



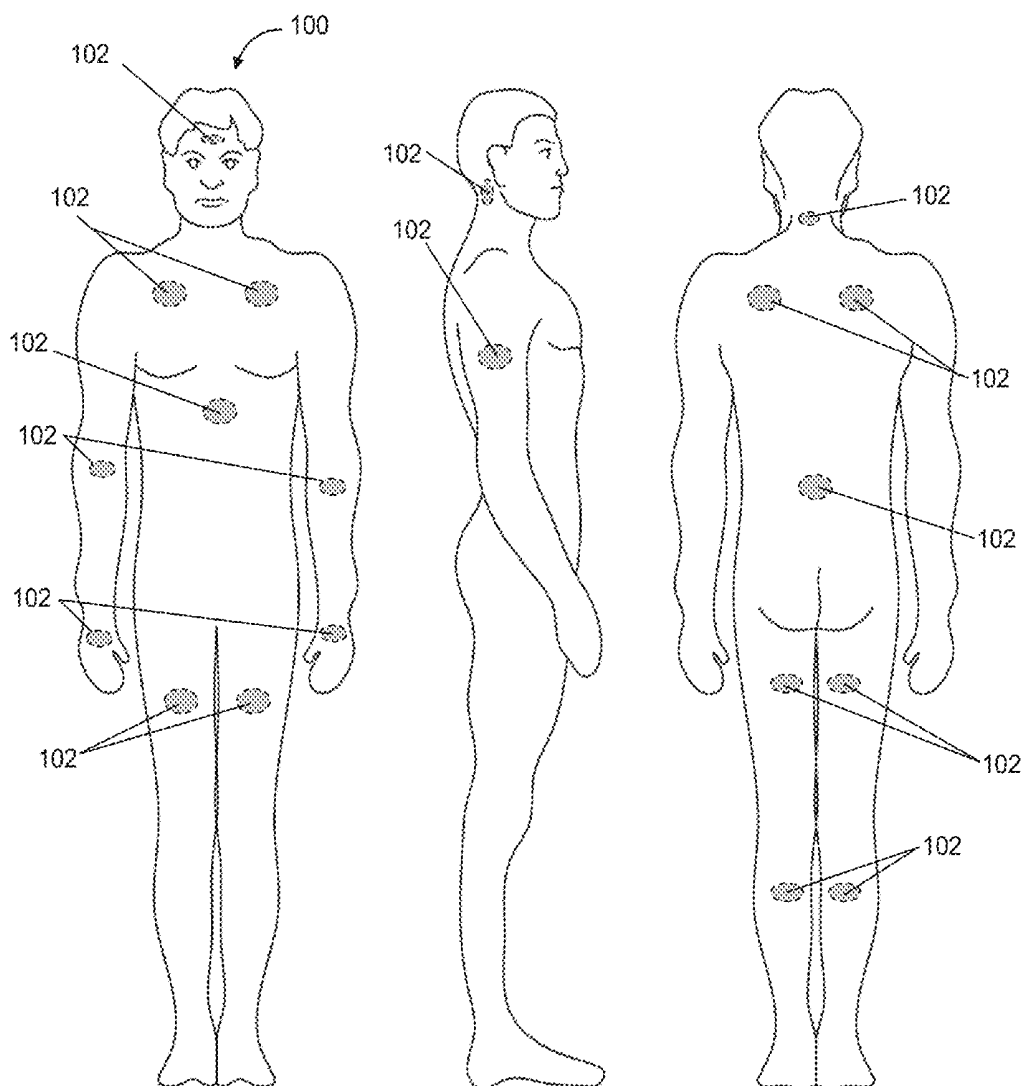
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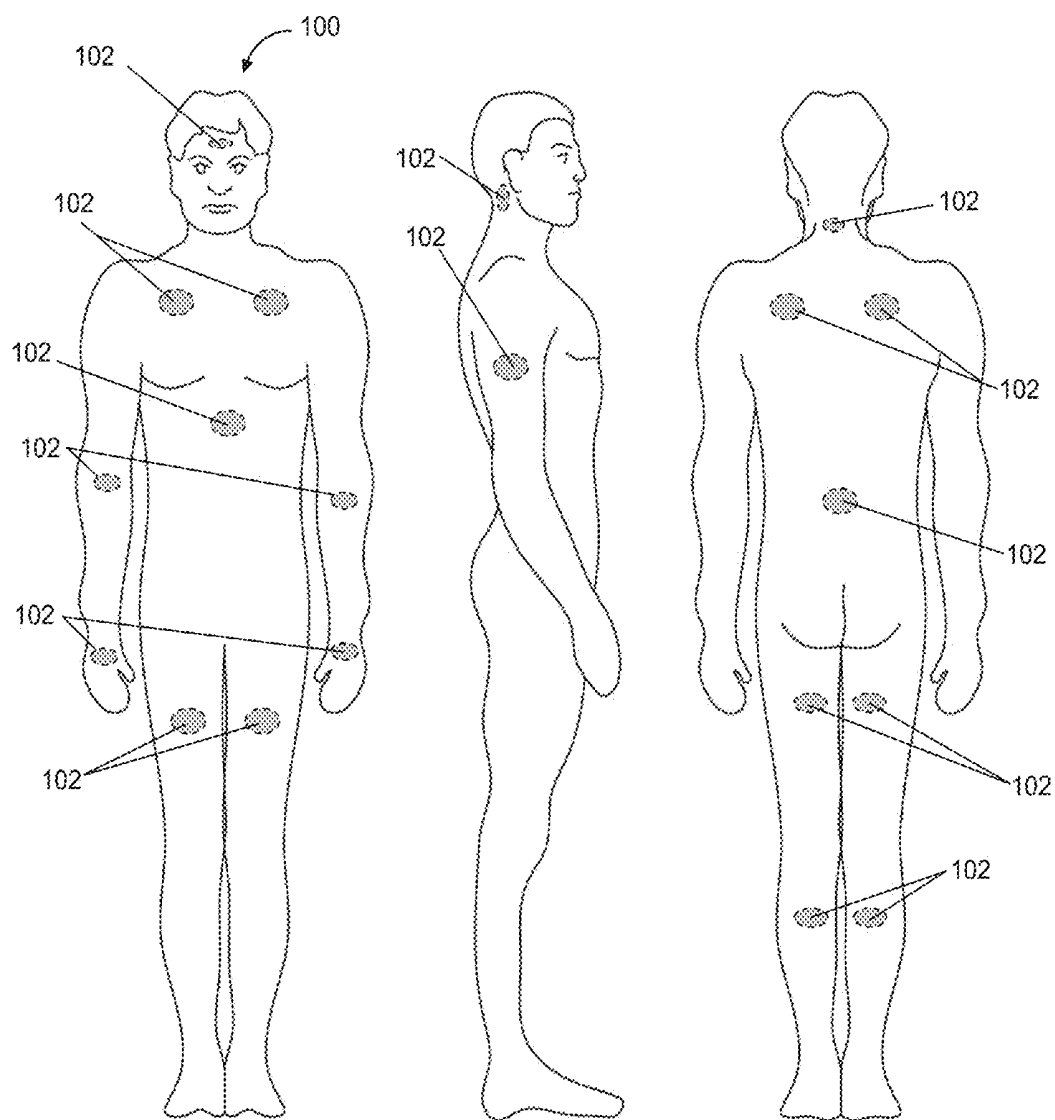
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Quinn et al.(10) **Pub. No.: US 2017/0035306 A1**(43) **Pub. Date: Feb. 9, 2017**(54) **METHOD AND APPARATUS FOR
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(57)

ABSTRACT

Aspects of the subject disclosure may include, for example, a biological sensor configured to be disabled when removed from a patient. Other aspect of the subject disclosure may include decommissioning a biological sensor responsive to a system detecting that the biological sensor is no longer in use. Other embodiments are disclosed.





100

FIG. 1

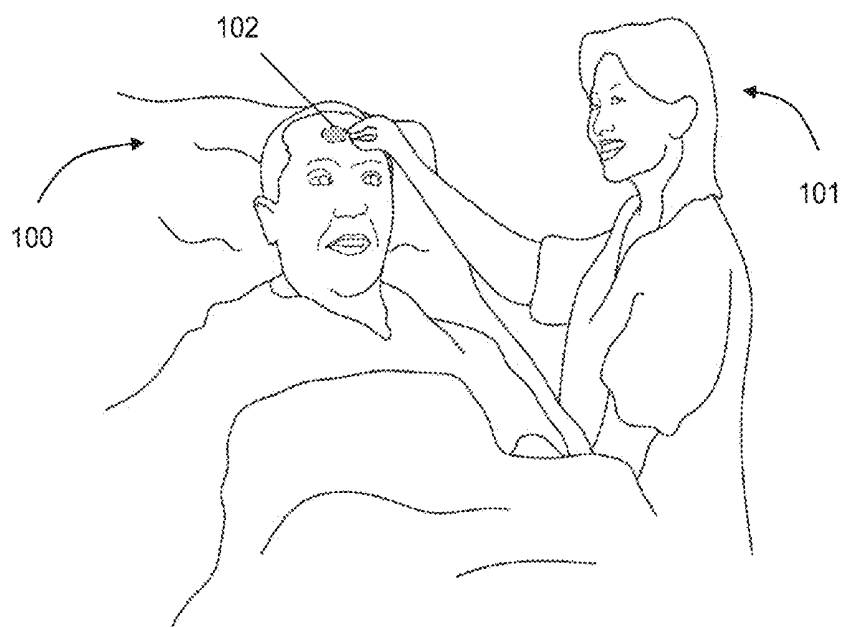


FIG. 2A

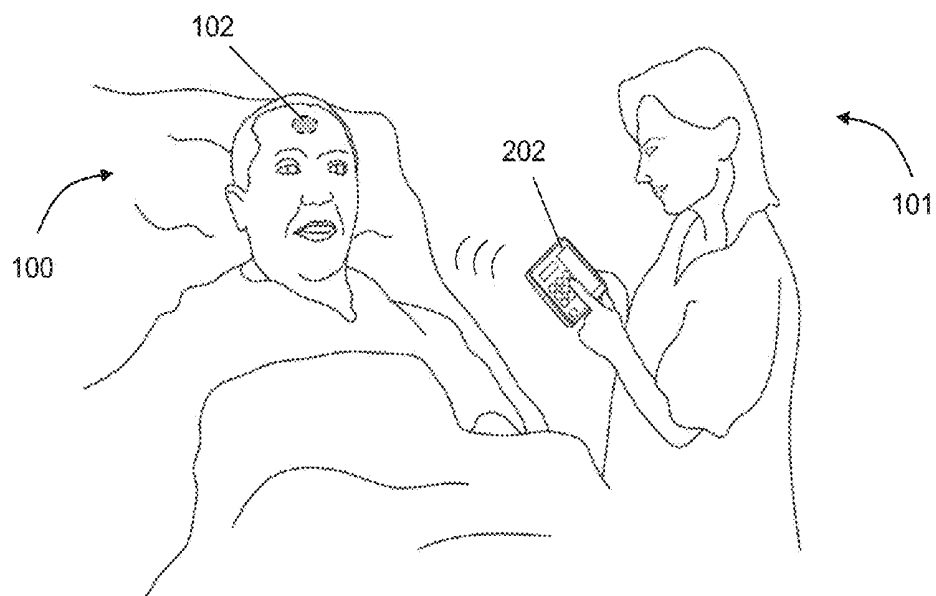


FIG. 2B

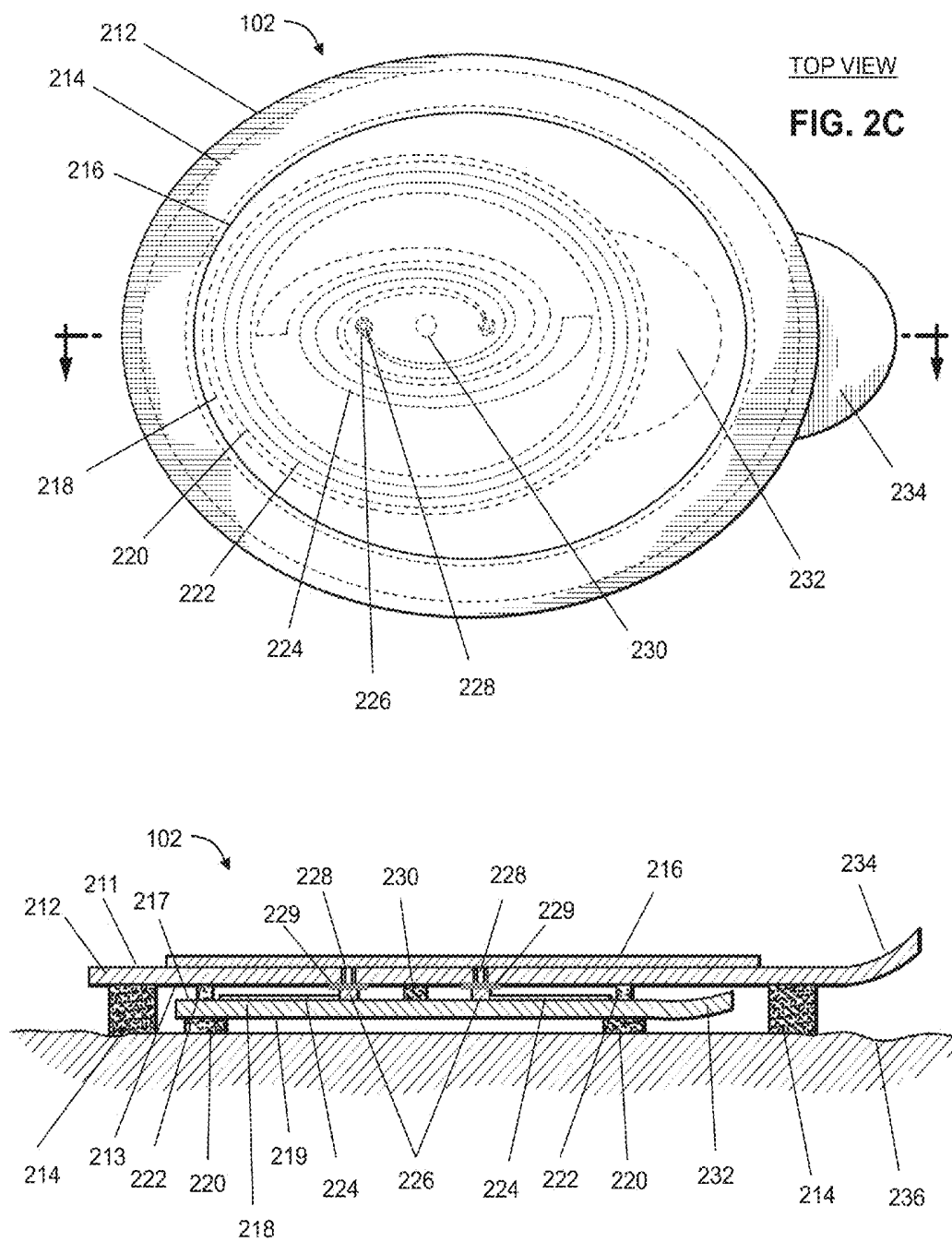
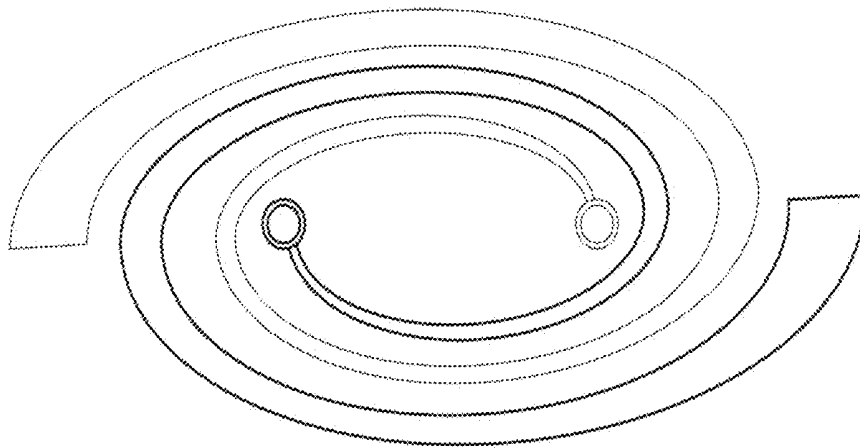


