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(54) Title: DATA-CAPABLE BAND FOR MEDICAL DIAGNOSIS, MONITORING, AND TREATMENT

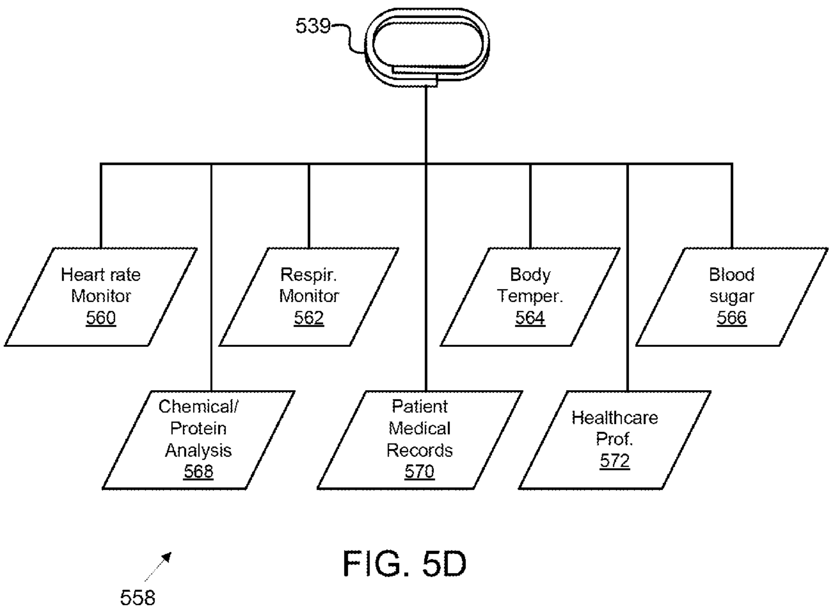

FIG. 5D

(57) Abstract: A data-capable band for medical diagnosis, monitoring, and treatment is described, including one or more sensors configured to gather data associated with diagnosis, monitoring or treatment of a medical condition, an application configured to determine the medical condition using the data gathered by the sensors, a memory configured to store the data and the application, and a notification facility configured to provide an array of notifications in relation to the monitoring and treatment of the medical conditions. The notifications may be alarms, may be designed to prompt movement, or may be associated with a drug regimen.

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DATA-CAPABLE BAND FOR MEDICAL DIAGNOSIS, MONITORING, AND TREATMENT

FIELD

The present invention relates generally to electrical and electronic hardware, computer software, wired and wireless network communications, and computing devices. More specifically, techniques for a data-capable personal worn or carried device for medical diagnosis, monitoring, and treatment, are described.

BACKGROUND

With the advent of greater computing capabilities in smaller personal and/or portable form factors and an increasing number of applications (i.e., computer and Internet software or programs) for different uses, consumers (i.e., users) have access to large amounts of personal data. Information and data are often readily available, but poorly captured using conventional data capture devices. Conventional devices typically lack capabilities that can capture, analyze, communicate, or use data in a contextually-meaningful, comprehensive, and efficient manner. Further, conventional solutions are often limited to specific individual purposes or uses, demanding that users invest in multiple devices in order to perform different activities (e.g., a sports watch for tracking time and distance, a GPS receiver for monitoring a hike or run, a cyclometer for gathering cycling data, and others). Although a wide range of data and information is available, conventional devices and applications fail to provide effective solutions that comprehensively capture data for a given user across numerous disparate activities.

Some conventional solutions combine a small number of discrete functions. Functionality for data capture, processing, storage, or communication in conventional devices such as a watch or timer with a heart rate monitor or global positioning system ("GPS") receiver are available conventionally, but are expensive to manufacture and purchase. Other conventional solutions for combining personal data capture facilities often present numerous design and manufacturing problems such as size restrictions, specialized materials requirements, lowered tolerances for defects such as pits or holes in coverings for water-resistant or waterproof devices, unreliability, higher failure rates, increased manufacturing time, and expense. Subsequently, conventional devices such as fitness watches, heart rate monitors, GPS-enabled fitness monitors, health monitors (e.g., diabetic blood sugar testing units), digital voice recorders, pedometers, altimeters, and other conventional personal data capture devices are generally manufactured for conditions that occur in a single or small groupings of activities.

