, de la SpO<sub>2</sub>, de la pression sanguine, du volume d'éjection systolique, du débit cardiaque, du mouvement, de l'activité, de la posture, de la fréquence du pouls et de la fréquence respiratoire.

20 **4.** Système de traitement de données physiologiques porté sur le corps selon l'une quelconque des revendications 1 à 3 comportant en outre un émetteur-récepteur pour communiquer sans fil avec un système d'acquisition de données extérieur au système de traitement de données physiologiques porté sur le corps.

25 **5.** Système de traitement de données physiologiques porté sur le corps selon la revendication 4, l'émetteur-récepteur comportant un circuit de communication adapté pour établir une connexion fonctionnelle avec le processeur par insertion dans la cavité d'interface; ou  
 les circuits électroniques comportant un microphone et un haut-parleur configurés pour la communication bidirectionnelle, facultativement le microphone et le haut-parleur étant relié fonctionnellement au processeur pour la communication par voix sur protocole Internet (VOIP).

30 **6.** Système de traitement de données physiologiques porté sur le corps selon la revendication 1, la cavité d'interface comportant un mécanisme de verrouilla-

- ge comprenant en outre une languette (311) sur une surface de la base (100), la languette (311) configurée pour s'insérer dans un évidement (602) sur le connecteur (600) lorsqu'elle est insérée et ainsi place le connecteur (600) dans le deuxième évidement (801). 5
7. Système de traitement de données physiologiques porté sur le corps selon la revendication 1, comportant en outre un bouchon adapté pour s'insérer dans une cavité d'interface qui n'est pas en utilisation opérable, le bouchon n'étant pas électriquement actif. 10
8. Système de traitement de données physiologiques porté sur le corps selon la revendication 7, le bouchon étant adapté pour s'insérer dans une cavité d'interface comportant un mécanisme de verrouillage, l'insertion du bouchon empêchant ainsi la séparation de la base (100) du boîtier (101) jusqu'à ce que le bouchon est enlevé. 15 20
9. Système de traitement de données physiologiques porté sur le corps selon la revendication 1, la base (100) comportant 25
- (a) une languette (312) à une première extrémité de celui-ci qui s'insère dans une ouverture correspondante dans le boîtier (101) lorsque elle est accouplée à celui-ci, et l'accouplement de la base (100) et du boîtier (101) formant une cavité d'interface comportant un mécanisme de verrouillage de manière distale par rapport à l'extrémité comportant la languette (312); ou 30
- (b) une structure de touche (306-309) configurée pour empêcher l'insertion d'un connecteur (600) incompatible dans une cavité d'interface. 35
10. Système de traitement de données physiologiques porté sur le corps selon la revendication 1, l'affichage fournissant une interface à écran tactile pour une entrée de données au processeur. 40
11. Système de traitement de données physiologiques porté sur le corps selon la revendication 1, la base et la sangle étant configurée sous la forme d'une unité jetable. 45
12. Système de traitement de données physiologiques porté sur le corps selon la revendication 1, la base (100) et le boîtier (101), lorsqu'ils sont accouplés, s'engageant ensemble par un ajustement par frottement ayant une force suffisante pour empêcher la séparation de la base (100) et du boîtier (101) en raison de la force de gravité. 50 55
13. Base (100) configurée pour recevoir de manière amovible un boîtier (101) supportant un processeur, dans lequel lorsque le boîtier est inséré dans la base, une ou plusieurs cavité(s) d'interface sont formées entre la base (100) et le boîtier (101), chaque cavité d'interface comportant un ou plusieurs contacts électriques (701 a, b; 702; 802) sur le boîtier (101) reliés fonctionnellement au processeur, et chaque cavité d'interface est adaptée pour recevoir un connecteur électrique (600) établissant un contact couliissant avec les contacts électriques (802) dans la cavité d'interface pour établir une connexion fonctionnelle entre une unité périphérique et le processeur, la base (100) comportant:
- un mécanisme de verrouillage à une première extrémité de la base (100), le mécanisme de verrouillage comportant au moins un évidement (304; 404) dans une partie de la base (100) qui fait partie d'une première cavité d'interface, lesdits premiers évidements (304; 404) sont configurés pour recevoir une partie du connecteur électrique (600) lorsqu'il est inséré; une languette (311) sur une partie de la base (100) faisant partie de la première cavité d'interface, la languette (311) est configurée pour s'insérer dans un évidement (602) sur le connecteur électrique (600) lorsqu'elle est insérée et ainsi place le connecteur (600) dans un évidement (801) sur une partie du boîtier (101) qui fait partie de la première cavité d'interface; une languette (312) à une deuxième extrémité de la base (100) qui est configurée pour s'insérer dans une ouverture correspondante du boîtier (101) lorsqu'elle est accouplée à celui-ci; l'insertion du connecteur électrique (600) dans la première cavité d'interface, de sorte que le connecteur (600) soit positionné dans l'évidement (801) sur le boîtier (101), empêchant la séparation de la base (100) du boîtier (101) jusqu'à ce que le connecteur (600) est enlevé.
14. Base (100) selon la revendication 13, la base (100) comportant
- (i) des ouvertures pour raccorder une sangle de retenue refermable; ou
- (ii) une structure de touche (306-309) configurée pour empêcher l'insertion d'un connecteur (600) incompatible dans la cavité d'interface; ou
- (iii) une ou plusieurs saillie(s) (313, 314) configurée(s) pour contacter le boîtier (101) lorsqu'elles sont accouplées à celui-ci, l'une ou plusieurs saillie(s) (313, 314) établissant un ajustement par frottement ayant une force suffisante pour empêcher la séparation de la base (100) et du boîtier (101) en raison de la force de gravité.
15. Base selon la revendication 13 ou le système de traitement de données physiologiques porté sur le corps selon la revendication 1, la base (100) étant