FIG. 2D SIDE VIEW



224

FIG. 2E

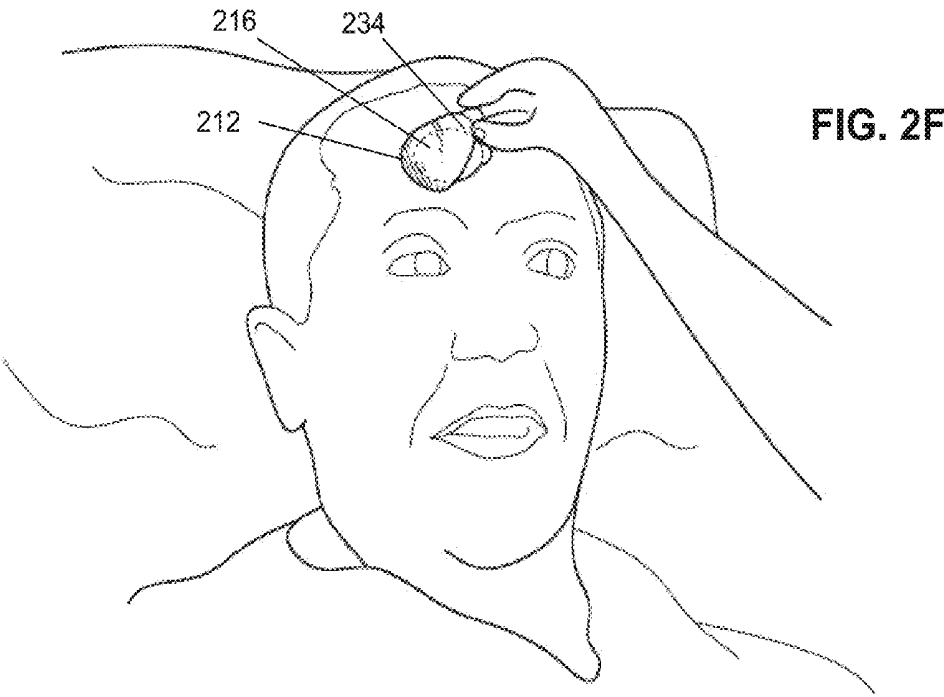


FIG. 2F

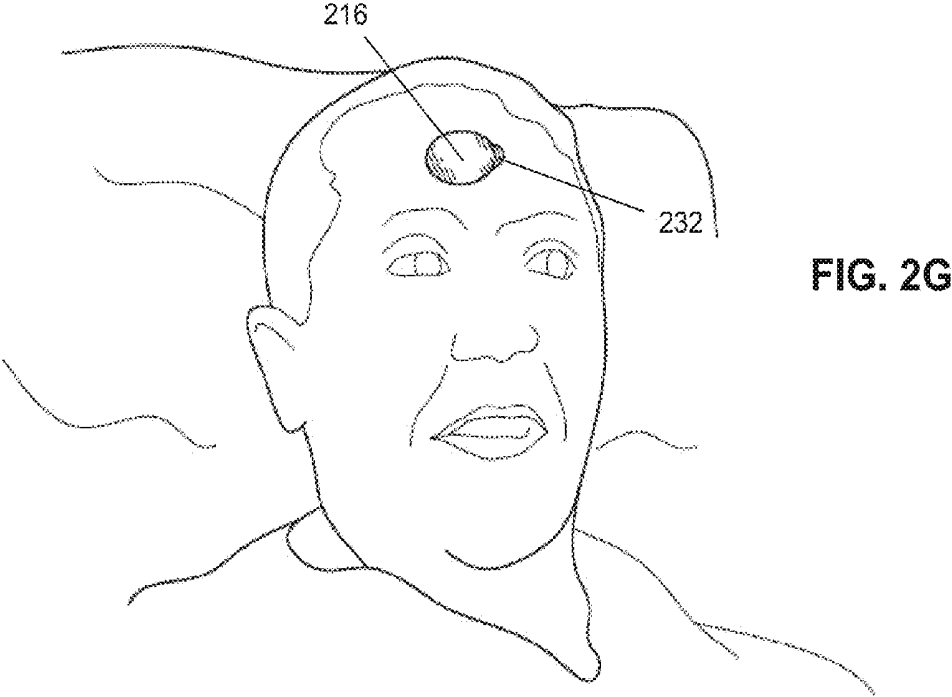
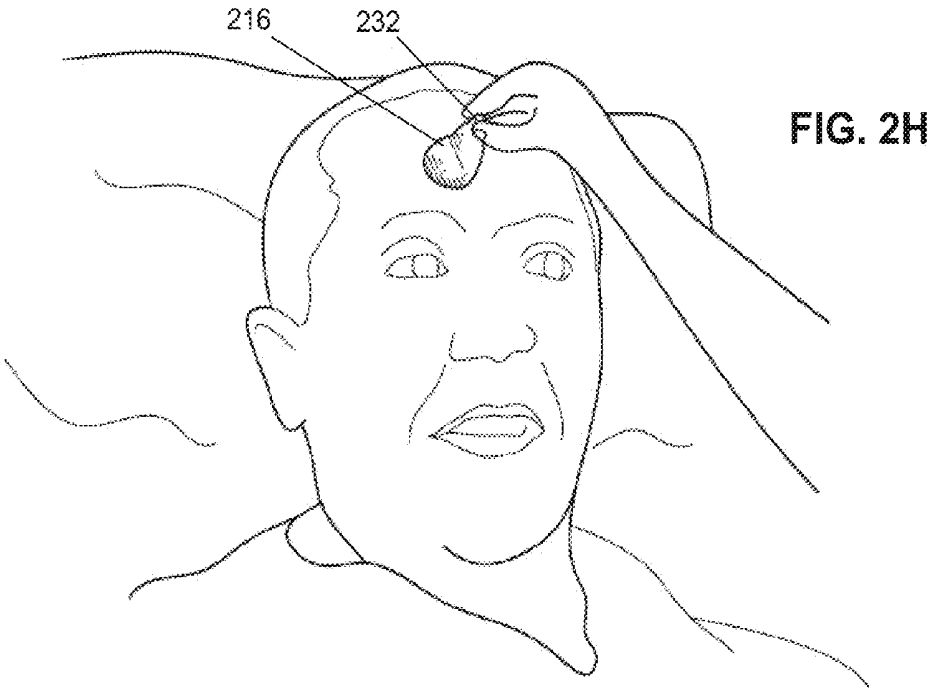
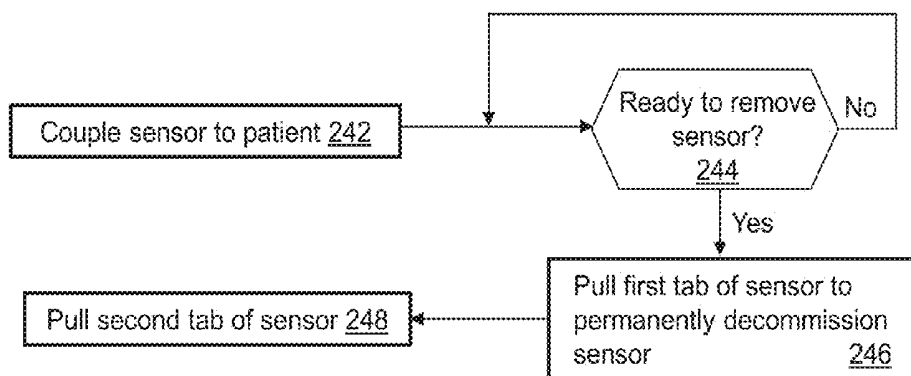
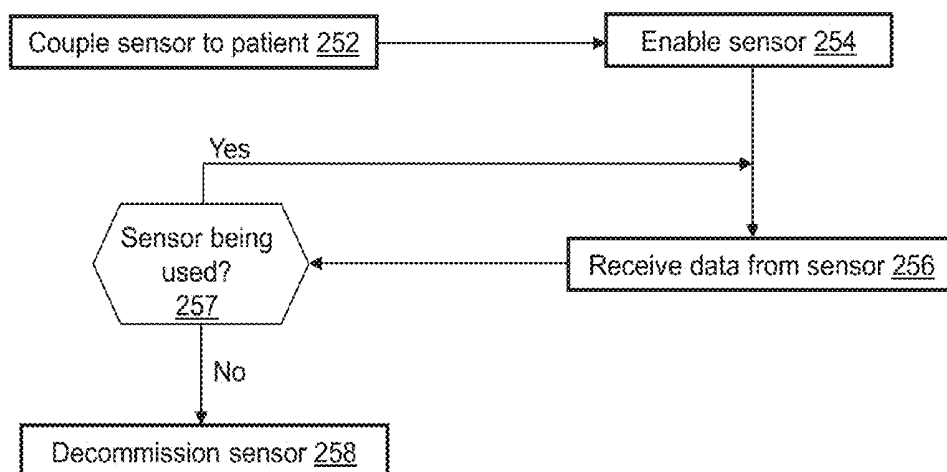