Generally, if the number of activities performed by conventional personal data capture devices increases, there is a corresponding rise in design and manufacturing requirements that results in significant consumer expense, which eventually becomes prohibitive to both investment and commercialization. Further, conventional manufacturing techniques are often limited and ineffective at meeting increased requirements to protect sensitive hardware, circuitry, and other components that are susceptible to damage, but which are required to perform various personal data capture activities. As a conventional example, sensitive electronic components such as printed circuit board assemblies ("PCBA"), sensors, and computer memory (hereafter "memory") can be significantly damaged or destroyed during manufacturing processes where overmoldings or layering of protective material occurs using techniques such as injection molding, cold molding, and others. Damaged or destroyed items subsequently raises the cost of goods sold and can deter not only investment and commercialization, but also innovation in data capture and analysis technologies, which are highly compelling fields of opportunity.

Thus, what is needed is a solution for data capture devices without the limitations of conventional techniques.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments or examples ("examples") are disclosed in the following detailed description and the accompanying drawings:

FIG. 1 illustrates an exemplary data-capable band system;

FIG. 2 illustrates a block diagram of an exemplary data-capable band;

FIG. 3 illustrates sensors for use with an exemplary data-capable band;

FIG. 4 illustrates an application architecture for an exemplary data-capable band;

FIG. 5A illustrates representative data types for use with an exemplary data-capable band;

FIG. 5B illustrates representative data types for use with an exemplary data-capable band in fitness-related activities;

FIG. 5C illustrates representative data types for use with an exemplary data-capable band in sleep management activities;

FIG. 5D illustrates representative data types for use with an exemplary data-capable band in medical-related activities;

FIG. 6 illustrates a transition between modes of operation of a band in accordance with various embodiments;

FIG. 7A illustrates a perspective view of an exemplary data-capable band;

FIG. 7B illustrates a side view of an exemplary data-capable band;

FIG. 8A illustrates a perspective view of an exemplary data-capable band;

FIG. 8B illustrates a side view of an exemplary data-capable band;

FIG. 9A illustrates a perspective view of an exemplary data-capable band;

FIG. 9B illustrates a side view of an exemplary data-capable band;

FIG. 10 illustrates an exemplary computer system suitable for use with a data-capable band;

FIG. 11 depicts a representative implementation of one or more bands and equivalent devices, as wearable devices, to form unique motion profiles, according to various embodiments; and

FIGS. 12 and 13 are diagrams representing examples of networks formed using one or more bands, according to some embodiments.

DETAILED DESCRIPTION

Various embodiments or examples may be implemented in numerous ways, including as a system, a process, an apparatus, a user interface, or a series of program instructions on a computer readable medium such as a computer readable storage medium or a computer network where the program instructions are sent over optical, electronic, or wireless communication links. In general, operations of disclosed processes may be performed in an arbitrary order, unless otherwise provided in the claims.

A detailed description of one or more examples is provided below along with accompanying figures. The detailed description is provided in connection with such examples, but is not limited to any particular example. The scope is limited only by the claims and numerous alternatives, modifications, and equivalents are encompassed. Numerous specific details are set forth in the following description in order to provide a thorough understanding. These details are provided for the purpose of example and the described techniques may be practiced according to the claims without some or all of these specific details. For clarity, technical material that is known in the technical fields related to the examples has not been described in detail to avoid unnecessarily obscuring the description.