configurée sous la forme d'une unité jetable.

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Fig. 1

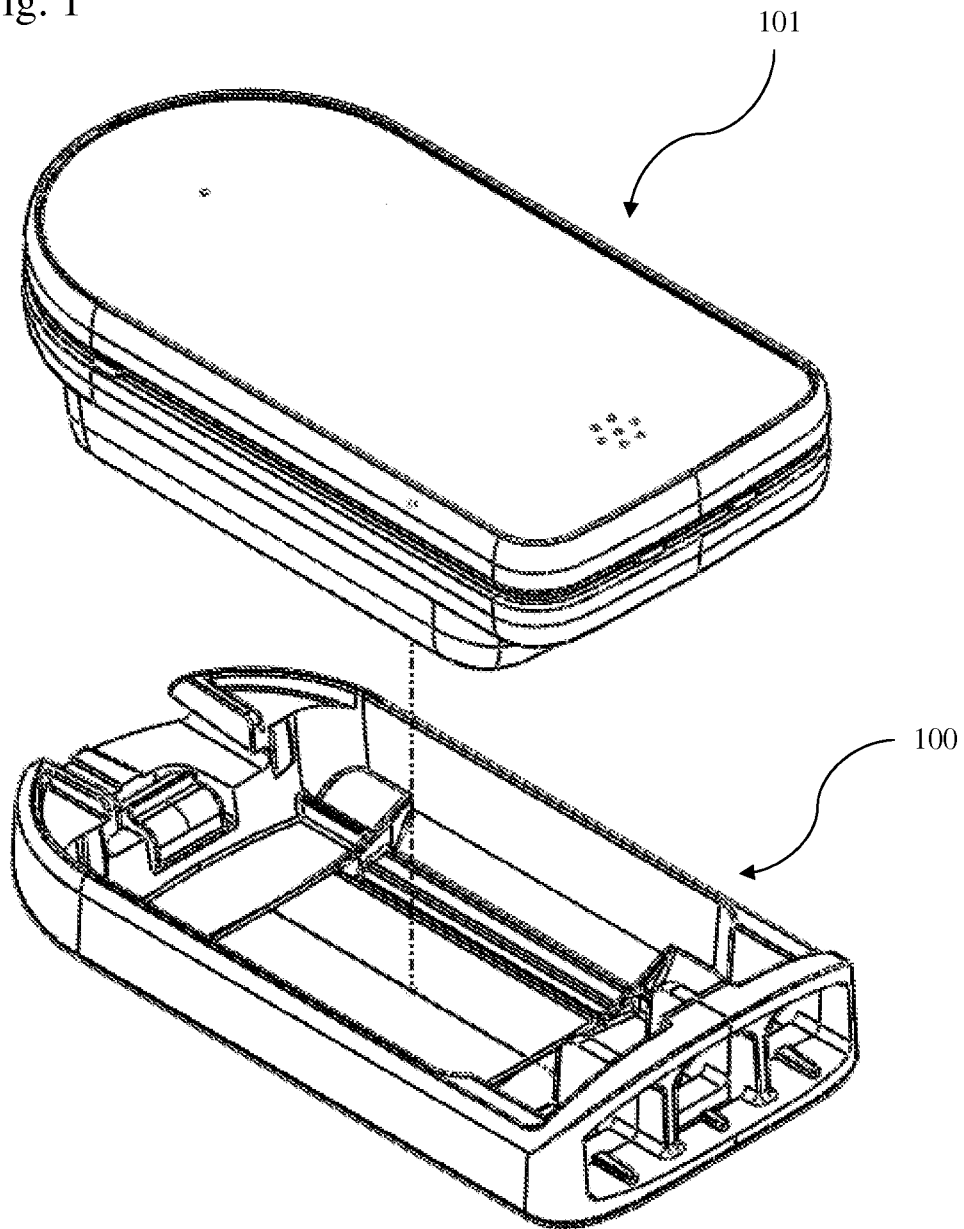


Fig. 2

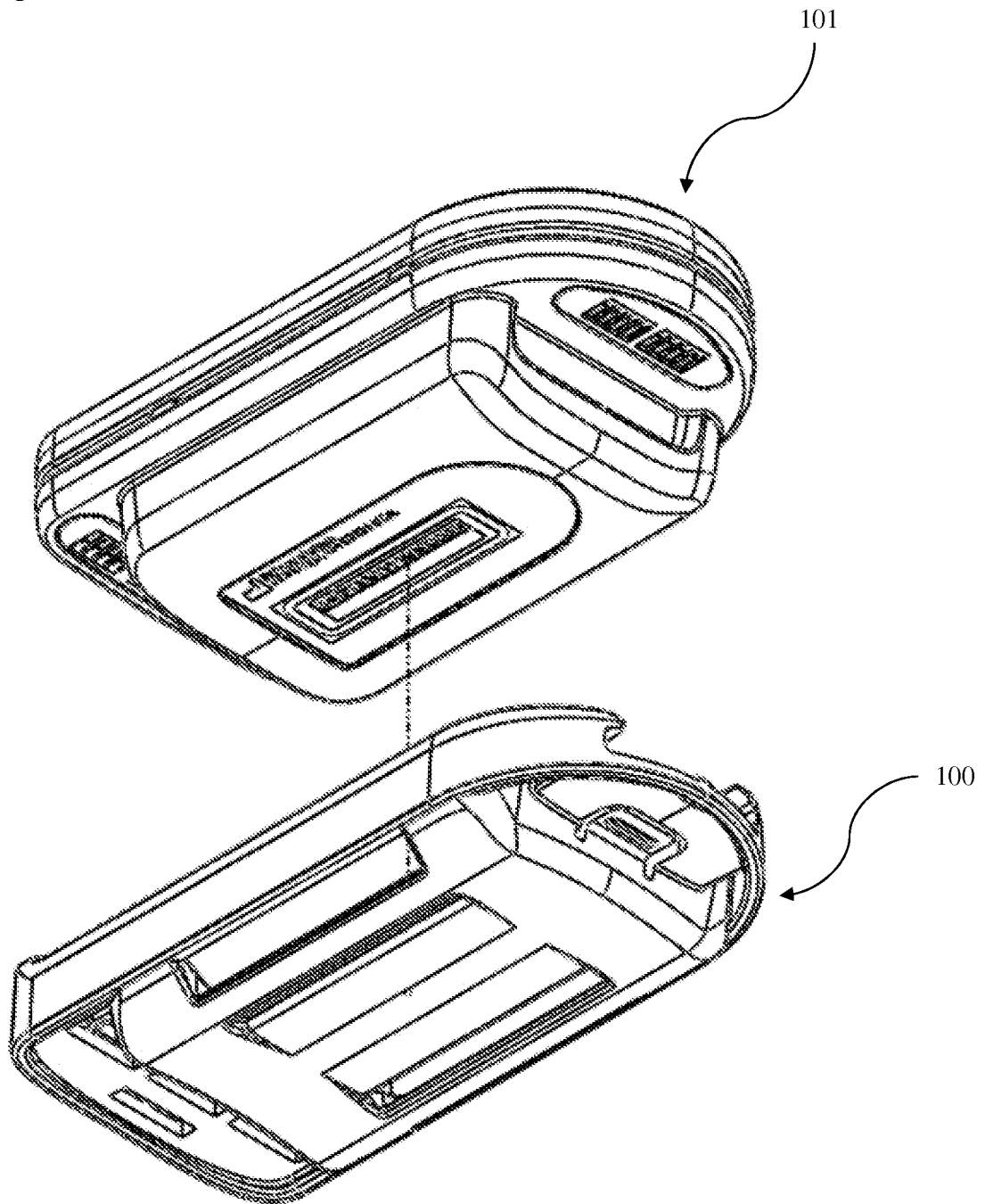


Fig. 3