FIG. 2G





240
FIG. 2J



250
FIG. 2K

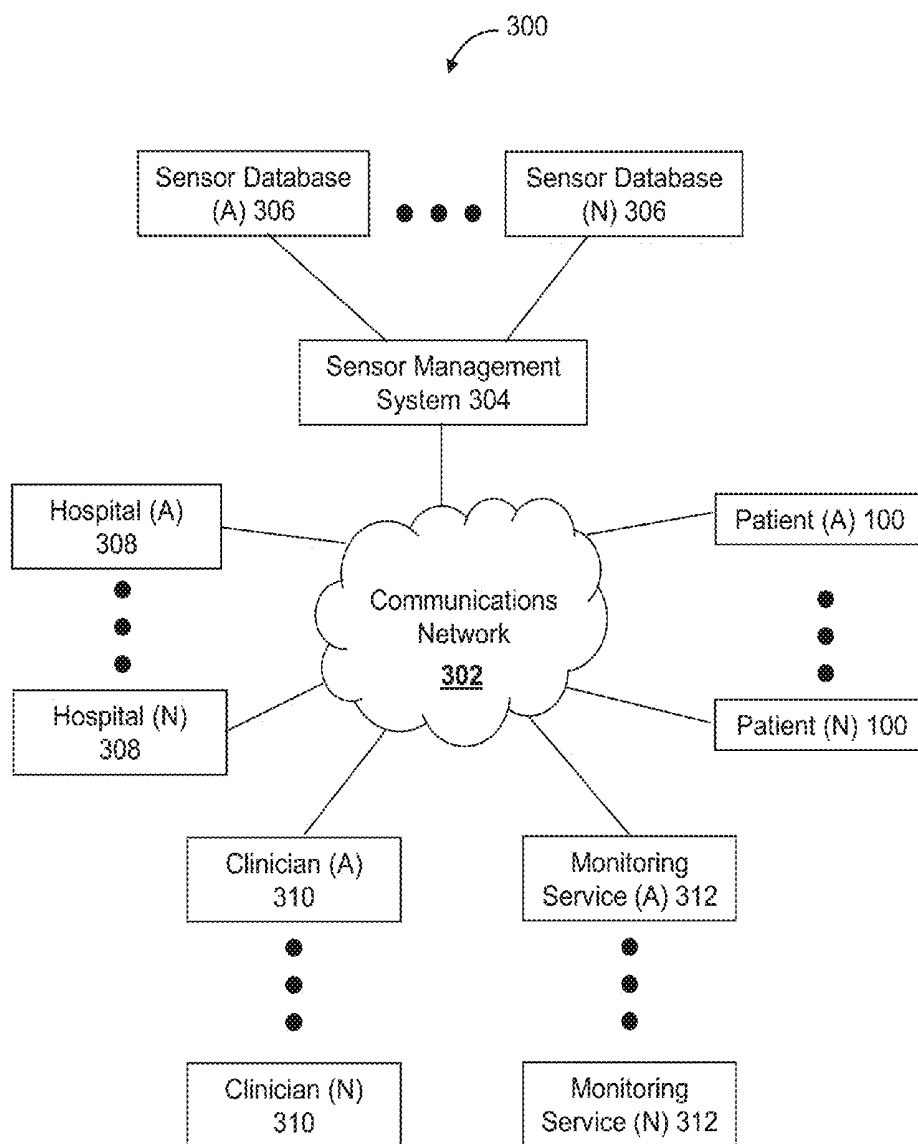


FIG. 3A

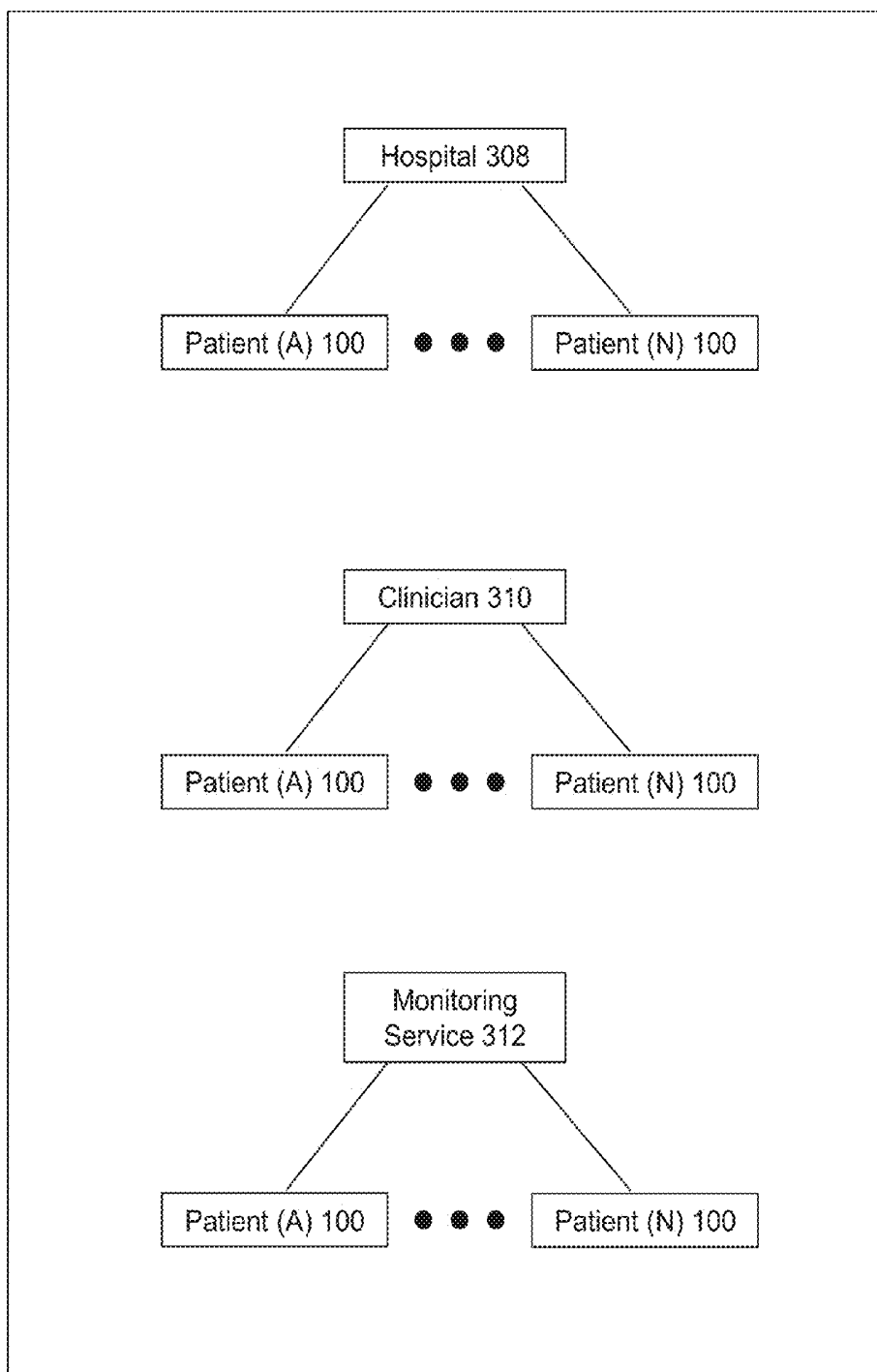


FIG. 3B

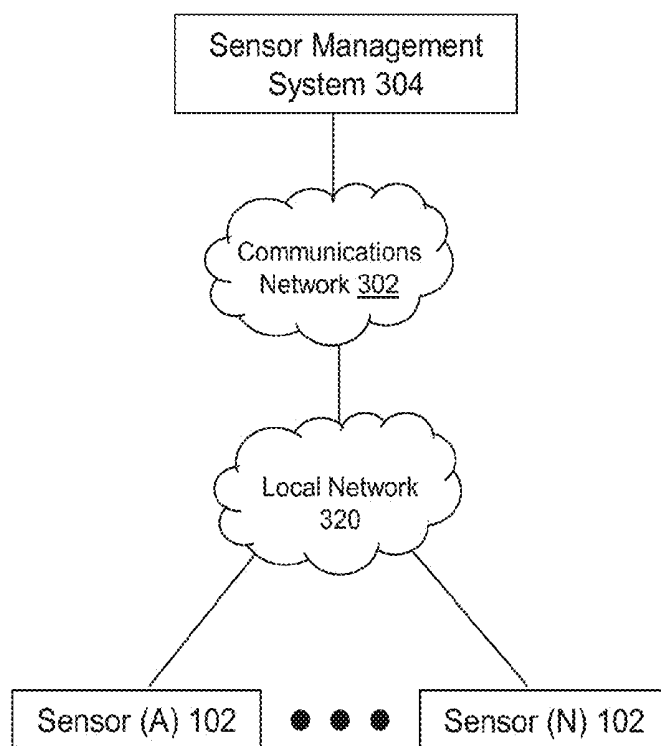


FIG. 3C

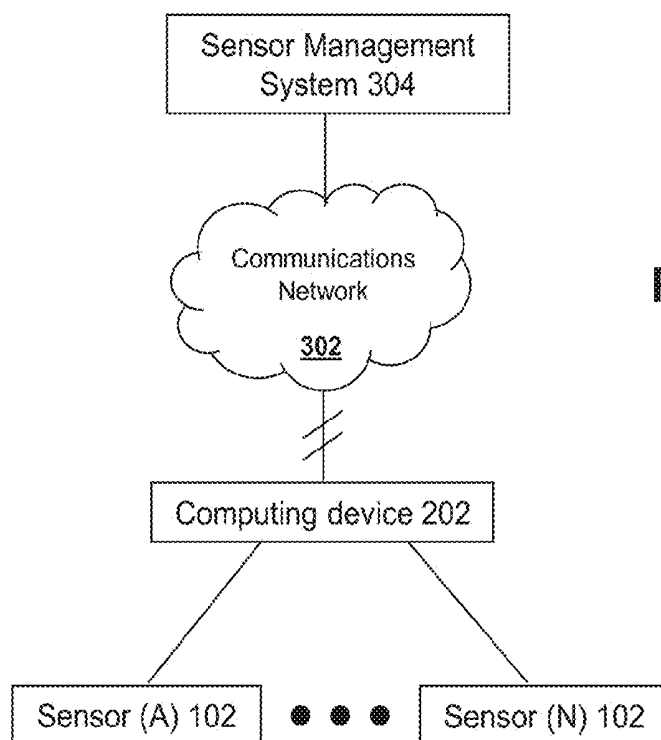


FIG. 3D

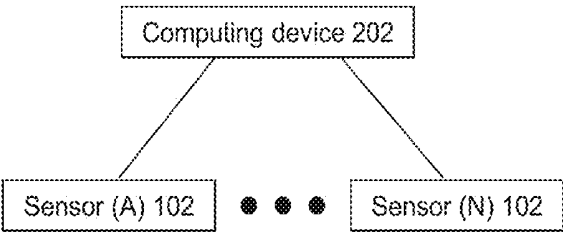


FIG. 3E

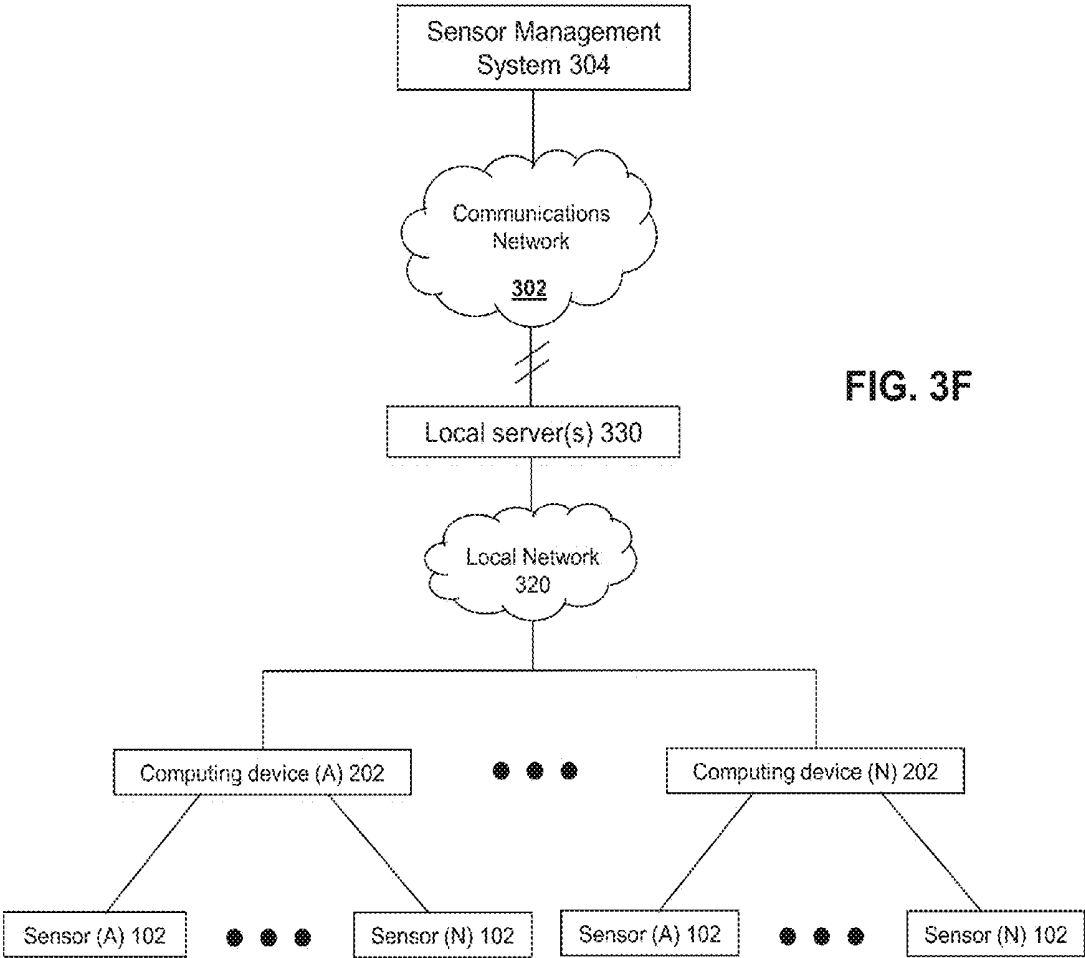


FIG. 3F

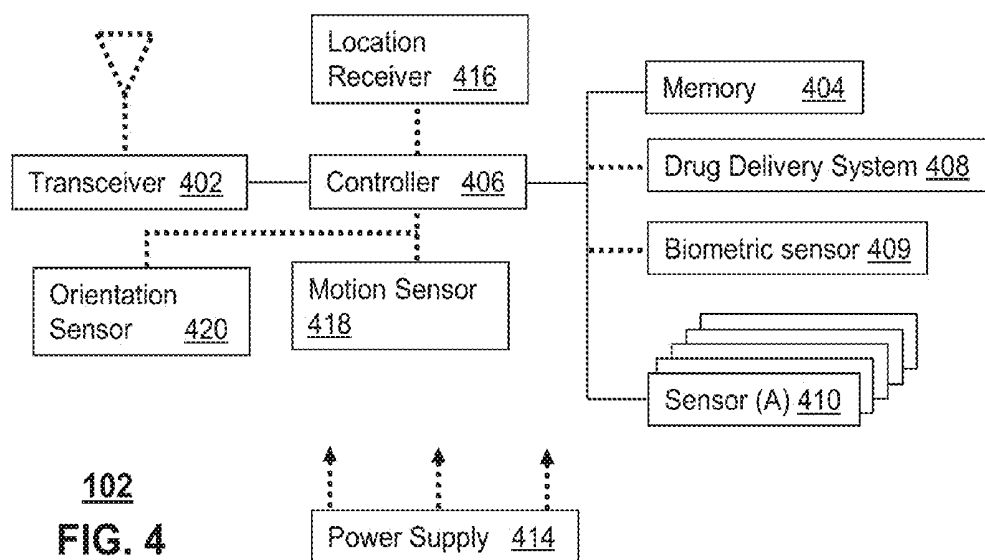


FIG. 4

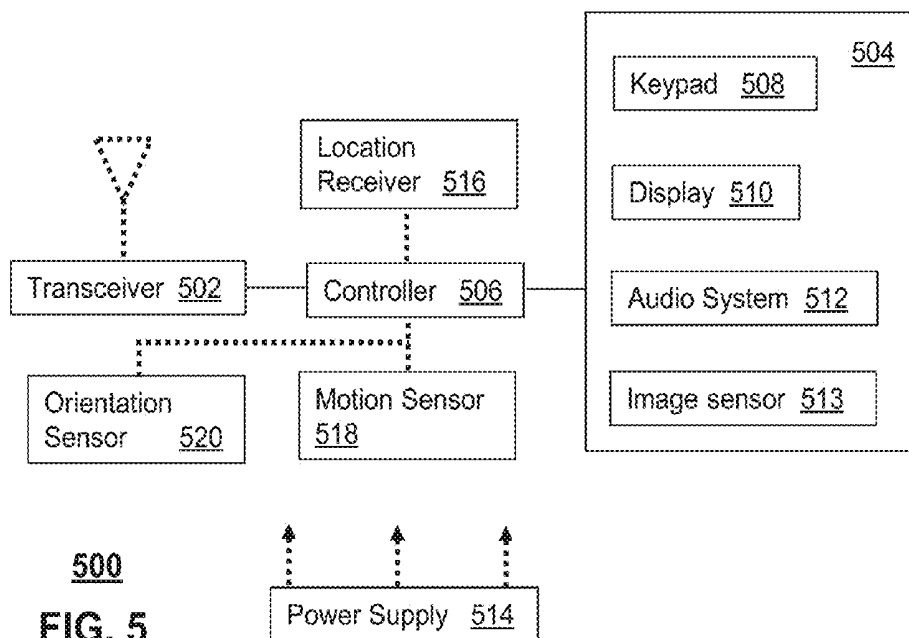
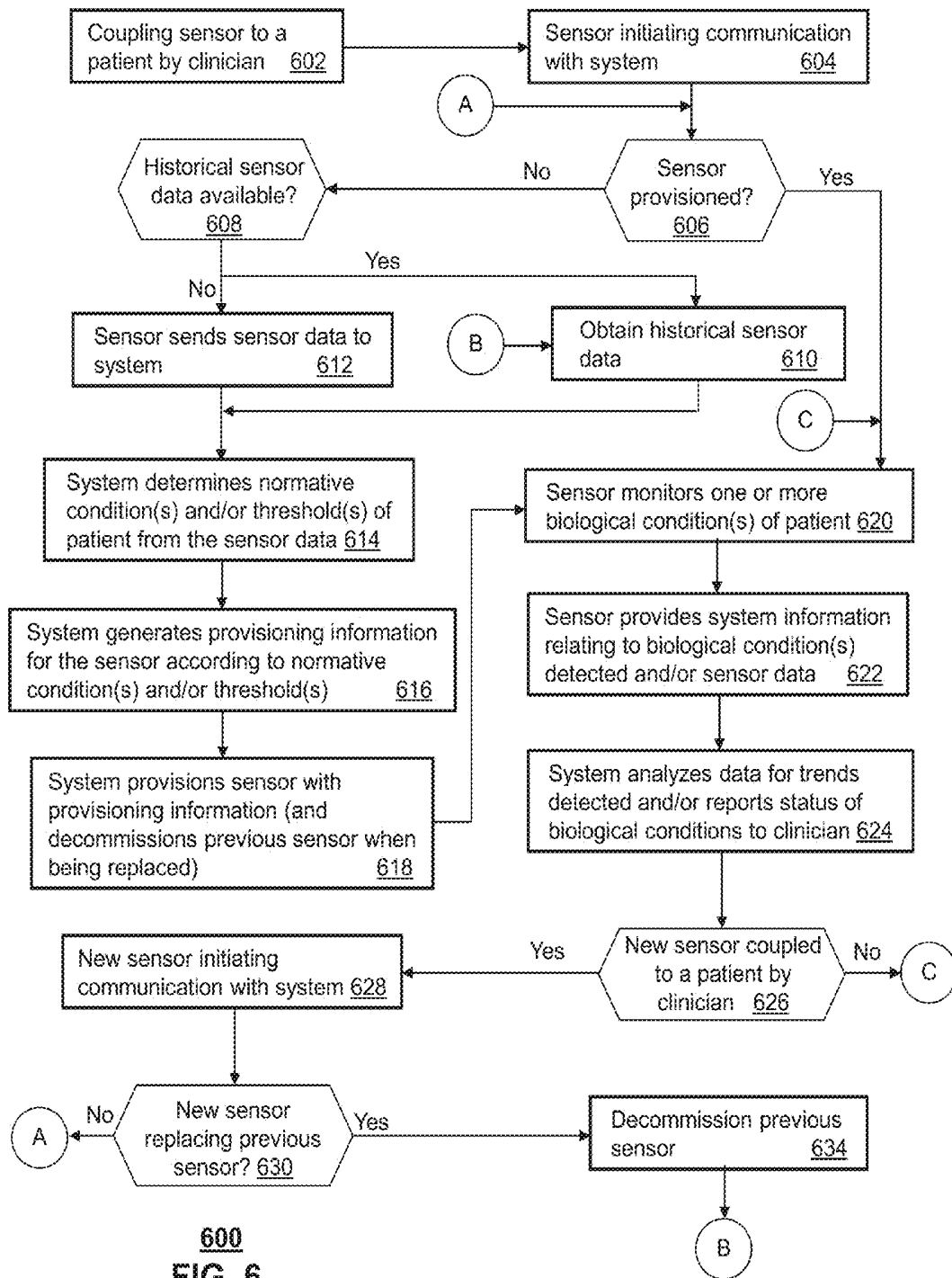