FIG. 1 illustrates an exemplary data-capable band system. Here, system 100 includes network 102, bands 104-112, server 114, mobile computing device 116, mobile communications device 118, computer 120, laptop 122, and distributed sensor 124. Bands 104-112 may be implemented as data-capable devices that may be worn as a strap or band around an arm, leg, ankle, or other bodily appendage or feature. In other examples, bands 104-112 may be attached directly or indirectly to other items, organic or inorganic, animate, or static. In still other examples, bands 104-112 may be used differently.

As described above, bands 104-112 may be implemented as wearable personal data or data capture devices (e.g., data-capable devices) that are worn by a user around a wrist, ankle, arm, ear, or other appendage, or attached to the body or affixed to clothing. One or more facilities, sensing elements, or sensors, both active and passive, may be implemented as part of bands 104-112 in order to capture various types of data from different sources. Temperature, environmental, temporal, motion, electronic, electrical, chemical, or other types of sensors (including those described below in connection with FIG. 3) may be used in order to gather varying amounts of data, which may be configurable by a user, locally (e.g., using user interface facilities such as buttons, switches, motion-activated/detected command structures (e.g., accelerometer-gathered data from user-initiated motion of bands 104-112), and others) or remotely (e.g., entering rules or parameters in a website or graphical user interface ("GUI") that may be used to modify control systems or signals in firmware, circuitry, hardware, and software implemented (i.e., installed) on bands 104-112). Bands 104-112 may also be implemented as data-capable devices that are configured for data communication using various types of communications infrastructure and media, as described in greater detail below. Bands 104-112 may also be wearable, personal, non-intrusive, lightweight devices that are configured to gather large amounts of personally relevant data that can be used to improve user health, fitness levels, medical conditions, athletic performance, sleeping physiology, and physiological conditions, or used as a sensory-based user interface ("UI") to signal social-related notifications specifying the state of the user through vibration, heat, lights or other sensory based notifications. For example, a social-related notification signal indicating a user is on-line can be transmitted to a recipient, who in turn, receives the notification as, for instance, a vibration.

Using data gathered by bands 104-112, applications may be used to perform various analyses and evaluations that can generate information as to a person's physical (e.g., healthy, sick, weakened, activity level, or other states), emotional, or mental state (e.g., an elevated body temperature or heart rate may indicate stress, a lowered heart rate and skin temperature, or reduced movement (e.g., excessive sleeping), may indicate physiological depression caused by exertion or other factors, chemical data gathered from evaluating out-gassing from the skin's surface may be analyzed to determine whether a person's diet is balanced or if various nutrients are lacking, salinity detectors may be evaluated to determine if high, lower, or proper blood sugar levels are present for diabetes management, and others). Generally, bands 104-112 may be configured to gather from sensors locally and remotely.

As an example, band 104 may capture (i.e., record, store, communicate (i.e., send or receive), process, or the like) data from various sources (i.e., sensors that are organic (i.e., installed, integrated, or otherwise implemented with band 104) or distributed (e.g., microphones on mobile computing device 116, mobile communications device 118, computer 120, laptop 122, distributed sensor 124, global positioning system ("GPS") satellites, or others, without limitation)) and exchange data with one or more of bands 106-112, server 114, mobile computing device 116, mobile communications device 118, computer 120, laptop 122, and distributed sensor 124. As shown here, a local sensor may be one that is incorporated, integrated, or otherwise implemented with bands 104-112. A remote or distributed sensor (e.g., mobile computing device 116, mobile communications device 118, computer 120, laptop 122, or, generally, distributed sensor 124) may be sensors that can be accessed, controlled, or otherwise used by bands 104-112. For example, band 112 may be configured to control devices that are also controlled by a given user (e.g., mobile computing device 116, mobile communications device 118, computer 120, laptop 122, and distributed sensor 124). For example, a microphone in mobile communications device 118 may be used to detect, for example, ambient audio data that is used to help identify a person's location, or an ear clip (e.g., a headset as described below) affixed to an ear may be used to record pulse or blood oxygen saturation levels. Additionally, a sensor implemented with a screen on mobile computing device 116 may be used to read a user's temperature or obtain a biometric signature while a user is interacting with data. A further example may include using data that is observed on computer 120 or laptop 122 that provides information as to a user's online behavior and the type of content that she is viewing, which may be used by bands 104-112. Regardless of the type or location of sensor used, data may be transferred to bands 104-112 by using, for example, an analog audio jack, digital adapter (e.g., USB, mini-USB), or other, without limitation, plug, or other type of connector that may be used to physically couple bands 104-112 to another device or system for transferring data and, in some examples, to provide power to recharge a battery (not shown). Alternatively, a wireless data communication interface or facility (e.g., a wireless radio that is configured to communicate data from bands 104-112 using one or more data communication protocols (e.g., IEEE 802.11a/b/g/n (WiFi), WiMax, ANT™, ZigBee®, Bluetooth®, Near Field Communications ("NFC"), and others)) may be used to receive or transfer data. Further, bands 104-112 may be configured to analyze, evaluate, modify, or otherwise use data gathered, either directly or indirectly.