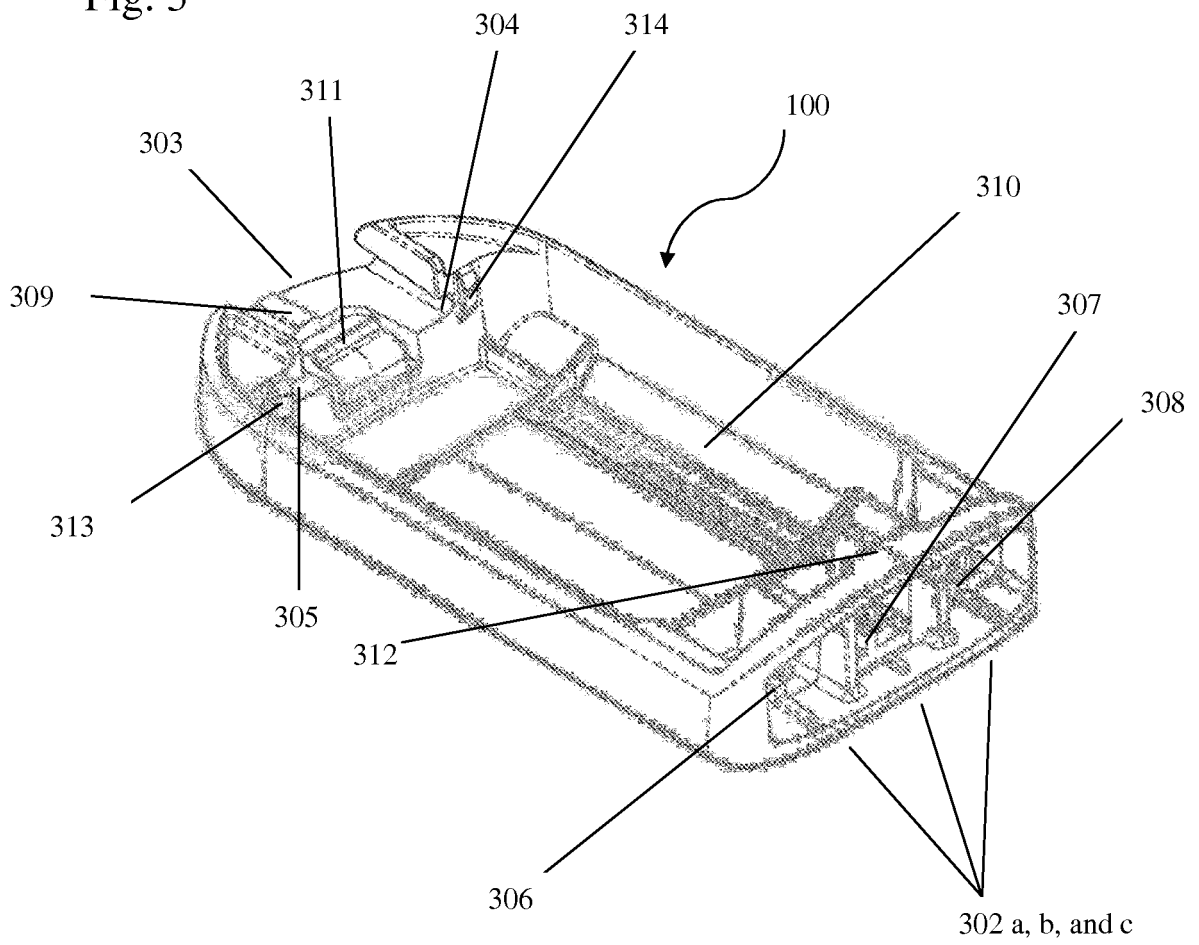


Fig. 4

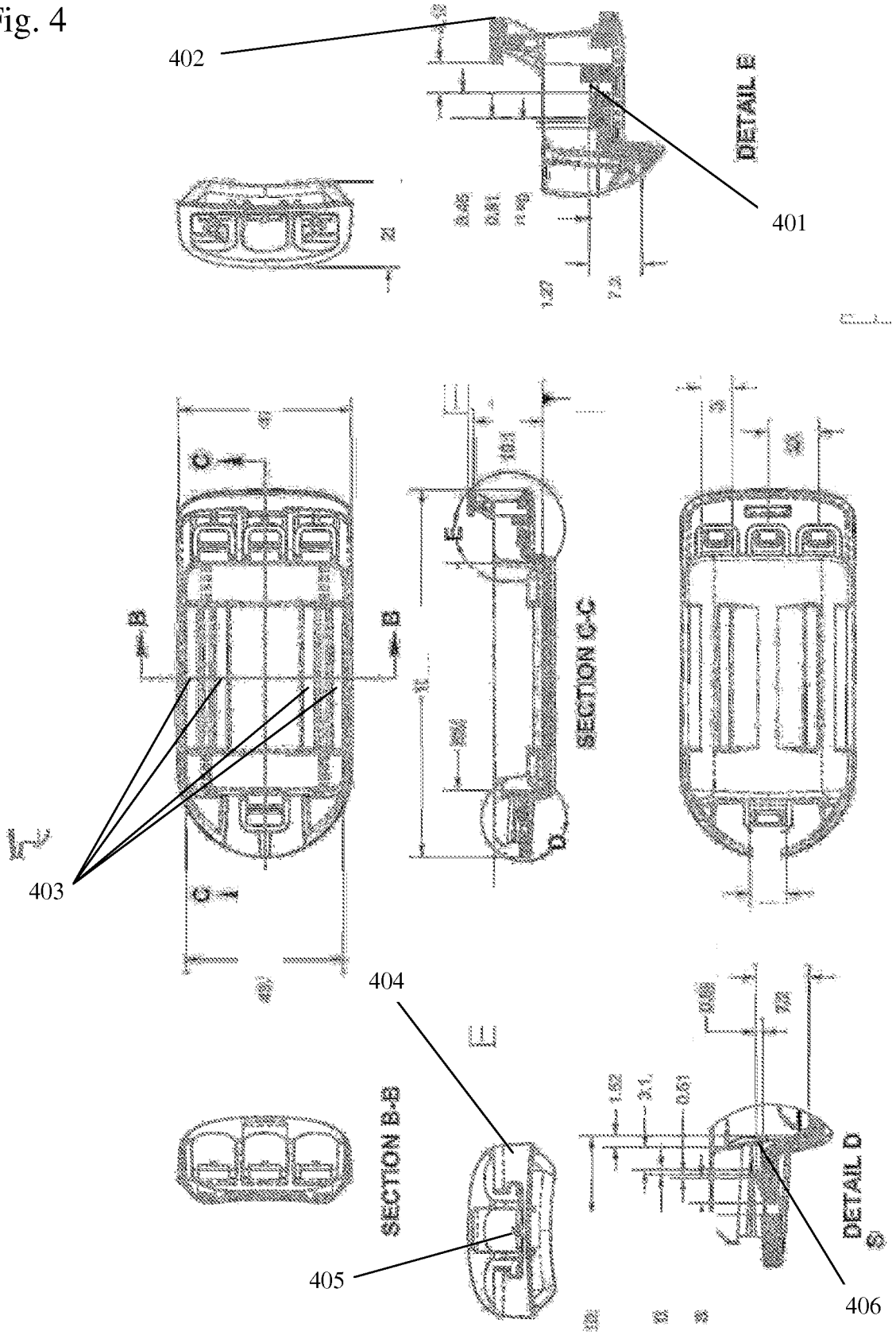
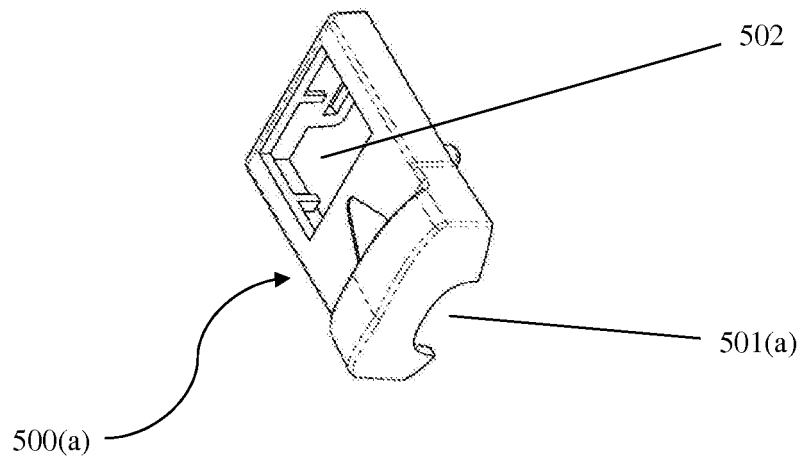