FIG. 5



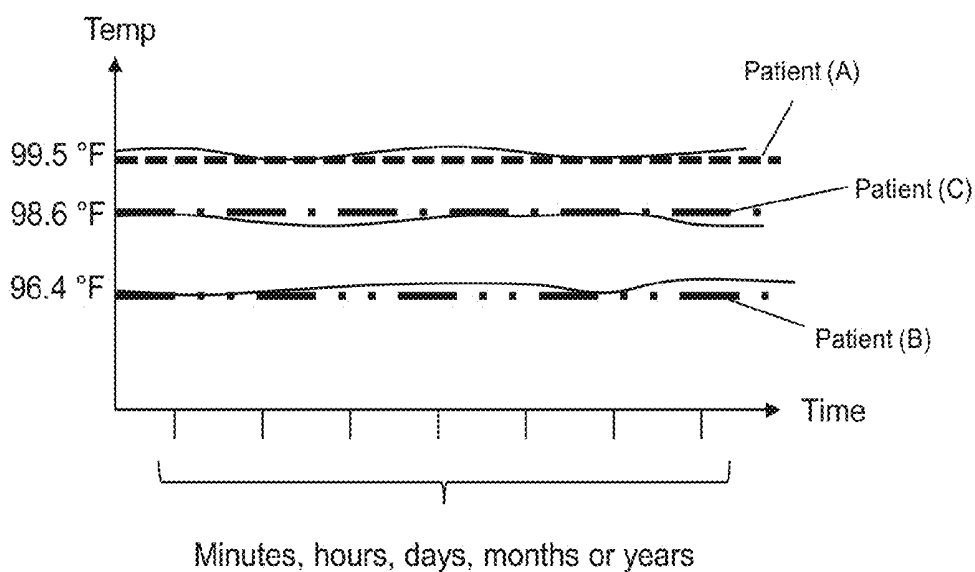


FIG. 7A

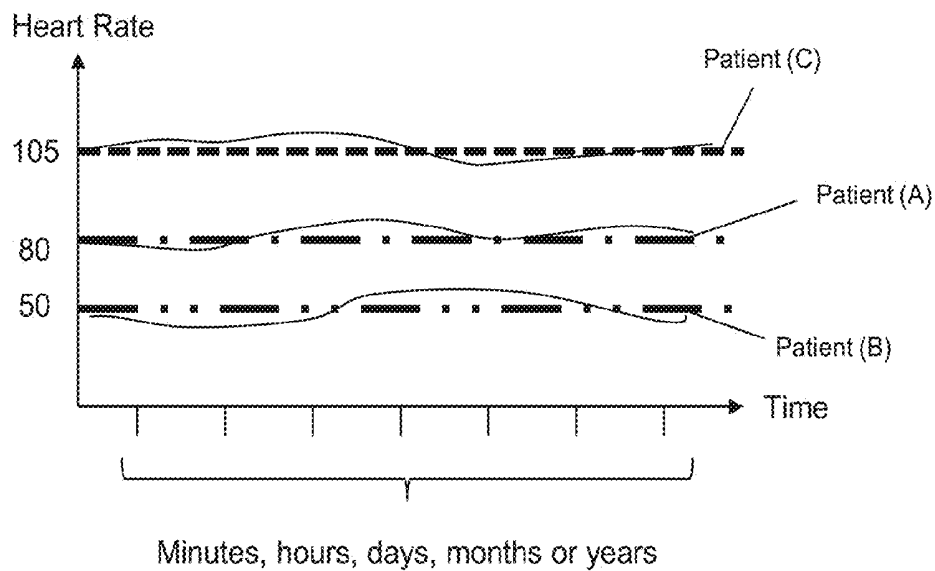


FIG. 7B

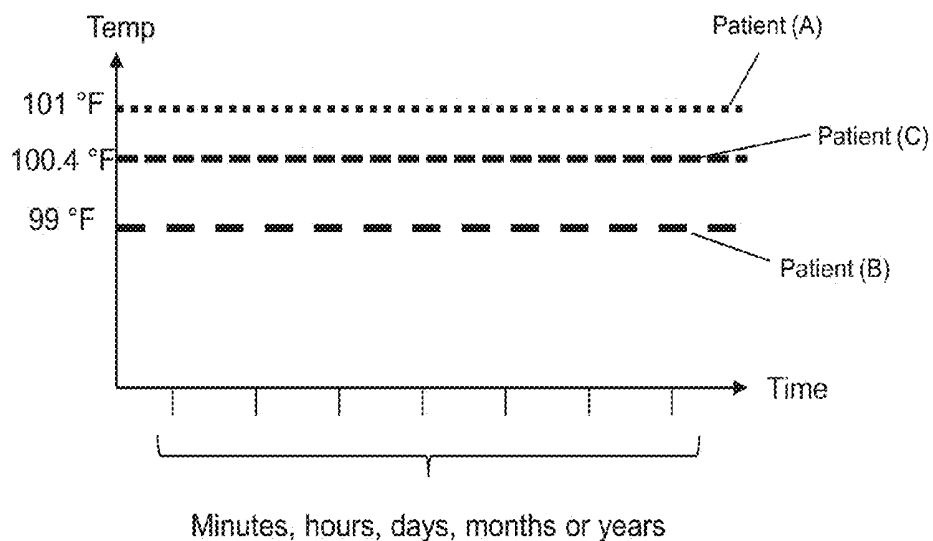


FIG. 7C

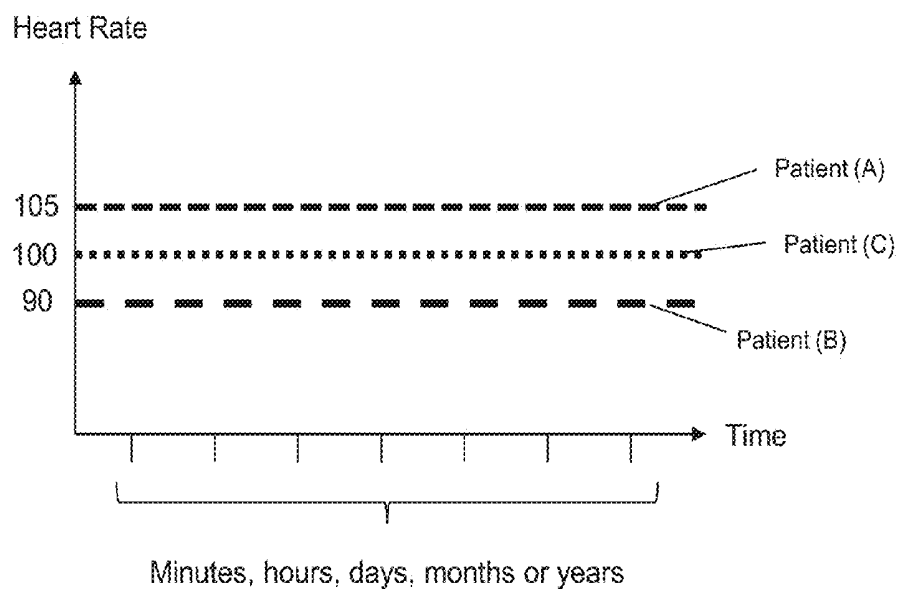
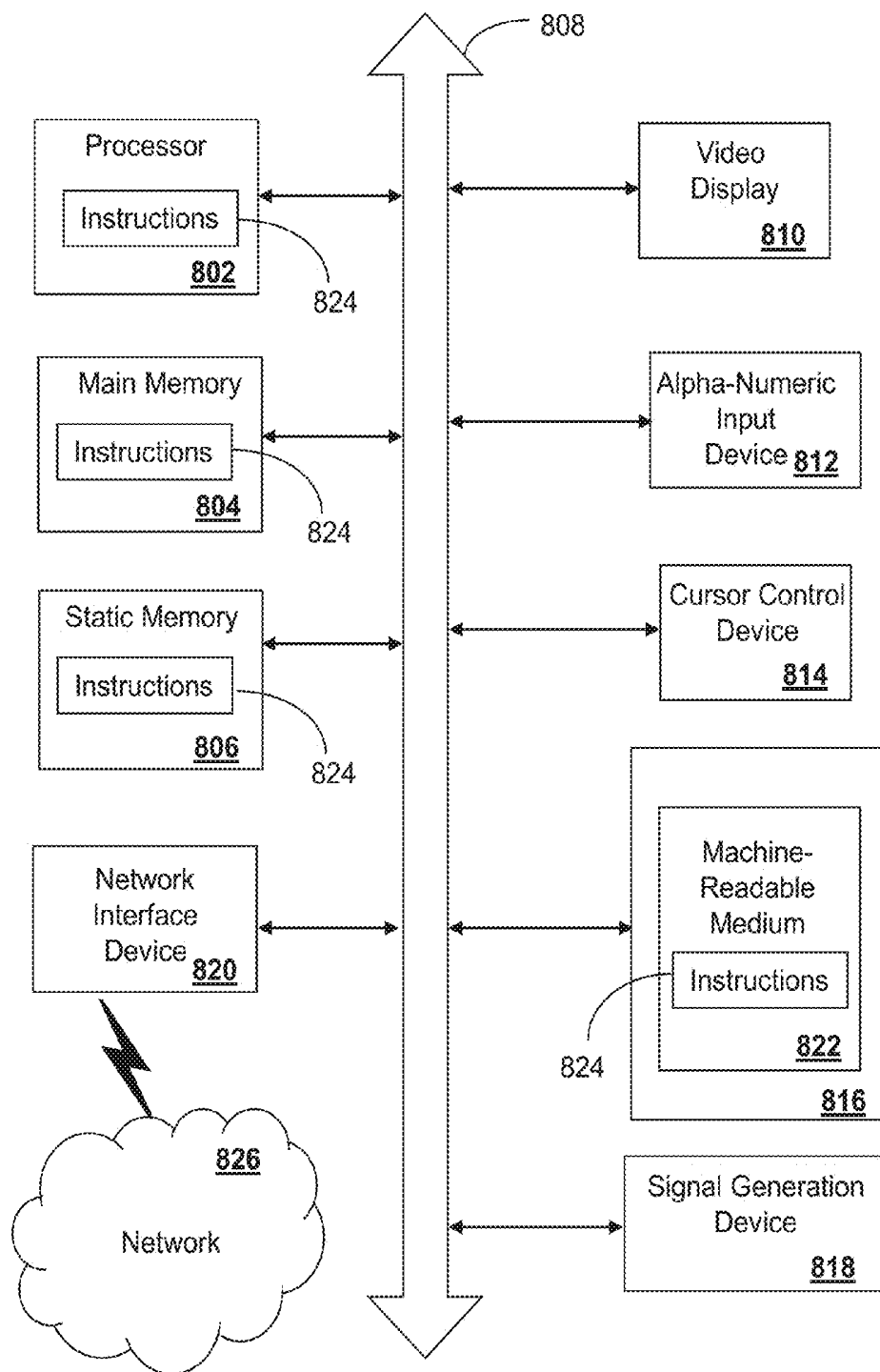


FIG. 7D



800
FIG. 8

METHOD AND APPARATUS FOR MANAGING SENSORS

FIELD OF THE DISCLOSURE

[0001] The subject disclosure relates to managing sensor data collected by a system.

BACKGROUND

[0002] Biological sensors can be used for measuring temperature, respiration, pulse rate, blood pressure, among other things. Some biological sensors can be implanted and can be configured to be battery-less. Battery-less sensors can utilize one or more antennas to receive radio frequency signals, and which can be converted to energy that powers components of the sensor while the radio frequency signals are present. Some biological sensors can also be configured to deliver dosages of a controlled substance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] Reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

[0004] FIG. 1 is a block diagram illustrating example, non-limiting embodiments for placing sensors on a patient in accordance with various aspects of the subject disclosure described herein;

[0005] FIGS. 2A-2B are block diagrams illustrating example, non-limiting embodiments for managing use of one or more sensors of a patient in accordance with various aspects of the subject disclosure described herein;

[0006] FIGS. 2C-2D are block diagrams illustrating example, non-limiting embodiments of a top view and side view of a biological sensor in accordance with various aspects of the subject disclosure described herein;

[0007] FIG. 2E is a block diagram illustrating an example, non-limiting embodiment of a removable component of a biological sensor in accordance with various aspects of the subject disclosure described herein;

[0008] FIGS. 2F-2I are block diagrams illustrating example, non-limiting embodiments for removing and decommissioning a biological sensor in accordance with various aspects of the subject disclosure described herein;

[0009] FIG. 2J is a block diagram illustrating an example, non-limiting embodiment of a method for decommissioning a biological sensor in accordance with various aspects of the subject disclosure described herein;

[0010] FIG. 2K is a block diagram illustrating an example, non-limiting embodiment of a method for decommissioning a biological sensor in accordance with various aspects of the subject disclosure described herein;

[0011] FIGS. 3A-3F are block diagrams illustrating example, non-limiting embodiments of a system for managing sensor data in accordance with various aspects of the subject disclosure described herein;

[0012] FIG. 4 is a block diagram illustrating an example, non-limiting embodiment of a biological sensor in accordance with various aspects of the subject disclosure described herein;

[0013] FIG. 5 is a block diagram illustrating an example, non-limiting embodiment of a computing device in accordance with various aspects of the subject disclosure described herein;

[0014] FIG. 6 is a block diagram illustrating an example, non-limiting embodiment of a method in accordance with various aspects of the subject disclosure described herein;

[0015] FIGS. 7A-7B are block diagrams illustrating example, non-limiting embodiments of plots of sensor data of a plurality of patients in accordance with various aspects of the subject disclosure described herein;

[0016] FIGS. 7C-7D are block diagrams illustrating example, non-limiting embodiments of thresholds used for monitoring biological conditions of the plurality of patients of FIGS. 7A-7B in accordance with various aspects of the subject disclosure described herein; and

[0017] FIG. 8 is a diagrammatic representation of a machine in the form of a computer system within which a set of instructions, when executed, may cause the machine to perform any one or more of the methods of the subject disclosure described herein.

DETAILED DESCRIPTION

[0018] The subject disclosure describes, among other things, illustrative embodiments for managing sensor data and usage of sensors generating the sensor data. Other embodiments are described in the subject disclosure.

[0019] One or more aspects of the subject disclosure include a machine-readable storage medium, including executable instructions that, when executed by a processor, facilitate performance of operations. The operations can include receiving data associated with a biological sensor, determining from the data that the biological sensor is no longer in use by a patient, and permanently decommissioning the biological sensor responsive to determining that the biological sensor is no longer in use by the patient.

[0020] One or more aspects of the subject disclosure include a biological sensor having a sensing device that facilitates generation of sensor data associated with a biological state of a patient, and an adhesive component of the sensing device that facilitates coupling to a skin of the patient and that facilitates being decoupled from the sensing device when a portion the biological sensor is removed from the patient, thereby permanently disabling operations of the sensing device.

[0021] One or more aspects of the subject disclosure include a system having a processor, and memory that stores executable instructions that, when executed by the processor, facilitate performance of operations. The operations can include determining from sensor data received from a biological sensor that the biological sensor is no longer in use by a patient, and permanently decommissioning the biological sensor responsive to determining that the biological sensor is no longer in use by the patient.

[0022] Turning now to FIG. 1, a block diagram illustrating example, non-limiting embodiments for placing biological sensors 102 on a patient 100 in accordance with various aspects of the subject disclosure is shown. FIG. 1 depicts a number of non-limiting illustrations of locations where biological sensors 102 can be placed on a patient 100. For example, biological sensors 102 can be placed on a patient's forehead, chest, abdomen, arms, hands, front or rear section of a thigh, behind an ear, on a side of an arm, neck, back, or calves as illustrated in FIG. 1. Other locations for placement of biological sensors 102 are possible and contemplated by the subject disclosure.

[0023] The biological sensors 102 can be placed or managed by a nurse 101 as shown in FIGS. 2A-2B. A nurse 101

can, for example, place a biological sensor **102** on the patient **100** as depicted in FIG. 2A and manage use of the biological sensor **102** with a computing device **202** such as a touch-screen tablet as depicted in FIG. 2B. The computing device **202** can also be represented by a smartphone, a laptop computer, or other suitable computing devices. The computing device **202** can be communicatively coupled to the biological sensor **102** by a wireless interface, such as, near field communications (NFC) having, for example, a range of 1-12 inches from the biological sensor **102**, Bluetooth®, ZigBee®, WiFi, or other suitable short range wireless technology. Alternatively, the computing device **202** can be communicatively coupled to the biological sensor **102** by a wired interface or tethered interface (e.g., a USB cable).

[0024] Biological sensors **102** can be placed on an outer surface of a skin of the patient **100** with an adhesive, or can be implanted in the patient **100**. Although the patient **100** is shown to be a human patient, a patient **100** can also be represented by a non-human species (e.g., a dog, a cat, a horse, cattle, a tiger, etc.) or any other type of biological organism which can use a biological sensor **102**. Biological sensors **102** can be used for a number of functions such as, for example, electrocardiogram measurements, measuring temperature, perspiration, pulse rate, blood pressure, respiration rate, glucose levels in blood, peripheral capillary oxygen saturation (SpO₂), and other measurable biological functions contemplated by the subject disclosure.

[0025] The biological sensors **102** can also be adapted to store measurements, compare measurements to biological markers to detect a biological condition, and to report such measurements and detected conditions. Biological sensors **102** are, however, not limited to monitoring applications. For example, biological sensors **102** can also be adapted to deliver controlled dosages of medication using, for example, micro-needles. Such sensors can also perform measurements to monitor a biological response by the patient **100** to the medication delivered, record and report measurements, frequency of dosages, amount of dosage delivered, and so on. The reports can also include temporal data such as day, month, year, time when measurement was performed and/or time when medication was delivered.

[0026] Now turning to FIGS. 2C-2D, block diagrams illustrating example, non-limiting embodiments of a top view and side view of a biological sensor **102** in accordance with various aspects of the subject disclosure described herein are shown. FIG. 2C illustrates a non-limiting embodiment of a top view of the biological sensor **102**. FIG. 2D illustrates a non-limiting embodiment of a side view of the biological sensor **102** that supplements the illustrations of FIG. 2C. The biological sensor **102** can comprise a circuit **216** disposed on a top surface **211** of a first substrate **212**. The circuit **216** and the first substrate **212** can comprise a single layer or multilayer flexible printed circuit board that electrically interconnects circuit components (not shown) of the circuit **216** using conductive traces and vias on a flexible substrate such as a polyimide substrate or other suitable flexible substrate technology. It will be appreciated that electrical components of the circuit **216** can also be disposed on a bottom surface **213** of the biological sensor **102**.

[0027] The biological sensor **102** can further comprise a second substrate **218** that adhesively couples to a bottom surface **213** of the first substrate **212**. In one embodiment, an adhesive layer **222** can be positioned near an outer edge of the second substrate **218**. The adhesive layer **222** can be used

to bind the second substrate **218** to the bottom surface **213** of the first substrate **212**. One or more components of the biological sensor **102** can be disposed on a top surface **217** or bottom surface **219** of the second substrate **218**. For example, an antenna **224** of the biological sensor **102** such as shown in FIG. 2E (shown also with ghosted lines in FIG. 2C) can be disposed on the top surface **217** of the second substrate **218**. The antenna **224** can be used for wireless communications between the biological sensor **102** and other communication devices. Other components of the biological sensor **102** can be disposed on the second substrate **218** in place of or in combination with the antenna **224**. For example, a transmitter, a power supply system, and/or a processor can be disposed on the top surface **217** or bottom surface **219** in place of or in combination with the antenna **224**. The second substrate **218** and the antenna **224** disposed thereon can also be constructed using flexible printed circuit board technology similar to or identical to the flexible printed circuit board technology used for constructing the first substrate **212** and circuit **216** disposed thereon.

[0028] To enable electrical connectivity between the antenna **224** and the circuit **216**, a conductive material **226** can be disposed on first and second feed points of the antenna **224**. The conductive material **226** (such as a metal contact) can be configured to make contact with first and second conductive pads **229** disposed on the bottom surface **213** of the first substrate **212**. The first and second conductive pads **229** can be electrically connected to first and second conductive vias **228**. The combination of the first and second conductive pads **229** and the first and second conductive vias **228** provide the first and second feed points of the antenna **224** electrical conductivity to one or more circuit components (e.g., transmitter and receiver) included in the circuit **216**. In an embodiment, the conductive material **226** of the first and second feed points can be configured so that it does not permanently adhered to the conductive pads **229** with solder or some other material with adherence properties.

[0029] To achieve electrical contact, an adhesive material **230** can be used at a center point (or at one or more other locations) of the second substrate **218** to cause the conductive material **226** to make electrical contact with the first and second conductive pads **229** by pressure (without adhesion). An adhesive layer **222** can also be used to maintain a stable position between the second substrate **218** and the first substrate **212** to avoid misaligning the conductive material **226** from the first and second conductive pads **229**. The adhesive interconnectivity between the first and second substrates **212** and **218**, respectively, provides an initial configuration in which the biological sensor **102** is in the form of a single unit prior to being placed on a skin surface **236** of a patient **100**.

[0030] The biological sensor **102** can further comprise an adhesive layer **214** disposed on the bottom surface **213** of the first substrate **212** that surrounds an outer edge of the first substrate **212**. Similarly, an adhesive layer **220** can be disposed on the bottom surface **219** of the first substrate **212** that surrounds an outer edge of the second substrate **218**. Prior to placing the biological sensor **102** on a patient **100**, a removable cover (not shown) can be coupled to the adhesive layers **214** and **220** to prevent exposing the adhesive layers **214** and **220** while the biological sensor **102** is in storage. The removable cover can be structurally configured with a smooth surface that reduces adherence to the adhesive

layers **214** and **220**, and thereby prevents damaging the adhesive properties of the adhesive layers **214** and **220** when the cover is removed. The removable cover can be further configured to extend outwardly from the adhesive layer **214** or it can include selectable tab to enable ease of removal of the cover from the biological sensor **102** in preparation for its use. The biological sensor **102** with an attached removable cover can be placed in a sealed package for storage purposes. In anticipation of the discussions that follow, it will be appreciated that the biological sensor **102** can include some or all of the components illustrated in FIG. 4, and can perform the operations described below.

[0031] Now turning to FIG. 2J, a block diagram illustrating an example, non-limiting embodiment of a method **240** for decommissioning the biological sensor **102** of FIGS. 2C-2D in accordance with various aspects of the subject disclosure described herein is shown. Method **240** will be described in view of FIGS. 2F-2I. Method **240** can begin with step **242** whereby a biological sensor **102** is placed on a patient **100** as shown in FIGS. 2A-2B. When a clinician (such as a nurse **101**) is prepared to utilize the biological sensor **102**, the sealed package holding the biological sensor **102** can be manually torn, and the cover can be removed thereby exposing adhesive layers **214** and **220**. The clinician can then place the biological sensor **102** on the skin **236** of the patient **100**. Upon doing so, the skin **236** of the patient **100** adheres to the adhesive layer **214** of the first substrate **212** and the adhesive layer **220** of the second substrate **218**.