In some examples, bands 104-112 may be configured to share data with each other or with an intermediary facility, such as a database, website, web service, or the like, which may be implemented by server 114. In some embodiments, server 114 can be operated by a third party providing, for example, social media-related services. Bands 104-112 and other related devices may exchange data with each other directly, or bands 104-112 may exchange data via a third party server, such as a third party like Facebook®, to provide social-media related services. Examples of other third party servers include those implemented by social networking services, including, but not limited to, services such as Yahoo! IM™, GTalk™, MSN Messenger™, Twitter® and other private or public social networks. The exchanged data may include personal physiological data and data derived from sensory-based user interfaces ("UI"). Server 114, in some examples, may be implemented using one or more processor-based computing devices or networks, including computing clouds, storage area networks ("SAN"), or the like. As shown, bands 104-112 may be used as a personal data or area network (e.g., "PDN" or "PAN") in which data relevant to a given user or band (e.g., one or more of bands 104-112) may be shared. As shown here, bands 104 and 112 may be configured to exchange data with each other over network 102 or indirectly using server 114. Users of bands 104 and 112 may direct a web browser hosted on a computer (e.g., computer 120, laptop 122, or the like) in order to access, view, modify, or perform other operations with data captured by bands 104 and 112. For example, two runners using bands 104 and 112 may be geographically remote (e.g., users are not geographically in close proximity locally such that bands being used by each user are in direct data communication), but wish to share data regarding their race times (pre, post, or in-race), personal records (i.e., "PR"), target split times, results, performance characteristics (e.g., target heart rate, target VO_2 max, and others), and other information. If both runners (i.e., bands 104 and 112) are engaged in a race on the same day, data can be gathered for comparative analysis and other uses. Further, data can be shared in substantially real-time (taking into account any latencies incurred by data transfer rates, network topologies, or other data network factors) as well as uploaded after a given activity or event has been performed. In other words, data can be captured by the user as it is worn and configured to transfer data using, for example, a wireless network connection (e.g., a wireless network interface card, wireless local area network ("LAN") card, cell phone, or the like. Data may also be shared in a temporally asynchronous manner in which a wired data connection (e.g., an analog audio plug (and associated software or firmware) configured to transfer digitally encoded data to encoded audio data that may be transferred between bands 104-112 and a plug configured to receive, encode/decode, and process data exchanged) may be used to transfer data from one or more bands 104-112 to various destinations (e.g., another of bands 104-112, server 114, mobile computing device 116, mobile communications device 118, computer 120, laptop 122, and distributed sensor 124). Bands 104-112 may be implemented with various types of wired and/or wireless communication facilities and are not intended to be limited to any specific technology. For example, data may be transferred from bands 104-112 using an analog audio plug (e.g., TRRS, TRS, or others). In other examples, wireless communication facilities using various types of data communication protocols (e.g., WiFi, Bluetooth®, ZigBee®, ANT™, and others) may be implemented as part of bands 104-112, which may include circuitry, firmware, hardware, radios, antennas, processors, microprocessors, memories, or other electrical, electronic, mechanical, or physical elements configured to enable data communication capabilities of various types and characteristics.