Fig. 5

A



B

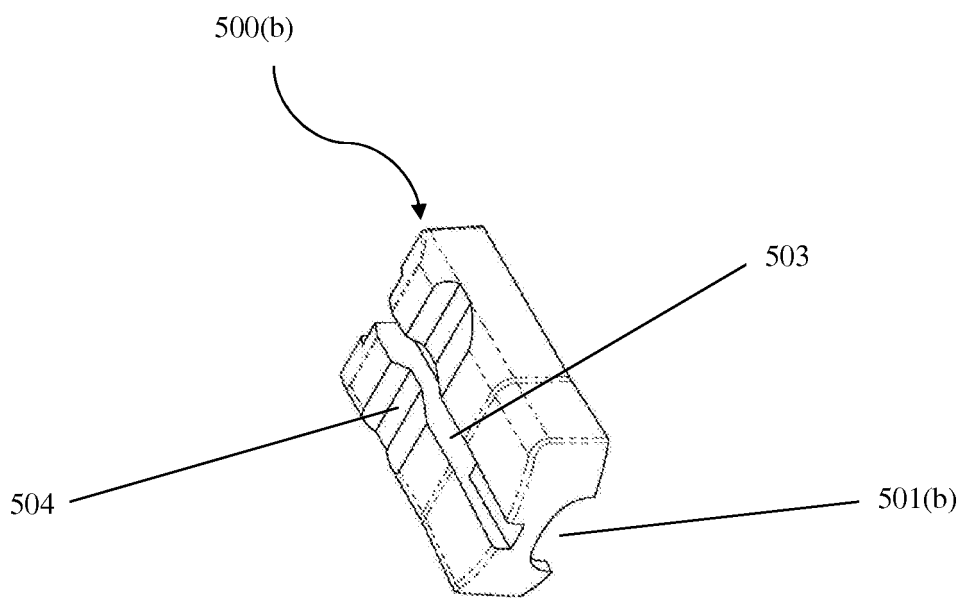


Fig. 6