[0032] At a later time (e.g., minutes, hours, days or weeks later), the clinician can determine at step **244** whether it is time to remove the biological sensor **102**. The first substrate **212** can comprise a tab **234** that does not adhere to the skin **236**. At step **246**, the tab **234** can be selected and pulled by the clinician to remove the biological sensor **102** when the clinician deems at step **244** that the biological sensor **102** is no longer to be used. The adhesive layers **222** and **220** can be configured so that the adhesive force between the bottom surface **213** of the first substrate **212** and the top surface **217** of the second substrate **218** is substantially weaker than the adhesive force between the skin **236** and the bottom surface **219** of the second substrate **218**.

[0033] A disparity in bonding forces can be accomplished by configuring the adhesive layer **220** so that it is wider than the adhesive layer **222** (e.g., 2:1) and/or by utilizing an adhesive material for the adhesive layer **220** that has a substantially stronger bonding force than a bonding force created by the adhesive material of the adhesive layer **222**. Consequently, when the clinician pulls tab **234** with sufficient force, the bond between the second substrate **218** and the first substrate **212** breaks enabling removal of the first substrate **212** from the second substrate **218**, while the second substrate **218** remains bonded to the skin **236** of the patient **100** as shown in FIGS. 2F-2G.

[0034] By separating the first substrate **212** from the second substrate **218**, the biological sensor **102** is permanently decommissioned since the biological sensor **102** can no longer transmit wireless signals to other communication devices as a result of the antenna **224** (that remains on the second substrate **218**) no longer making electrical contact with the circuit **216** of the first substrate **212**. To complete the removal process of the biological sensor **102**, the clinician can pull tab **232** of the second substrate **218** at step **248**, which is also not bonded to the skin **236**, thereby removing the remaining portion of the biological sensor **102** as shown

in FIGS. 2H-2I. According to FIGS. 2F-2I the biological sensor **102** can be decommissioned by a clinician in a two-step approach.

[0035] It will be appreciated that the biological sensor **102**, illustrated in FIGS. 2C-2D, can be modified or otherwise adapted with other embodiments that enable decommissioning of the biological sensor **102** in a manner similar to the steps illustrated in FIGS. 2F-2I. For example, the conductive materials **226** of the antenna **224** can be weakly bonded to conductive pads **229** with solder instead of relying on pressure contact. In this embodiment, the adhesive material **230** may no longer be required. The adhesive layer **220** can be configured to adhere to the skin **236** of the patient **100** such that it exceeds a force to break the solder joint between the conductive materials **226** and the conductive pads **229**.

[0036] In yet another embodiment, the second substrate **218** can include a component that inductively couples to the circuit **216** of the first substrate **212**. In this embodiment, electrical physical contact between the component and the circuit **216** is not required. If the component in the second substrate **218** is required to maintain operations of the biological sensor **102**, then the biological sensor **102** will be decommissioned when the first substrate **212** of the biological sensor **102** is removed from the patient **100** (as illustrated in FIGS. 2F-2G), which in turn removes the inductive coupling between the circuit **216** of the first substrate **212** and the component of the second substrate **218**. It will be appreciated that any circuit component required to operate the biological sensor **102** can be disposed on the second substrate **218** for purposes of decommissioning the biological sensor **102** when it is removed from the patient **100** as shown in FIGS. 2F-2I.

[0037] The subject disclosure therefore contemplates modifications to the foregoing embodiments of the biological sensor **102** that enables removal, damage or other form of modification to one or more components of the biological sensor **102**, which can serve to decommission the biological sensor **102** when a clinician removes the biological sensor **102** from the skin **236** of a patient **100**. Such a decommissioning process can help prevent inadvertent reuse, overuse or misuse of the biological sensor **102**.

[0038] Now turning to FIG. 2K, a block diagram illustrating an example, non-limiting embodiment of a method **250** for decommissioning a biological sensor **102** in accordance with various aspects of the subject disclosure described herein is shown. Method **250** can be used as an alternative embodiment to method **240**. Particularly, method **250** can be used in instances where physical removal of the biological sensor **102** from the skin **236** of patient **100** does not result in a decommissioning of the biological sensor **102**. With this in mind, method **250** can begin at step **252** where a clinician places a biological sensor **102** on a patient **100** as shown in FIGS. 2A-2B. The clinician can enable the biological sensor **102** at step **254** utilizing the computing device **202** shown in FIG. 2B, a sensor management system **304** shown in FIG. 3A, or other sensor management techniques, which are described below in accordance with the flowchart illustrated in FIG. 6. For illustration purposes only, it will be assumed that the biological sensor **102** is being managed by the computing device **202** and/or the sensor management system **304**. Other embodiments are disclosed.

[0039] Once the biological sensor **102** is enabled, the computing device **202** or sensor management system **304** can receive data from the biological sensor **102**. At step **257**,

the computing device **202** or sensor management system **304** can be configured to determine from the data whether the biological sensor **102** is no longer in use. For example, the data received from the biological sensor **102** can be motion sensor data generated by a motion sensor **418** shown in FIG. **4** described below. Motion sensor data can indicate that the biological sensor has been stationary for a period of time (e.g., 1 hour or more) which may indicate that the biological sensor **102** is no longer being used by the patient **100**.

[0040] The data can further include biological sensor data such as the patient's pulse rate, blood pressure, temperature, and/or other biological sensing data generated by one or more sensors **410** of the biological sensor **102** (shown in FIG. **4** and described below). If, for example, the biological sensor data is devoid of biological sensor readings (e.g., no pulse or blood pressure), a determination can be made that the biological sensor **102** is no longer in use. Similarly, if biological sensor data does not correspond to an expected range of the patient **100** (e.g., temperature reading received is room temperature as opposed to body temperature), then similarly a determination can be made that the biological sensor **102** is no longer in use. The computing device **202** or sensor management system **304** can analyze a single aspect or a combination aspects of the data it receives at step **256** to make a determination at step **257** whether the biological sensor **102** is in use.

[0041] If a determination is made that the biological sensor **102** continues to be in use by the patient **100**, the computing device **202** or sensor management system **304** can proceed to step **256** to continue monitoring data it receives from the biological sensor **102**. If, on the other hand, a determination is made that the biological sensor **102** is no longer in use, the computing device **202** or sensor management system **304** can proceed to step **258** and decommission the biological sensor **102**. The computing device **202** or sensor management system **304** can accomplish this step in several ways.

[0042] In one embodiment, the computing device **202** or sensor management system **304** can send wireless instructions to the biological sensor **102** to disable communications permanently. Upon receiving such instructions, the biological sensor **102** can permanently disable a transmitter of the biological sensor **102** by, for example, opening a switch that connects an antenna to the transmitter. The switch can be an electromechanical device designed to remain open after it is switched to an open position thereby permanently disabling communications by the biological sensor **102**. Alternatively, the biological sensor **102** can be configured to store information in a nonvolatile memory which informs the biological sensor **102** that communications (or operations in general) are to be permanently disabled. The nonvolatile memory can be configured such that once the information is written into memory it cannot be removed/erased from the memory. In yet another embodiment, the computing device **202** or sensor management system **304** can be configured to permanently decommission the biological sensor **102** by discontinuing communications with the biological sensor **102** and/or ignoring messages transmitted by the biological sensor **102**. In one embodiment, the decision by the computing device **202** or sensor management system **304** to stop communication (or ignore communications by the biological sensor **102**) can be associated with a unique identification number that is associated with the biological sensor **102**. In another embodiment, the computing device **202** or sensor

management system **304** can be configured to stop communication (or ignore communications) with one or more biological sensor **102** associated with a patient in response to the patient being discharged. The computing device **202** or sensor management system **304** can be integrated or communicatively coupled to a patient discharge system to detect when a patient is discharged.

[0043] It will be appreciated that method **250** can be adapted so that the biological sensor **102** can be configured to perform steps **257** and **258** independent of the computing device **202** or sensor management system **304**. For example, the biological sensor **102** can be configured to decommission itself if after a certain period (e.g., 1 hour) it has not detected motion, a pulse or other biological sensor readings. Method **250** can also be adapted so that steps **256-258** can be performed by an ancillary device such as a trash dispenser. For example, a trash dispenser can be configured with a communication device enabled to receive data from the biological sensor **102**, analyze the data at step **257** and decommission the biological sensor **102** at step **258** as previously described. The trash dispenser can also be configured to transmit a message to the computing device **202** or sensor management system **304**, the message providing an identification (e.g., patient ID, or other unique identifier) of the biological sensor **102**, and indicating that the biological sensor **102** has been decommissioned. The computing device **202** or sensor management system **304** can use this information to record the decommissioning of the biological sensor **102**.

[0044] While for purposes of simplicity of explanation, the respective processes are shown and described as a series of blocks in FIGS. **2J-2K**, it is to be understood and appreciated that the claimed subject matter is not limited by the order of the blocks, as some blocks may occur in different orders and/or concurrently with other blocks from what is depicted and described herein. Moreover, not all illustrated blocks may be required to implement the methods described herein.

[0045] Turning now to FIGS. **3A-3F**, block diagrams illustrating example, non-limiting embodiments of a system **300** for managing sensor data in accordance with various aspects of the subject disclosure is shown. FIG. **3A** depicts a network architecture in which one or more sensor management systems **304** are communicatively coupled to hospitals (A)-(N) **308**, clinicians (A)-(N) **310**, monitoring services (A)-(N) **312**, and/or patients (A)-(N) **100**, singly or in combination. The sensor management system **304** can record and access data from sensor databases (A)-(N) **306**. In an embodiment, hospitals (A)-(N) **308**, clinicians (A)-(N) **310**, and monitoring services (A)-(N) **312** can provide the sensor management system **304** access to patients **100** through their systems and local network devices as depicted in FIG. **3B**. Alternatively, the sensor management system **304** can be communicatively coupled to patients (A)-(N) **100** directly as shown in FIG. **3A** without intervening health care providers (such as hospitals, clinicians, or monitoring services), and instead provide care providers access to information of certain patients recorded in the sensor databases (A)-(N) **306**.

[0046] FIGS. **3C-3F** depict different arrangements for managing sensors **102**. In one embodiment, for example, the sensor management system **304** can be communicatively coupled to sensors **102** via the communications network **302** which is communicatively coupled to a local network **320**

(e.g., a local area network, WiFi access point, etc.) having access to the sensors 102 as depicted in FIG. 3C. In another embodiment, the sensor management system 304 can be communicatively coupled to sensors 102 via the communications network 302 which is communicatively coupled to a computing device 202 (such as shown in FIG. 2B) having access to the sensors 102 as depicted in FIG. 3D. In some embodiments, the computing device 202 can operate off-line (i.e., without access to the sensor management system 304) as depicted in FIG. 3D with the hash lines. While off-line, the computing device 202 can collect sensor data from sensors 102, provision sensors 102, and perform other tasks which can be recorded locally in a memory of the computing device 202. Once the computing device 202 restores access to the sensor management system 304 via communications network 302, the computing device 202 can provide the sensor management system 304 access to its local memory to update databases 306 with new sensor data, provisioning data, and so on.

[0047] In yet another embodiment, the computing device 202 can be configured to operate independently from the sensor management system 304 as depicted in FIG. 3E and collect sensor data from sensors 102, provision sensors 102, and perform other tasks which are recorded locally in the memory of the computing device 202. In another embodiment, the sensor management system 304 can be configured to communicate with one or more local servers 330 as depicted in FIG. 3F, which have access to computing devices 202 via a local network 320. The computing devices 202 can provide sensor management information to the local servers 330. The local servers 330 in turn can provide the sensor management system 304 access to the sensor information collected from the computing devices 202. In some embodiments, the local servers 330 can also be configured to operate independently from the sensor management system 304.

[0048] It will be appreciated from the number of illustrations shown in FIGS. 3A-3F that any number of network configurations between sensors 102 and other devices managing use of the sensors 102 is possible. It is further noted that the arrangements in FIGS. 3A-3F can be adapted for managing sensors worn by a patient located in a residence, a clinic, a doctor's office, a hospital, outdoors, while in transit, while traveling, and so on.

[0049] It is also noted that the communications network 302 and the local network 320 shown in FIGS. 3A-3F can comprise a landline communications network (e.g., packet switched landline networks, circuit switched networks, etc.), a wireless communications network (e.g., cellular communications, WiFi, etc.), or combinations thereof. It is also noted that the computing device 202 of FIG. 2B can be configured to initiate communications with the biological sensor 102 and the communications network 302 to provide the sensor management system 304 access to the biological sensors 102 used by multiple patients. In this embodiment, the computing device 202 can serve as a gateway between the communications network 302 and the biological sensors 102. In other embodiments, the biological sensors 102 can gain direct access to the communications network 302 by way of a gateway that provide internet access (e.g., a WiFi access point).

[0050] The sensor management system 304 can be configured to store endless amounts of biological data of patients 100 over long periods of time (e.g., an entire

lifetime and/or generations of patients) in databases 306. Such data can serve to provide historical information that may be invaluable to the patients 100 and their lineages.

[0051] Turning now to FIG. 4, a block diagram illustrating an example, non-limiting embodiment of a biological sensor 102 is shown. The biological sensor 102 can comprise a wireline and/or wireless transceiver 402 (herein transceiver 402), a power supply 414, a location receiver 416, a motion sensor 418, an orientation sensor 420, a memory 404, a drug delivery system 408, a biometric sensor 409, one or more sensors 410, and a controller 406 for managing operations thereof. Not all of the components shown in the biological sensor 102 are necessary. For example, in one embodiment the biological sensor 102 can comprise the transceiver 402, the controller 406, the memory 404, one or more sensors 410, and the power supply 404. In other embodiments, the biological sensor 102 can further include one or more components not used in the previous embodiment such as the drug delivery system 408, the biometric sensor 409, the location receiver 416, the motion sensor 418, the orientation sensor 420, or any combinations thereof. Accordingly, any combinations of component of the biological sensor 102 depicted in FIG. 4 are possible and contemplated by the subject disclosure.

[0052] Although FIGS. 1 and 2A-2B depict topical applications of the biological sensor 102 on an outer skin of the patient 100, in other embodiments, the biological sensor 102 can in whole or in part be embedded in a patient 100. For example, a certain sensor 410 may be embedded in a skin of the patient 100 while other components of the biological sensor 102 may be located on an outer surface of the skin. In other embodiments, a certain sensor 410 may be attached to an organ (e.g., the heart). Accordingly, the biological sensor 102 can be located in a number of places within a patient's body, outside a patient's body, or combinations thereof.

[0053] The transceiver 402 can support short-range or long-range wireless access technologies such as RFID, Near Field Communications (NFC), Bluetooth®, ZigBee®, WiFi, DECT, or cellular communication technologies, just to mention a few (Bluetooth® and ZigBee® are trademarks registered by the Bluetooth® Special Interest Group and the ZigBee® Alliance, respectively). Cellular technologies can include, for example, CDMA-1X, UMTS/HSDPA, GSM/GPRS, TDMA/EDGE, EV/DO, WiMAX, SDR, LTE, as well as other next generation wireless communication technologies as they arise. The transceiver 402 can also be adapted to support cable protocols (e.g., USB, Firewire, Ethernet, or other suitable cable technologies), circuit-switched wireline access technologies (such as PSTN), packet-switched wireline access technologies (such as TCP/IP, VoIP, etc.), or combinations thereof.

[0054] The drug delivery system 408 can comprise micro-needles, one or more reservoirs of one or more drugs, and a piezo inkjet (not shown). The piezo inkjet can be coupled to the one or more reservoirs to selectively deliver dosages via the micro-needles. The piezo inkjet can be coupled to the controller 406 which can provide controlled delivery of dosages of one or more drugs by the drug delivery system 408. The biometric sensor 409 can be a fingerprint sensor, a voice sensor (with a built-in microphone), or any other type of suitable biometric sensor for identifying a user of the biological sensor 102. The sensors 410 can use common biological sensing technology for measuring biological

functions of a patient including, but not limited to, temperature, perspiration, pulse rate, blood pressure, respiration rate, glucose levels in the blood, SpO₂, ECG/EKG, and so on.

[0055] The power supply **414** can utilize common power management technologies such as replaceable and rechargeable batteries, supply regulation technologies, and/or charging system technologies for supplying energy to the components of the biological sensor **102** to facilitate long-range or short-range portable applications. Alternatively, or in combination, the power supply **414** can utilize external power sources such as DC power supplied over a physical interface such as a USB port or other suitable tethering technologies.

[0056] In other embodiments, the biological sensor can be battery-less. In this embodiment, the power supply **414** can utilize circuitry that powers the components of the biological sensor **102** utilizing RF energy received by an antenna or other receptive element. In one embodiment, for example, the biological sensor **102** can use NFC technology to intercept RF signals generated by the computing device **202** when the computing device **202** is held about a foot or less away from the biological sensor **102**. In another embodiment, the biological sensor **102** can utilize battery-less technology similar to that used by passive RFID devices. Other suitable battery-less technologies can be applied to the embodiments of the subject disclosure.

[0057] The location receiver **416** can utilize location technology such as a global positioning system (GPS) receiver capable of identifying a location of the biological sensor **102** using signals generated by a constellation of GPS satellites. The motion sensor **418** can utilize motion sensing technology such as an accelerometer, a gyroscope, or other suitable motion sensing technology to detect a motion of the biological sensor **102** in three-dimensional space. The orientation sensor **420** can utilize orientation sensing technology such as a magnetometer to detect the orientation of the biological sensor **102** (north, south, west, east, as well as combined orientations in degrees, minutes, or other suitable orientation metrics).

[0058] The controller **406** can utilize computing technologies such as a microprocessor, a digital signal processor (DSP), programmable gate arrays, application specific integrated circuits, which can be coupled to the memory **404**. The memory **404** can utilize memory technologies such as Flash, ROM, RAM, SRAM, DRAM or other storage technologies for executing instructions, controlling operations of the biological sensor **102**, and for storing and processing sensing data supplied by the aforementioned components of the biological sensor **102**.

[0059] Turning now to FIG. 5, a block diagram illustrating an example, non-limiting embodiment of a computing device **202** in accordance with various aspects of the subject disclosure is shown. Computing device **202** can comprise a wireline and/or wireless transceiver **502** (herein transceiver **502**), a user interface (UI) **504**, a power supply **514**, a location receiver **516**, a motion sensor **518**, an orientation sensor **520**, and a controller **506** for managing operations thereof. The transceiver **502** can support short-range or long-range wireless access technologies such as Bluetooth®, ZigBee®, WiFi, DECT, or cellular communication technologies, just to mention a few. Cellular technologies can include, for example, CDMA-1X, UMTS/HSDPA, GSM/GPRS, TDMA/EDGE, EV/DO, WiMAX, SDR, LTE, as well as other next generation wireless communication

technologies as they arise. The transceiver **502** can also be adapted to support circuit-switched wireline access technologies (such as PSTN), packet-switched wireline access technologies (such as TCP/IP, VoIP, etc.), and combinations thereof.

[0060] The UI **504** can include a depressible or touch-sensitive keypad **508** with a navigation mechanism such as a roller ball, a joystick, a mouse, or a navigation disk for manipulating operations of the computing device **202**. The keypad **508** can be an integral part of a housing assembly of the computing device **202** or an independent device operably coupled thereto by a tethered wireline interface (such as a USB cable) or a wireless interface supporting for example Bluetooth®. The keypad **508** can represent a numeric keypad commonly used by phones, and/or a QWERTY keypad with alphanumeric keys. The UI **504** can further include a display **510** such as monochrome or color LCD (Liquid Crystal Display), OLED (Organic Light Emitting Diode) or other suitable display technology for conveying images to an end user of the computing device **202**. In an embodiment where the display **510** is touch-sensitive, a portion or all of the keypad **508** can be presented by way of the display **510** with navigation features.

[0061] In another embodiment, display **510** can use touch screen technology to serve as a user interface for detecting user input. As a touch screen display, the computing device **202** can be adapted to present a user interface with graphical user interface (GUI) elements that can be selected by a user with a touch of a finger. The touch screen display **510** can be equipped with capacitive, resistive or other forms of sensing technology to detect how much surface area of a user's finger has been placed on a portion of the touch screen display. This sensing information can be used to control the manipulation of the GUI elements or other functions of the user interface. The display **510** can be an integral part of the housing assembly of the computing device **202** or an independent device communicatively coupled thereto by a tethered wireline interface (such as a cable) or a wireless interface.

[0062] The UI **504** can also include an audio system **512** that utilizes audio technology for conveying low volume audio (such as audio heard in proximity of a human ear) and high volume audio (such as speakerphone for hands free operation). The audio system **512** can further include a microphone for receiving audible signals of an end user. The audio system **512** can also be used for voice recognition applications. The UI **504** can further include an image sensor **513** such as a charged coupled device (CCD) camera for capturing still or moving images.

[0063] The power supply **514** can utilize common power management technologies such as replaceable and rechargeable batteries, supply regulation technologies, and/or charging system technologies for supplying energy to the components of the computing device **202** to facilitate long-range or short-range portable applications. Alternatively, or in combination, the charging system can utilize external power sources such as DC power supplied over a physical interface such as a USB port or other suitable tethering technologies.

[0064] The location receiver **516** can utilize location technology such as a GPS receiver for identifying a location of the computing device **202** based on signals generated by a constellation of GPS satellites, which can be used for facilitating location services such as navigation. The motion sensor **518** can utilize motion sensing technology such as an

accelerometer, a gyroscope, or other suitable motion sensing technology to detect motion of the computing device 202 in three-dimensional space. The orientation sensor 520 can utilize orientation sensing technology such as a magnetometer to detect the orientation of the computing device 202 (north, south, west, and east, as well as combined orientations in degrees, minutes, or other suitable orientation metrics).

[0065] The controller 506 can utilize computing technologies such as a microprocessor, a digital signal processor (DSP), programmable gate arrays, application specific integrated circuits, and/or a video processor with associated storage memory such as Flash, ROM, RAM, SRAM, DRAM or other storage technologies for executing computer instructions, controlling, and processing data supplied by the aforementioned components of the computing device 202.

[0066] Other components not shown in FIG. 5 can be used in one or more embodiments of the subject disclosure. For instance, the computing device 202 can also include a slot for adding or removing an identity module such as a Subscriber Identity Module (SIM) card. SIM cards can be used for identifying subscriber services, executing programs, storing subscriber data, and so forth. The computing device 202 as described herein can operate with more or less of the circuit components shown in FIG. 5. These variant embodiments can be used in one or more embodiments of the subject disclosure.

[0067] Turning now to FIG. 6, a block diagram illustrating an example, non-limiting embodiment of a method 600 in accordance with various aspects of the subject disclosure is shown. Method 600 can be applied to any combination of the embodiments of FIGS. 1, 2A-2B, 3A-3B, and 4-5. Method 600 can begin with step 602 where a biological sensor 102 is placed on a patient 100 by one of a number of known means such as, for example, being placed by a clinician (e.g., a nurse as shown in FIG. 2A). In one embodiment, the biological sensor 102 can utilize an adhesive for coupling to the skin of the patient 100. In another embodiment, the clinician can be a surgeon that implants the biological sensor 102 in whole or in part in a body portion of the patient 100.

[0068] At step 604, the biological sensor 102 can be configured to initiate communications with a system. In one embodiment the biological sensor 102 can initiate communications with a computing device 202 such as shown in FIG. 2B. In this embodiment, the biological sensor 102 can initiate communications utilizing, for example, short range wireless technology such as near field communications (NFC), Bluetooth®, ZigBee®, WiFi or other suitable short range wireless communications technology. The computing device 202 in turn can communicate with the sensor management system 304 via the communications network 302 to provide the sensor management system 304 access to information supplied by the biological sensor 102.

[0069] In another embodiment, the biological sensor 102 can initiate communications with the sensor management system 304 by way of the communications network 302 utilizing long range wireless technology such cellular technology or other suitable long range wireless communications technology. In yet another embodiment, the biological sensor 102 can initiate communications with the sensor management system 304 by way of the communications network 302 utilizing wireline communications technology.

[0070] In one embodiment, for example, the biological sensor 102 can be tethered to the computing device 202 with a cable (e.g., a USB cable). In this embodiment, the computing device 202 can provide the sensor management system 304 access to information supplied by the biological sensor 102. In another embodiment, the biological sensor 102 can have access to a local network providing connectivity to the Internet by way of a cable (e.g., Ethernet cable). In this embodiment, the sensor management system 304 can have direct access to the biological sensor 102.

[0071] Based on the foregoing embodiments, the system referred to in step 604 and in subsequent steps can be represented by the computing device 202, the sensor management system 304, or a combination thereof. The term system as utilized in method 600 can be adapted to represent solely the computing device 202, solely the sensor management system 304, or a combination of the computing device 202 and the sensor management system 304, each configured to cooperate therebetween in a manner that achieves the embodiments described by method 600. It is also noted that other arrangements are possible as shown in FIGS. 3A-3F.

[0072] At step 606, the system can determine whether the biological sensor 102 is provisioned. This determination can be made a number of ways. For example, a clinician 101 can enter information on a computing device 202 which signals the sensor management system 304 that the biological sensor 102 is a new sensor placed on patient 100, which has not been provisioned. In another embodiment, the biological sensor 102 can be polled by the sensor management system 304 (or by the computing device 202) to determine if the biological sensor 102 has been provisioned. In another embodiment, the sensor management system 304 (and/or the computing device 202) can be configured to determine that a prior biological sensor 102 has been used (or is currently in use) by the patient 100 and the new biological sensor 102 that was detected is of a different serial number, but functionally equivalent or similar to the prior biological sensor 102.

[0073] In another embodiment, the sensor management system 304 (or the computing device 202) can be configured to receive from the biological sensor 102 an identification of the patient 100. To obtain this information, the biological sensor 102 can be configured to receive the identification of the patient 100 from the computing device 202. In another embodiment, the biological sensor 102 can obtain the identification from a wristband worn by the patient 100 that includes an RFID device or other device suitable to convey the identification of the patient 100 wirelessly to the biological sensor 102. Upon obtaining the identification of the patient 100, the sensor management system 304 (or the computing device 202) can be configured to retrieve a record of the patient 100 indexed according to the identification of the patient, and detect therefrom that the biological sensor 102 is not identified in a chart of the patient 100.

[0074] In yet another embodiment, the sensor management system 304 (or the computing device 202) can be configured to detect an expiration of a utilization period applied to a prior biological sensor 102 and determine that the biological sensor 102 now detected is a replacement sensor that has not been provisioned. There are many other ways to perform inventory management of biological sensors 102 to determine when the biological sensor 102 is not provisioned. For example, the sensor management system 304 (or the computing device 202) can be configured to

detect that provisioning data stored by the sensor management system 304 (or the computing device 202) is not synchronized with data stored in the biological sensor 102 by comparing time stamps associated with data stored in the biological sensor 102 to time stamps associated with data stored in the databases 306 of the sensor management system 304 (or the memory of the computing device 202). If the time stamps of the sensor management system 304 (or the memory of the computing device 202) are not the same as the time stamps of the biological sensor 102, then the sensor management system 304 (or the computing device 202) can detect the biological sensor 102 has not been provisioned. In yet another embodiment, the biological sensor 102 can provide the sensor management system 304 (or the computing device 202) information indicating it has not been provisioned.

[0075] These and other alternative embodiments for determining whether a biological sensor 102 is provisioned are contemplated by the subject disclosure.

[0076] Referring back to step 606, if the sensor management system 304 (or the computing device 202) detects the biological sensor 102 is not provisioned, the sensor management system 304 (or the computing device 202) can proceed to step 608 where it can determine whether historical sensor data is available. The historical sensor data can originate from prior biological sensors used by the patient 100. The historical sensor data can represent data captured minutes, hours, days, months or years before the new biological sensor 102 is detected at step 604. If the historical sensor data is available, the sensor management system 304 (or the computing device 202) can proceed to step 610 to obtain such data from a memory device used to retain records of the patient 100 (e.g., the customer sensor databases 306 or an internal memory of the computing device 202).

[0077] Once the historical sensor data is obtained, the sensor management system 304 (or the computing device 202) can proceed to step 614 to determine normative conditions and/or thresholds for detecting one or more biological conditions of the patient 100 from the historical sensor data collected from one or more previously used biological sensors 102. The historical sensor data collected from the one or more previously used biological sensors 102 can be over a period of time such as minutes, hours, days, weeks, months, years, or longer. The time period used for selecting historical sensor data can be driven by a number of factors. For example, the time period may be based on a specific protocol initiated by a clinician (nurse and/or doctor). The protocol can be initiated as a result of a procedure performed on the patient (e.g., surgery, therapy, drug application, and so on), a protocol for monitoring patient vitals, or a protocol customized by the clinician to address a particular disease. Any medical protocol prescribed by the clinician or a medical organization are contemplated by the subject disclosure. Once a time period is selected, the historical sensor data can be analyzed to identify one or more normative conditions and/or thresholds for the patient 100. FIGS. 7A-7D illustrate non-limiting example embodiments for determining normative conditions, and thresholds for detecting biological conditions.

[0078] Turning now to FIG. 7A, a block diagram illustrating an example, non-limiting embodiment of a plot of sensor data of a plurality of patients in accordance with various aspects of the subject disclosure is shown. FIG. 7

depicts three patients (A), (B) and (C). Historical sensor data of patient (A) indicates that the patient has had an average temperature of 99.5° Fahrenheit (F.) over a select period. In one embodiment, the clinician may be aware that patient (A) has exhibited this temperature over extended periods of time and thereby can form an opinion that such a temperature does not pose a health risk to patient (A) even though it is higher than a population norm of 98.6° F. In one embodiment, the clinician can record his opinion in a chart of patient (A), which can be accessible to the sensor management system 304 (or the computing device 202). In one embodiment, the sensor management system 304 (or the computing device 202) can access the chart of patient (A) and determine from the clinician's opinion that such a temperature may be considered a normative condition for patient (A) given the physiological state and health of patient (A). In another embodiment, the sensor management system 304 (or the computing device 202) can analyze the sensor data of the patient (A) in relation to the patient's temperature, other sensory data (e.g., blood pressure, pulse rate, respiration rate, blood pressure and so on) and/or other medical history, and determine, without relying on the clinician's opinion, that such a temperature may be considered a normative condition for patient (A) given the physiological state and health of patient (A).

[0079] In another embodiment, the clinician may be aware that patient (A) may be subject to an illness that the clinician expects will result in a rise in temperature, which the clinician records in the chart of patient (A). In yet another embodiment, the clinician may be applying a drug treatment to patient (A) that the clinician knows will cause a rise in temperature, which the clinician records in the chart of patient (A). The sensor management system 304 (or the computing device 202) can be configured to analyze the chart of patient (A) and consider the temperature a normative condition of patient (A) based on the entries of the clinician indicating an expected rise in temperature. Alternatively, the sensor management system 304 (or the computing device 202) can be configured to analyze the sensor data, detect from the chart that patient (A) has an illness, or is subject to a drug therapy, access information relating to the illness or drug therapy (from databases 306 or other information storage system(s)), and determine, without relying on the clinician's opinion, from the sensor data and the information obtained about the illness or drug therapy that the temperature of patient (A) would be higher than normal, and therefore can be considered a normative condition of patient (A).

[0080] Turning now to patient (B), the historical sensor data of patient (B) indicates that the patient has had an average temperature of 96.4° F. over a select period. In one embodiment, the clinician may be aware that patient (B) has exhibited this temperature over extended periods of time and that such a temperature does not pose a health risk to patient (B). Clinician can record his or her opinion in a chart of patient (B) accessible to the sensor management system 304 (or the computing device 202). Thus such a temperature may be considered a normative condition for patient (B) given the physiological state and health of patient (B). In another embodiment, the clinician may be aware that patient (B) may be subject to an illness that results in such a temperature. In yet another embodiment, the clinician may be applying a drug treatment to patient (B) that the clinician knows will cause a drop in temperature.

[0081] The sensor management system 304 (or the computing device 202) can be configured to analyze the chart of patient (B) and consider the temperature a normative condition of patient (B) based on the entries of the clinician indicating an expected drop in temperature. Alternatively, the sensor management system 304 (or the computing device 202) can be configured to analyze the sensor data, detect from the chart that patient (B) has an illness, or is subject to a drug therapy, access information relating to the illness or drug therapy (from databases 306 or other information storage system(s)), and determine, without relying on the clinician's opinion, from the sensor data and the information obtained about the illness or drug therapy that the temperature of patient (B) would be lower than normal, and therefore can consider it a normative condition of patient (B).

[0082] Turning now to patient (C), the historical sensor data of patient (C) indicates that the patient has had an average temperature of 98.6° F. over a select period, which coincides with what most clinicians may consider an average temperature for the general population. Thus the clinician does not have to consider exceptions for patient (C). Accordingly, this temperature will be used as a normative condition for patient (C). The sensor management system 304 (or the computing device 202) can be configured to analyze the chart of patient (C) and consider the temperature a normative condition of patient (C). Alternatively, the sensor management system 304 (or the computing device 202) can be configured to analyze the sensor data, and determine, without relying on the clinician's opinion, that the sensor data coincides with the general population, and therefore can consider it a normative condition of patient (C).

[0083] Turning now to FIG. 7B, a block diagram illustrating an example, non-limiting embodiment of a plot of sensor data of the plurality of patients (A)-(C) of FIG. 7A. Historical sensor data of patient (A) indicates that the patient has had an average pulse rate of 80 beats per minute over a select period. The sensor management system 304 (or the computing device 202) can be configured to consider such a pulse rate a normative condition for patient (A) given that a range of 60 to 100 beats per minute is generally a healthy pulse rate. In one embodiment, the clinician can record his opinion in a chart of patient (A), which can be accessed by the sensor management system 304 (or the computing device 202).

[0084] Turning now to patient (B), the historical sensor data of patient (B) indicates that the patient has had an average pulse rate of 50 beats per minute over a select period. In one embodiment, the clinician may be aware that patient (B) has exhibited this pulse rate over extended periods of time given the athletic training undertaken by patient (B). In one embodiment, the clinician can record his opinion in a chart of patient (B), which can be accessed by the sensor management system 304 (or the computing device 202). In one embodiment, the sensor management system 304 (or the computing device 202) can access the chart of patient (B) and determine from the clinician's opinion that such a pulse rate may be considered a normative condition for patient (B) given the physiological state and health of patient (B). In another embodiment, the sensor management system 304 (or the computing device 202) can analyze the sensor data of the patient (B) in relation to the patient's pulse rate, other sensory data (e.g., temperature,

blood pressure, respiration rate, blood pressure and so on) and other medical history, and determine, without relying on the clinician's opinion, that such a pulse rate may be considered a normative condition for patient (B) given the physiological state and health of patient (B).