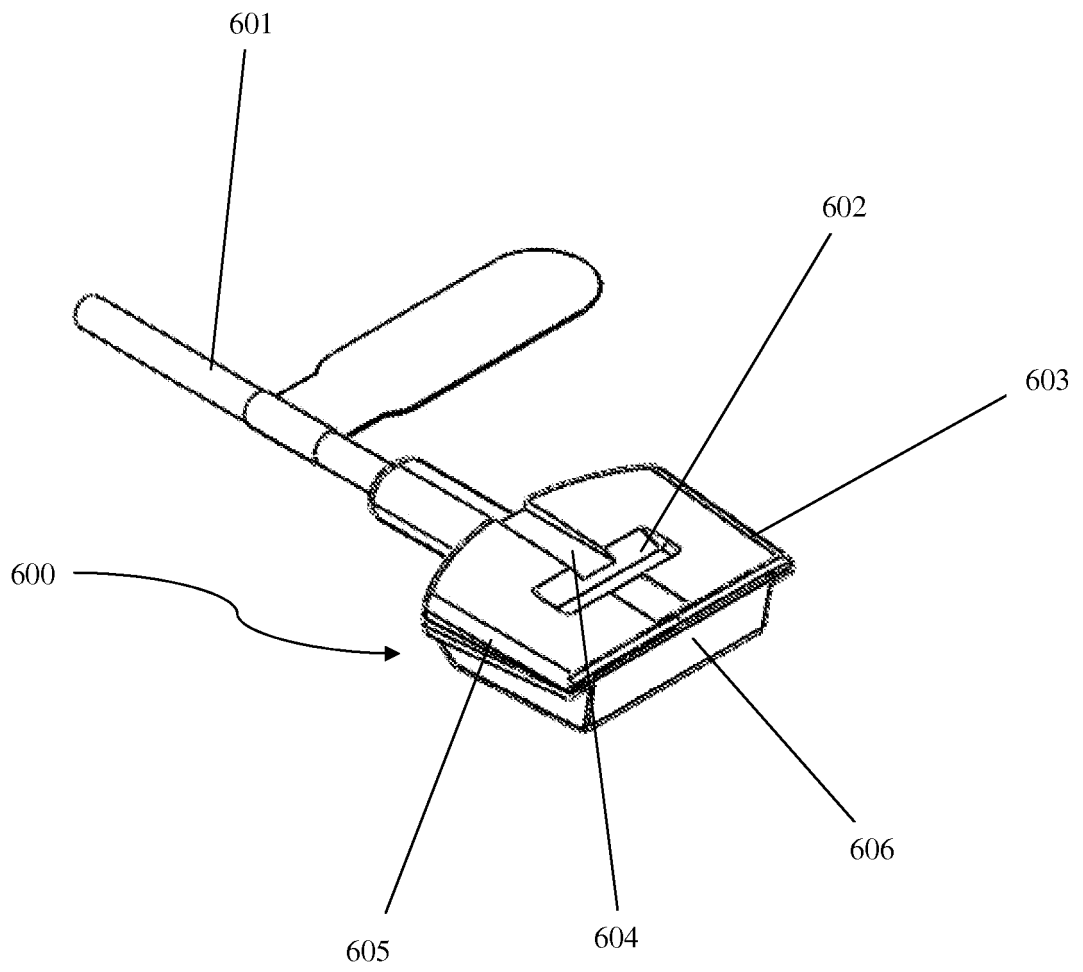


Fig. 7

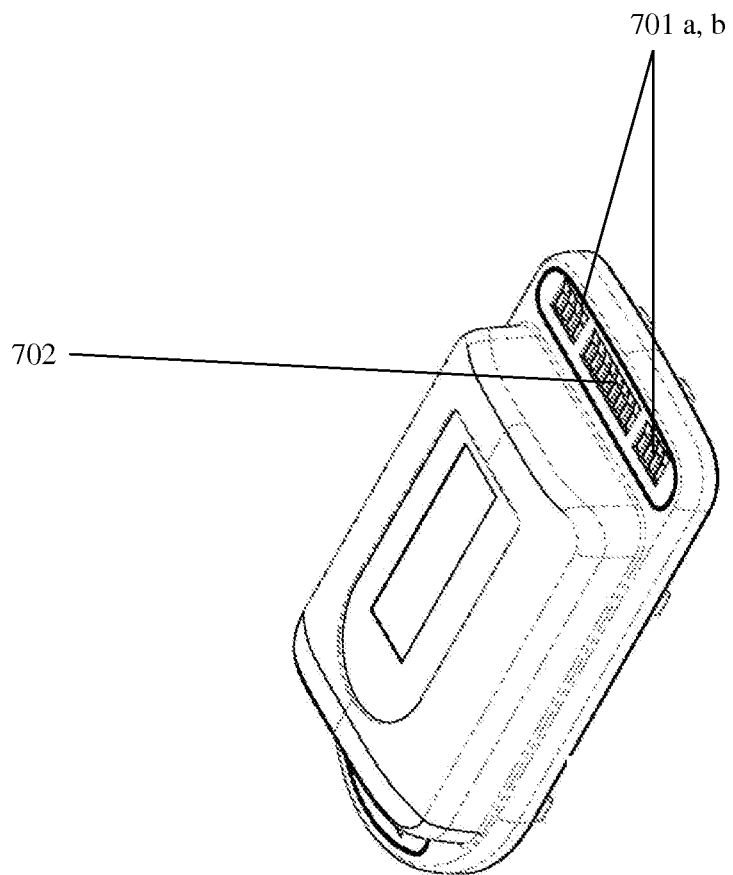


Fig. 8

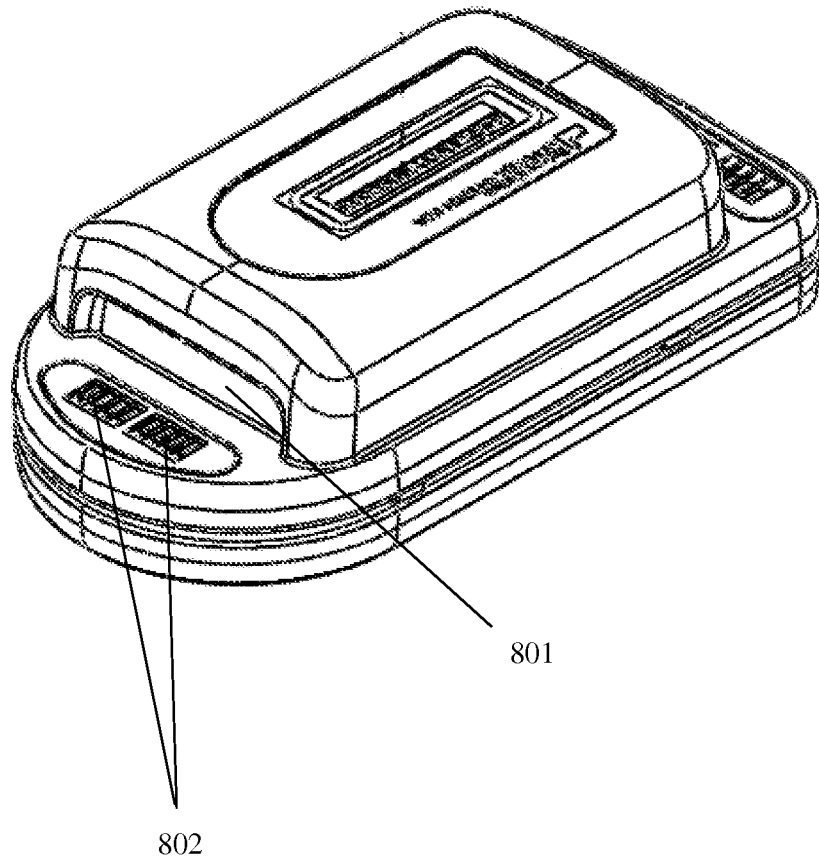
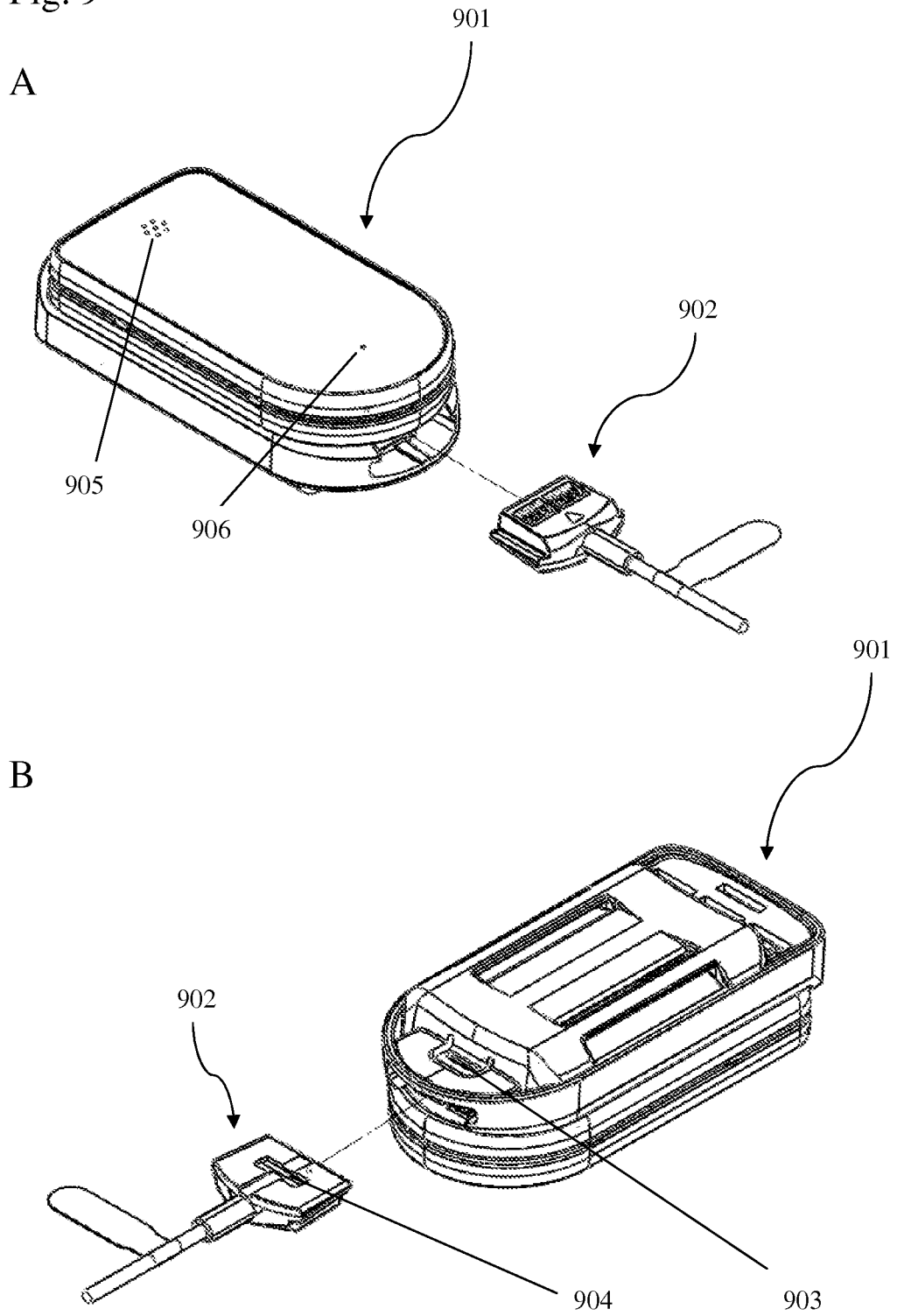