[0085] Turning now to patient (C), the historical sensor data of patient (C) indicates that the patient has had an average pulse rate of 105 beats per minute over a select period, which is above normal. In one embodiment, the clinician may be aware that patient (C) has a condition such as, for example, hypertension, coronary artery disease, thyroid disease, etc., which can result in a higher pulse rate that the clinician records in the chart of patient (C). In yet another embodiment, the clinician may be applying a drug treatment to patient (C) that the clinician knows will cause a rise in pulse rate, which the clinician records in the chart of patient (C).

[0086] In one embodiment, the sensor management system 304 (or the computing device 202) can be configured to analyze the chart of patient (C) and consider the pulse rate a normative condition of patient (C) based on the entries of the clinician indicating an expected rise in pulse rate. Alternatively, the sensor management system 304 (or the computing device 202) can be configured to analyze the sensor data, detect from the chart that patient (C) has an illness, or is subject to a drug therapy, access information relating to the illness or drug therapy (from databases 306 or other information storage system(s)), and determine, without relying on the clinician's opinion, from the sensor data and the information obtained about the illness or drug therapy that the pulse rate of patient (C) would be higher than normal, and therefore can be considered a normative condition of patient (C).

[0087] Turning now to FIG. 7C, a block diagram illustrating an example, non-limiting embodiment of temperature thresholds used for monitoring biological conditions of the plurality of patients (A)-(C) according to the sensor data of FIG. 7A. Turning now to patient A, given the normative condition of patient (A) averages at 99.5° F., the clinician may consider an adverse biological condition to begin at 101° F. If, for example, patient (A) does not have an illness or is not being treated with drug therapy to cause a normative condition at 99.5° F., then a threshold of 101° F. may be considered the beginning of a fever. If, on the other hand, patient (A) is subject to an illness or drug therapy resulting in the normative condition, then a rise in temperature to 101° F. may reflect an adverse biological condition that is more than just a fever. For example, the adverse biological condition may represent a body's negative reaction to the drug therapy and/or a worsening of the illness. In one embodiment, the threshold can be established by the clinician, which the clinician can record in the chart of patient (A). In another embodiment the threshold can be established by protocols relating to the illness and/or the drug therapy.

[0088] In one embodiment, the sensor management system 304 (or the computing device 202) can be configured to analyze the chart of patient (A) and generate the threshold shown in FIG. 7C. Alternatively, the sensor management system 304 (or the computing device 202) can be configured to analyze the normative condition of patient (A), detect from the chart that patient (A) has an illness, and/or is subject to a drug therapy, access information relating to the illness and/or drug therapy (e.g., specific protocols), and

determine, without relying on the clinician's proposed threshold, the threshold shown in FIG. 7C.

[0089] Turning now to patient (B), given the normative condition of patient (B) averages at 96.4° F., the clinician may consider an adverse biological condition to begin at 99° F. If, for example, patient (B) does not have an illness or is not being treated with drug therapy to cause a normative condition at 96.4° F., then a threshold of 99° F. may be considered the beginning of a fever. If, on the other hand, patient (B) is subject to an illness or drug therapy resulting in the normative condition, then a rise in temperature to 99° F. may reflect an adverse biological condition that is more than just a fever. For example, the adverse biological condition may represent a body's negative reaction to the drug therapy and/or a worsening of the illness. In one embodiment, the threshold can be established by the clinician, which the clinician can record in the chart of patient (B). In another embodiment the threshold can be established by protocols relating to the illness and/or the drug therapy.

[0090] In one embodiment, the sensor management system 304 (or the computing device 202) can be configured to analyze the chart of patient (B) and generate the threshold shown in FIG. 7C. Alternatively, the sensor management system 304 (or the computing device 202) can be configured to analyze the normative condition of patient (B), detect from the chart that patient (B) has an illness, and/or is subject to a drug therapy, access information relating to the illness and/or drug therapy (e.g., specific protocols), and determine, without relying on the clinician's proposed threshold, the threshold shown in FIG. 7C.

[0091] Turning now to patient (C), given the normative condition of patient (C) averages at 98.6° F. is considered normal for the general population, the clinician may consider an adverse biological condition to begin at 100.4° F. Such a threshold can be used for detecting a fever. The clinician can record in the chart of patient (C) that patient (C) exhibits the temperature norm of the general population. The sensor management system 304 (or the computing device 202) can be configured to analyze the chart of patient (C) and generate the threshold shown in FIG. 7C. Alternatively, the sensor management system 304 (or the computing device 202) can be configured to analyze the normative condition of patient (C), and determine that an appropriate threshold for detecting a fever follows the norm of the general population and thus arrive at the threshold shown in FIG. 7C.

[0092] Turning now to FIG. 7D, a block diagram illustrating an example, non-limiting embodiment of pulse rate thresholds used for monitoring biological conditions of the plurality of patients (A)-(C) according to the sensor data of FIG. 7B. Turning now to patient A, given the normative condition of patient (A) averages at 80 beats per minute, which is considered normal for the general population, the clinician may consider an adverse biological condition to begin at 105 beats per minute when the patient is at rest (5% above the norm of the general population, which is 100 beats per minute). The biological sensor 102 used by patient (A) can detect that the patient is at rest utilizing, for example, the motion sensor 418 depicted in FIG. 4. In one embodiment, the threshold can be established by the clinician, which the clinician can record in the chart of patient (A). In one embodiment, the sensor management system 304 (or the computing device 202) can be configured to analyze the chart of patient (A) and generate the threshold shown in FIG.

7D. Alternatively, the sensor management system 304 (or the computing device 202) can be configured to analyze the normative condition of patient (A), and determine, without relying on the clinician's opinion, that patient (A) should use a threshold applied to the general population, such as, for example, a threshold of 100 beats per minute.

[0093] Turning now to patient (B), given the normative condition of patient (B) averages at 50 beats per minute, if, for example, patient (B) does not have an illness and is not being treated with drug therapy to cause a normative condition at 50 beats per minute, then the clinician may consider an adverse biological condition to begin at 90 beats per minute when the patient is at rest. Even though 90 beats per minute is below a population threshold of 100 beats per minute, the clinician may consider a change from 50 to 90 beats per minute to be a substantial change for a patient with a history of rigorous athletic training. The biological sensor 102 used by patient (B) can detect that the patient is at rest utilizing, for example, the motion sensor 418 depicted in FIG. 4. The chart of patient (B) may also include information indicating the last time patient (B) was measured at 50 beats per minute.

[0094] In one embodiment, the sensor management system 304 (or the computing device 202) can be configured to determine from the chart of patient (B) the threshold of 90 beats per minute and thereafter monitor patient (B) for unexpected changes. The sensor management system 304 (or the computing device 202) can also be configured to detect unexpected rapid changes in pulse rate in a relatively short period (e.g., 48 hours or less). Further, the sensor management system 304 (or the computing device 202) can also be configured to detect a trend in the pulse rate of patient (B) (e.g., an upward trend in pulse rate over weeks or months).

[0095] Turning now to patient (C), given the normative condition of patient (C) averages at 105 beats per minute, which is high (likely due to illness, e.g., hypertension), the clinician may consider an adverse biological condition to begin at 100 beats per minute when patient (C) is at rest. The clinician may have set a threshold below the normative condition as a result of the clinician prescribing medication to reduce hypertension in patient 100. Such prescription may reduce the pulse rate of the patient by, for example, 15% (e.g., ~90 beats per minute). The clinician can enter the prescribed medication in the chart of patient 100 which is accessible to the sensor management system 304 (or the computing device 202). Although FIG. 7B shows a normative condition of 105 beats per minute, the sensor management system 304 (or the computing device 202) can be configured to recognize an adjusted normative condition of 90 beats per minute while patient 100 is using the hypertension medication.

[0096] In one embodiment, the sensor management system 304 (or the computing device 202) can be configured to determine from the chart of patient (C) the threshold of 100 beats per minute and thereafter monitor patient (C) for unexpected changes. The sensor management system 304 (or the computing device 202) can also be configured to detect unexpected rapid changes in pulse rate in a relatively short period (e.g., 48 hours or less). Further, the sensor management system 304 (or the computing device 202) can also be configured to detect a trend in the pulse rate of patient (C) (e.g., an upward trend in pulse rate over weeks or months).

[0097] The foregoing embodiments for determining normative conditions and thresholds of a patient as shown in FIGS. 7A-7D can also be used for other vital signs (e.g., blood pressure, respiration rate), as well as to other biological functions that can be measured for a patient (e.g., red cell count, SpO₂, glucose levels in the blood, electrocardiogram measurements, and so on). Additionally, the sensor management system 304 (or the computing device 202) can be configured to analyze sensor data of more than one biological function at a time to assess normative conditions and thresholds rather than relying on a single biological function. The sensor management system 304 (or the computing device 202) can, for example, correlate one type of biological sensor data (e.g., pulse rate) with another type of biological sensor data (e.g., blood pressure) to determine a normative condition and/or threshold. In this manner, the sensor management system 304 (or the computing device 202) can perform a more holistic analysis of the patient's sensor data.

[0098] It is further noted that the normative conditions and the thresholds of FIGS. 7A-7D can have a temporal component. That is, a normative condition may be considered normative only for a period of time either by instructions from the clinician, medical protocols and/or other medical conditions associated with the patient 100 that can be determined by the sensor management system 304 (or the computing device 202). In one embodiment, a threshold can be set for a specific time period. For example, the sensor management system 304 (or the computing device 202) can detect when a drug therapy has begun and when it ends by obtaining information from the chart of the patient 100. In an embodiment, the sensor management system 304 (or the computing device 202) can be configured to change normative conditions and corresponding thresholds upon expiration of such periods.

[0099] In another embodiment, the sensor management system 304 (or the computing device 202) can be adapted to use ranges of the normative conditions and thresholds shown in FIGS. 7A-7D. That is, a normative condition and/or a threshold can have a range having an upper and lower limit. In another embodiment, more than one normative condition and more than one threshold can be used to identify different biological conditions that may arise in a patient as the patient's sensor data shows measurements drifting in one direction or another. In yet another embodiment, the sensor management system 304 (or the computing device 202) can be adapted to detect sensor data trends that it can use to predict future outcomes before they occur. A sensor data trend can, for example, identify a specific course that measurements may be taking, which in turn can provide the sensor management system 304 (or the computing device 202) a projected trajectory and time when an adverse condition may occur. In another embodiment, the sensor management system 304 (or the computing device 202) can be adapted to detect erratic changes in sensor data. Such changes can be flagged as a problem with the biological sensors 102 (e.g., a malfunction) and/or biological issues that may need to be addressed.

[0100] It is further noted that algorithms for detecting biological conditions can be generated by the sensor management system 304 (or the computing device 202). In one embodiment, for example, the sensor management system 304 (or the computing device 202) can be configured to generate a script or software program that emulates a spe-

cific medical protocol used for detecting biological conditions associated with an illness of the patient, an adverse reaction to a drug therapy being applied to the patient, or some other biological condition to be monitored. The script or software can be generated by the sensor management system 304 (or the computing device 202) can, for example, detect trends, detect when sensor measurements exceed thresholds, detect erratic or rapid changes, applying hysteresis to sensor measurements to filter out short bursts of anomalous readings, detect malfunctions in the biological sensor 102, and so on. So long as the biological sensor 102 has the computing resources, any algorithm of any complexity can be supplied to the biological sensor 102. For example, a script or software can determine how often a patient 100 is sensed. Patients that are healthy, for instance, may be sensed less frequently thereby saving battery power of the sensor 102. Patients that may have a condition may have a script or software that's more aggressive on readings.

[0101] The script or software can comprise instructions executable by the biological sensor 102, or macro instructions that can be translated (compiled) by the biological sensor 102 into executable instructions. Each algorithm can be given a version which can be sent to the biological sensors 102 for version tracking. As medical protocols change, the sensor management system 304 (or the computing device 202) can query biological sensors 102 for versions and download new algorithmic versions when a version used by the biological sensors 102 is out-of-date. The sensor management system 304 (or the computing device 202) can also be configured to provide new algorithmic versions to the biological sensors 102 that are pre-programmed with a certain algorithmic version that may be out-of-date.

[0102] Referring back to FIG. 6, the foregoing embodiments illustrate ways to process historical sensor data obtained at step 610 (and chart information if available for the patient 100) to determine normative conditions and/or thresholds at step 614. It is noted that chart information may be electronically stored by the sensor management system 304, the computing device 202, or other storage systems accessible by the sensor management system 304 and/or the computing device 202.

[0103] Referring back to step 608, if the sensor management system 304 (or the computing device 202) detects that historical sensor data is not available for the patient 100, the sensor management system 304 (or the computing device 202) can proceed to step 612. At this step, the sensor management system 304 (or the computing device 202) can collect sensor data from the new sensor until sufficient sensor data is available to determine normative conditions and/or thresholds for the patient according to the sensor data (and chart information if available for the patient).

[0104] Referring now to step 614, once the normative condition(s) and/or threshold(s) have been determined according to historical sensor data obtained at step 610, the sensor management system 304 (or the computing device 202) can proceed to step 616 and generate provisioning information for the new biological sensor 102 detected at step 606. The provisioning information can include, among other things, one or more normative conditions, one or more thresholds, one or more algorithms (if the biological sensor 102 is not pre-programmed or has an out-of-date algorithm), a most recent history of sensor data measurements (e.g., measurements performed in the last hour), identification

information of the patient **100**, a last known location of the patient, certain chart information relating to the patient (e.g., illness type, drug therapy type, date of surgery, type of surgery, etc.), and so on. The amount of information included in the provisioning information generated at step **616** can depend on the memory resources of the biological sensor **102**, the function of the biological sensor **102**, usage preferences of the clinician (e.g., ability to recall a short history of sensor data), and so forth.

[0105] Once provisioning information has been generated, the sensor management system **304** (or the computing device **202**) can proceed to step **618** and provide the provisioning information to the biological sensor **102**. The biological sensor **102** can then begin to monitor one or more biological conditions of the patient at step **620**. Such conditions can be determined from an algorithm provided to (or pre-programmed in) the biological sensor **102**. In one embodiment, the algorithm can detect that sensor measurements exceed a specific threshold or a threshold range. In other embodiments, the algorithm can detect sensor data trends, erratic or rapid changes, and/or predict future outcomes. At step **622**, the biological sensor **102** can provide the sensor management system **304** (or the computing device **202**) information relating to detection of biological conditions monitored by the biological sensor **102**, including without limitations, sensor data measurements, measurements exceeding a specific threshold or threshold range, trends in sensor data, erratic or rapid changes in sensor data, predicted adverse biological conditions, and so on. Such information can be provided to the sensor management system **304** (or the computing device **202**) with time stamps (e.g., time of day: hours/minutes/second, date: month/day/year).

[0106] If trend information is not provided at step **622**, the sensor management system **304** (or the computing device **202**) can be configured at step **624** to analyze the sensor data to detect trends, erratic or rapid changes and so on. The sensor management system **304** (or the computing device **202**) can also be configured to report a status of biological conditions of the patient **100** to clinicians. For example, if no adverse biological conditions have been detected, the clinician can be provided a history of the measured sensor data in a status report that indicates no adverse biological conditions were detected. If, on the other hand, one or more adverse biological conditions were detected, the clinician can be provided with a detailed report that includes sensor data that exceeded one or more thresholds, time stamp information associated with the sensor data, and so on. The sensor management system **304** (or the computing device **202**) can also be configured to provide trend information if available. If adverse biological conditions are not presently detected, but trend information predicts a future adverse condition, then the sensor management system **304** (or the computing device **202**) can provide such information to the clinician to enable the clinician to take preemptive action to avoid such adverse condition from occurring.

[0107] At steps **626-628**, the sensor management system **304** (or the computing device **202**) can monitor placement of another new biological sensor **102** on the patient **100**. If another new biological sensor **102** is not detected, the sensor management system **304** (or the computing device **202**) can proceed to step **620** and repeat the processes previously described. If, however, another new biological sensor **102** is detected, the sensor management system **304** (or the com-

puting device **202**) can proceed to step **628** to obtain a model number, serial number or other identification data from the new biological sensor **102** to determine if the new sensor is of the same type and function as the previous sensor. Additionally, the sensor management system **304** (or the computing device **202**) can obtain patient identification data from the new biological sensor **102**, which the biological sensor may have obtained from a wrist band of the patient including an RFID, the biometric sensor **409** of FIG. 4, or by patient information provided to the biological sensor **102** by way of the computing device **202** of the clinician as depicted in FIG. 2B.

[0108] If the new biological sensor **102** is the same as the previous sensor and has been coupled to the same patient, then the sensor management system **304** (or the computing device **202**) can proceed to step **630** and determine if the new biological sensor **102** is a replacement for the previous same sensor. If the new biological sensor **102** is not the same as the previous sensor, a determination can be made whether the new sensor is a replacement sensor by the sensor management system **304** (or the computing device **202**) by obtaining information from the new sensor indicating it is a replacement sensor, determining that the new sensor does have in its memory a patient identifier, or by receiving input data from, for example, the computing device **202** initiated by, for example, a clinician, indicating it is a replacement sensor. If such information is not provided by the new sensor or the computing device **202**, and/or the new sensor has been coupled to a different patient, then the sensor management system **304** (or the computing device **202**) can proceed to step **606** and perform the same sequence of steps previously described for the same patient if the new sensor is associated with the same patient, or for a different patient in which case a new record would be created in the databases **306** or other storage resources of the sensor management system **304** (or the computing device **202**).