Fig. 9



**REFERENCES CITED IN THE DESCRIPTION**

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专利名称(译)	用于患者监护的模块化ARMBAND处理器		
公开(公告)号	<a href="#">EP2675348B1</a>	公开(公告)日	2019-11-06
申请号	EP2012747239	申请日	2012-02-17
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IPC分类号	A61B5/02 A61B5/00 A61B5/0205 A61B5/024 A61B5/029 A61B5/0404 G06F1/16 A61B5/021 A61B5/053 A61B5/08 A61B5/11 A61B5/145		
CPC分类号	A61B5/02427 A61B5/6826 A61B2505/03 A61B2560/0412 A61B2560/0443 A61B2562/0238 G16H20/17 G16H40/63 G16H40/67 G16H50/20 G16H50/30 A61B5/0022 A61B5/0024 A61B5/0059 A61B5/02055 A61B5/021 A61B5/02438 A61B5/029 A61B5/0404 A61B5/053 A61B5/0816 A61B5/1116 A61B5/1118 A61B5/14542 A61B5/6824 A61B5/6831 A61B5/742 A61B5/7465 A61B5/749 A61B2560/045 A61B2562/0219 A61B2562/222 A61B2562/227 G06F1/163 G06F19/00		
优先权	61/444285 2011-02-18 US		
其他公开文献	EP2675348A1 EP2675348A4		
外部链接	<a href="#">Espacenet</a>		

摘要(译)

本发明提供了一种生理探针，该探针舒适地附接到患者的拇指的根部，从而释放他们的手指以用于医院中的常规活动，例如阅读和进食。该探头包括单独的支架模块和传感器模块，可固定到拇指并测量与时间相关的信号，这些信号与在660和905 nm附近工作的LED相对应。包含易受磨损的元件的托架模块优选地设置为一次性单元。

Fig. 1