[0109] Referring back to step **630**, in one embodiment, the sensor management system **304** (or the computing device **202**) can determine that the new biological sensor **102** is replacing the previous sensor upon receiving a message from the computing device **202** of the clinician as noted above. The message can indicate which sensor is being replaced by identifying the serial number of the previous sensor in the message and identifying the serial number of the new sensor. In another embodiment, the sensor management system **304** (or the computing device **202**) can determine that the new biological sensor **102** is replacing a previous sensor based on the new biological sensor **102** not being programmed with a patient identifier. In yet another embodiment, the sensor management system **304** (or the computing device **202**) can determine that the new biological sensor **102** is replacing a previous sensor based on an understanding that two of the same type of sensors for the same patient is not common practice for the clinician and in such instances detecting a new sensor represents a replacement procedure undertaken by the clinician. It should be noted that there may be instances when a new biological sensor of the same type will not be considered a replacement sensor. For example, a clinician may wish to use the same sensor in multiple locations of a patient's body. Such exceptions can be noted by the clinician using the computing device **202**. In yet another embodiment, the sensor management system **304** (or the computing device **202**) can determine that the new biological sensor **102** is replacing a

previous sensor based on a utilization period of the previous sensor expiring or detecting that the previous sensor is damaged or malfunctioning. Other suitable detection methods for determining a replacement of sensors are contemplated by the subject disclosure.

[0110] Once a replacement event is detected, the sensor management system **304** (or the computing device **202**) can proceed to step **634** and decommission the previous sensor. The decommissioning process can represent noting in a record of the patient **100** that the serial number of the biological sensor **102** being replaced has been decommissioned. Once the sensor is decommissioned, the sensor management system **304** (or the computing device **202**) can be configured to ignore sensor data from the decommissioned sensor if such data were to be provided. The sensor management system **304** (or the computing device **202**) can then proceed to step **610** to obtain historical sensor data produced by the previous sensor and any predecessor sensors. The sensor management system **304** (or the computing device **202**) can then proceed to perform subsequent steps as previously described. The sensor management system **304** (or the computing device **202**) can be provisioned to provide the new biological sensor **102** some or all of the obtained historical sensor data of one or more previous sensors for local storage, enabling retrieval by the computing device **202** if desired. It is further noted that the steps of method **600** can be adapted so that the sensors **102** (new or old) can proactively (e.g., without polling by the sensor management system **304** or the computing device **202**) initiate communications with the sensor management system **304** or the computing device **202** and provide updates as needed. Such a process can be pre-programmed into the sensors **102** or a script or software can be provided to the sensors **102** by the sensor management system **304** or the computing device **202** to enable a proactive communication process.

[0111] While for purposes of simplicity of explanation, the respective processes are shown and described as a series of blocks in FIG. 6, it is to be understood and appreciated that the claimed subject matter is not limited by the order of the blocks, as some blocks may occur in different orders and/or concurrently with other blocks from what is depicted and described herein. Moreover, not all illustrated blocks may be required to implement the methods described herein.

[0112] Upon reviewing the aforementioned embodiments, it would be evident to an artisan with ordinary skill in the art that said embodiments can be modified, reduced, or enhanced without departing from the scope of the claims described below. For example, method **600** can be adapted so that the sensor management system **304** or the computing device **202** tracks GPS coordinates of patients **100** using a location receiver **416** of the biological sensor **102**. GPS data can be used, for example, to analyze the activities of the patient **100** and in some instances such activities may be used to analyze the sensor data. For example, the GPS coordinate data may indicate that a patient was walking or jogging. Such information can be used to distinguish sensor data taken at rest versus other activities. Orientation and motion data produced by the orientation sensor **420** and motion sensor **418** can be used to more accurately assess a 3D position of the patient **100**, and a level of activity of the patient **100** (e.g., lying down, running in place, sitting, etc.). By further refining the activity of the patient **100** with 3D positioning information, the sensor management system **304**

can more precisely analyze sensor data obtained from one or more biological sensors **102** coupled to a patient **100**.

[0113] It should be understood that devices described in the exemplary embodiments can be in communication with each other via various wireless and/or wired methodologies. The methodologies can be links that are described as coupled, connected and so forth, which can include unidirectional and/or bidirectional communication over wireless paths and/or wired paths that utilize one or more of various protocols or methodologies, where the coupling and/or connection can be direct (e.g., no intervening processing device) and/or indirect (e.g., an intermediary processing device such as a router).

[0114] FIG. 8 depicts an exemplary diagrammatic representation of a machine in the form of a computer system **800** within which a set of instructions, when executed, may cause the machine to perform any one or more of the methods described above. One or more instances of the machine can operate, for example, as the devices depicted in the drawings of the subject disclosure. In some embodiments, the machine may be connected (e.g., using a network **826**) to other machines. In a networked deployment, the machine may operate in the capacity of a server or a client user machine in a server-client user network environment, or as a peer machine in a peer-to-peer (or distributed) network environment.

[0115] The machine may comprise a server computer, a client user computer, a personal computer (PC), a tablet, a smart phone, a laptop computer, a desktop computer, a control system, a network router, switch or bridge, or any machine capable of executing a set of instructions (sequential or otherwise) that specify actions to be taken by that machine. It will be understood that a communication device of the subject disclosure includes broadly any electronic device that provides voice, video or data communication. Further, while a single machine is illustrated, the term “machine” shall also be taken to include any collection of machines that individually or jointly execute a set (or multiple sets) of instructions to perform any one or more of the methods discussed herein.

[0116] The computer system **800** may include a processor (or controller) **802** (e.g., a central processing unit (CPU)), a graphics processing unit (GPU, or both), a main memory **804** and a static memory **806**, which communicate with each other via a bus **808**. The computer system **800** may further include a display unit **810** (e.g., a liquid crystal display (LCD), a flat panel, or a solid state display). The computer system **800** may include an input device **812** (e.g., a keyboard), a cursor control device **814** (e.g., a mouse), a disk drive unit **816**, a signal generation device **818** (e.g., a speaker or remote control) and a network interface device **820**. In distributed environments, the embodiments described in the subject disclosure can be adapted to utilize multiple display units **810** controlled by two or more computer systems **800**. In this configuration, presentations described by the subject disclosure may in part be shown in a first of the display units **810**, while the remaining portion is presented in a second of the display units **810**.

[0117] The disk drive unit **816** may include a tangible computer-readable storage medium **822** on which is stored one or more sets of instructions (e.g., software **824**) embodying any one or more of the methods or functions described herein, including those methods illustrated above. The instructions **824** may also reside, completely or at least

partially, within the main memory **804**, the static memory **806**, and/or within the processor **802** during execution thereof by the computer system **800**. The main memory **804** and the processor **802** also may constitute tangible computer-readable storage media.

[0118] Dedicated hardware implementations including, but not limited to, application specific integrated circuits, programmable logic arrays and other hardware devices can likewise be constructed to implement the methods described herein. Application specific integrated circuits and programmable logic array can use downloadable instructions for executing state machines and/or circuit configurations to implement embodiments of the subject disclosure. Applications that may include the apparatus and systems of various embodiments broadly include a variety of electronic and computer systems. Some embodiments implement functions in two or more specific interconnected hardware modules or devices with related control and data signals communicated between and through the modules, or as portions of an application-specific integrated circuit. Thus, the example system is applicable to software, firmware, and hardware implementations.

[0119] In accordance with various embodiments of the subject disclosure, the operations or methods described herein are intended for operation as software programs or instructions running on or executed by a computer processor or other computing device, and which may include other forms of instructions manifested as a state machine implemented with logic components in an application specific integrated circuit or field programmable gate array. Furthermore, software implementations (e.g., software programs, instructions, etc.) including, but not limited to, distributed processing or component/object distributed processing, parallel processing, or virtual machine processing can also be constructed to implement the methods described herein. It is further noted that a computing device such as a processor, a controller, a state machine or other suitable device for executing instructions to perform operations or methods may perform such operations directly or indirectly by way of one or more intermediate devices directed by the computing device.

[0120] While the tangible computer-readable storage medium **822** is shown in an example embodiment to be a single medium, the term “tangible computer-readable storage medium” should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, and/or associated caches and servers) that store the one or more sets of instructions. The term “tangible computer-readable storage medium” shall also be taken to include any non-transitory medium that is capable of storing or encoding a set of instructions for execution by the machine and that cause the machine to perform any one or more of the methods of the subject disclosure. The term “non-transitory” as in a non-transitory computer-readable storage includes without limitation memories, drives, devices and anything tangible but not a signal per se.

[0121] The term “tangible computer-readable storage medium” shall accordingly be taken to include, but not be limited to: solid-state memories such as a memory card or other package that houses one or more read-only (non-volatile) memories, random access memories, or other re-writable (volatile) memories, a magneto-optical or optical medium such as a disk or tape, or other tangible media which can be used to store information. Accordingly, the disclosure

is considered to include any one or more of a tangible computer-readable storage medium, as listed herein and including art-recognized equivalents and successor media, in which the software implementations herein are stored.

[0122] Although the present specification describes components and functions implemented in the embodiments with reference to particular standards and protocols, the disclosure is not limited to such standards and protocols. Each of the standards for Internet and other packet switched network transmission (e.g., TCP/IP, UDP/IP, HTML, HTTP) represent examples of the state of the art. Such standards are from time-to-time superseded by faster or more efficient equivalents having essentially the same functions. Wireless standards for device detection (e.g., RFID), short-range communications (e.g., Bluetooth®, WiFi, Zigbee®), and long-range communications (e.g., WiMAX, GSM, CDMA, LTE) can be used by computer system **800**.

[0123] The illustrations of embodiments described herein are intended to provide a general understanding of the structure of various embodiments, and they are not intended to serve as a complete description of all the elements and features of apparatus and systems that might make use of the structures described herein. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The exemplary embodiments can include combinations of features and/or steps from multiple embodiments. Other embodiments may be utilized and derived therefrom, such that structural and logical substitutions and changes may be made without departing from the scope of this disclosure. Figures are also merely representational and may not be drawn to scale. Certain proportions thereof may be exaggerated, while others may be minimized. Accordingly, the specification and drawings are to be regarded in an illustrative rather than a restrictive sense.

[0124] Although specific embodiments have been illustrated and described herein, it should be appreciated that any arrangement which achieves the same or similar purpose may be substituted for the embodiments described or shown by the subject disclosure. The subject disclosure is intended to cover any and all adaptations or variations of various embodiments. Combinations of the above embodiments, and other embodiments not specifically described herein, can be used in the subject disclosure. For instance, one or more features from one or more embodiments can be combined with one or more features of one or more other embodiments. In one or more embodiments, features that are positively recited can also be negatively recited and excluded from the embodiment with or without replacement by another structural and/or functional feature. The steps or functions described with respect to the embodiments of the subject disclosure can be performed in any order. The steps or functions described with respect to the embodiments of the subject disclosure can be performed alone or in combination with other steps or functions of the subject disclosure, as well as from other embodiments or from other steps that have not been described in the subject disclosure. Further, more than or less than all of the features described with respect to an embodiment can also be utilized.

[0125] Less than all of the steps or functions described with respect to the exemplary processes or methods can also be performed in one or more of the exemplary embodiments. Further, the use of numerical terms to describe a device, component, step or function, such as first, second, third, and so forth, is not intended to describe an order or function

unless expressly stated so. The use of the terms first, second, third and so forth, is generally to distinguish between devices, components, steps or functions unless expressly stated otherwise. Additionally, one or more devices or components described with respect to the exemplary embodiments can facilitate one or more functions, where the facilitating (e.g., facilitating access or facilitating establishing a connection) can include less than every step needed to perform the function or can include all of the steps needed to perform the function.

[0126] In one or more embodiments, a processor (which can include a controller or circuit) has been described that performs various functions. It should be understood that the processor can be multiple processors, which can include distributed processors or parallel processors in a single machine or multiple machines. The processor can be used in supporting a virtual processing environment. The virtual processing environment may support one or more virtual machines representing computers, servers, or other computing devices. In such virtual machines, components such as microprocessors and storage devices may be virtualized or logically represented. The processor can include a state machine, application specific integrated circuit, and/or programmable gate array including a Field PGA. In one or more embodiments, when a processor executes instructions to perform “operations”, this can include the processor performing the operations directly and/or facilitating, directing, or cooperating with another device or component to perform the operations.

[0127] The Abstract of the Disclosure is provided with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, it can be seen that various features are grouped together in a single embodiment for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed embodiments require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed embodiment. Thus the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separately claimed subject matter.

What is claimed is:

1. A machine-readable storage medium, comprising executable instructions that, when executed by a processor, facilitate performance of operations, comprising:

receiving data associated with a biological sensor;
determining from the data that the biological sensor is no longer in use by a patient; and
permanently decommissioning the biological sensor responsive to determining that the biological sensor is no longer in use by the patient.

2. The machine-readable storage medium of claim 1, wherein the data comprises motion sensor data, and wherein the determining comprises determining from the motion sensor data that the biological sensor is in a stationary position for a period of time thereby indicating it is no longer in use.

3. The machine-readable storage medium of claim 2, wherein the biological sensor comprises a motion sensor that generates the motion sensor data.

4. The machine-readable storage medium of claim 1, wherein the data comprises biological sensor data produced

by the biological sensor, and wherein the determining comprises determining that the biological sensor data is not providing biological readings associated with the patient.

5. The machine-readable storage medium of claim 4, wherein the biological sensor comprises a temperature sensor, and wherein the biological sensor data comprises a temperature measurement that indicates the biological sensor data is not providing temperature readings associated with the patient.

6. The machine-readable storage medium of claim 4, wherein the biological sensor data is devoid of a biological measurement relating to a biological organism similar to the patient.

7. The machine-readable storage medium of claim 1, wherein the biological sensor is permanently decommissioned by permanently disabling communications by the biological sensor.

8. The machine-readable storage medium of claim 7, wherein the communications is permanently disabled by disabling a transmitter of the biological sensor.

9. The machine-readable storage medium of claim 7, wherein the communications is permanently disabled by storing information in a memory of the biological sensor that cannot be altered, the information indicating that the biological sensor is to permanently cease communications.

10. The machine-readable storage medium of claim 1, wherein the biological sensor is permanently decommissioned by permanently disabling communications with the biological sensor, which is identified according to an identifier uniquely associated with the biological sensor.

11. The machine-readable storage medium of claim 1, wherein the determining comprises determining that the biological sensor is no longer in use by the patient responsive to the data indicating that the patient has been discharged.

12. The machine-readable storage medium of claim 1, wherein the processor is an integral component of the biological sensor.

13. The machine-readable storage medium of claim 1, wherein the processor comprises a computing device that is communicatively coupled to the biological sensor, and operates independently from the biological sensor.

14. A biological sensor, comprising:

a sensing device that facilitates generation of sensor data associated with a biological state of a patient; and
an adhesive component of the sensing device that facilitates coupling to a skin of the patient and that facilitates being decoupled from the sensing device when a portion the biological sensor is removed from the patient, thereby permanently disabling operations of the sensing device.

15. The biological sensor of claim 14, wherein the sensing device comprises a circuit.

16. The biological sensor of claim 15, wherein the adhesive component comprises a portion of the circuit, and wherein when the portion of the biological sensor is removed from the patient the portion of the circuit is disconnected from the sensing device, thereby permanently disabling operations of the sensing device.

17. The biological sensor of claim 15, wherein the circuit comprises a transmitter that facilitates transmission of the sensor data, an antenna that couples to the transmitter and facilitates a transmission of a wireless signal, a power supply system that facilitates supplying energy to the sensing

device, a processor that facilitates controlling operations of the sensing device, or any combinations thereof.

18. The biological sensor of claim **14**, wherein the adhesive component facilitates being decoupled from the sensing device by removing physical contact between the adhesive component and the portion of the biological sensor.

19. The biological sensor of claim **14**, wherein the adhesive component is decoupled from the sensing device by removing electrical contact or inductive coupling between the adhesive component and the portion of the biological sensor.

20. The biological sensor of claim **14**, wherein the portion of the biological sensor comprises a first tab, and wherein the adhesive component comprises a second tab.

21. The biological sensor of claim **20**, wherein the first tab facilitates removal of the portion of the biological sensor from the patient and decoupling of the adhesive component from the sensing device, and wherein the second tab facilitates removal of the adhesive component from the skin of the patient.

22. A system, comprising:
a processor; and
a memory that stores executable instructions that, when executed by the processor, facilitate performance of operations, comprising:

determining from sensor data received from a biological sensor that the biological sensor is no longer in use by a patient; and

permanently decommissioning the biological sensor responsive to determining that the biological sensor is no longer in use by the patient.

23. The system of claim **22**, wherein the data comprises motion sensor data, and wherein the determining comprises determining from the motion sensor data that the biological sensor is no longer in use.

24. The system of claim **22**, wherein the determining comprises determining that the sensor data is not providing biological readings associated with the patient.

25. The system of claim **22**, wherein the system comprises a trash dispenser that directs the biological sensor to permanently disable communications initiated by the biological sensor.

26. The system of claim **25**, wherein the operations further comprise transmitting a message to a sensor management system, the message identifying the biological sensor and indicating that the biological sensor has been decommissioned.

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摘要(译)

本公开的方面可以包括例如被配置为当从患者移除时被禁用的生物传感器。本公开的其他方面可以包括响应于系统检测到生物传感器不再使用而停用生物传感器。公开了其他实施例。