As data-capable devices, bands 104-112 may be configured to collect data from a wide range of sources, including onboard (not shown) and distributed sensors (e.g., server 114, mobile computing device 116, mobile communications device 118, computer 120, laptop 122, and distributed sensor 124) or other bands. Some or all data captured may be personal, sensitive, or confidential and various techniques for providing secure storage and access may be implemented. For example, various types of security protocols and algorithms may be used to encode data stored or accessed by bands 104-112. Examples of security protocols and algorithms include authentication, encryption, encoding, private and public key infrastructure, passwords, checksums, hash codes and hash functions (e.g., SHA, SHA-1, MD-5, and the like), or others may be used to prevent undesired access to data captured by bands 104-112. In other examples, data security for bands 104-112 may be implemented differently.

Bands 104-112 may be used as personal wearable, data capture devices that, when worn, are configured to identify a specific, individual user. By evaluating captured data such as motion data from an accelerometer, biometric data such as heart rate, skin galvanic response, and other biometric data, and using long-term analysis techniques (e.g., software packages or modules of any type, without limitation), a user may have a unique pattern of behavior or motion and/or biometric responses that can be used as a signature for identification. For example, bands 104-112 may gather data regarding an individual person's gait or other unique biometric, physiological or behavioral characteristics. Using, for example, distributed sensor 124, a biometric signature (e.g., fingerprint, retinal or iris vascular pattern, or others) may be gathered and transmitted to bands 104-112 that, when combined with other data, determines that a given user has been properly identified and, as such, authenticated. When bands 104-112 are worn, a user may be identified and authenticated to enable a variety of other functions such as accessing or modifying data, enabling wired or wireless data transmission facilities (i.e., allowing the transfer of data from bands 104-112), modifying functionality or functions of bands 104-112, authenticating financial transactions using stored data and information (e.g., credit card, PIN, card security numbers, and the like), running applications that allow for various operations to be performed (e.g., controlling physical security and access by transmitting a security code to a reader that, when authenticated, unlocks a door by turning off current to an electromagnetic lock, and others), and others. Different functions and operations beyond those described may be performed using bands 104-112, which can act as secure, personal, wearable, data-capable devices. The number, type, function, configuration, specifications, structure, or other features of system 100 and the above-described elements may be varied and are not limited to the examples provided.

FIG. 2 illustrates a block diagram of an exemplary data-capable band. Here, band 200 includes bus 202, processor 204, memory 206, notification facility 208, accelerometer 210, sensor 212, battery 214, and communications facility 216. In some examples, the quantity, type, function, structure, and configuration of band 200 and the elements (e.g., bus 202, processor 204, memory 206, notification facility 208, accelerometer 210, sensor 212, battery 214, and communications facility 216) shown may be varied and are not limited to the examples provided. As shown, processor 204 may be implemented as logic to provide control functions and signals to memory 206, notification facility 208, accelerometer 210, sensor 212, battery 214, and communications facility 216. Processor 204 may be implemented using any type of processor or microprocessor suitable for packaging within bands 104-112 (FIG. 1). Various types of microprocessors may be used to provide data processing capabilities for band 200 and are not limited to any specific type or capability. For example, a MSP430F5528-type microprocessor manufactured by Texas Instruments of Dallas, Texas may be configured for data communication using audio tones and enabling the use of an audio plug-and-jack system (e.g., TRRS, TRS, or others) for transferring data captured by band 200. Further, different processors may be desired if other functionality (e.g., the type and number of sensors (e.g., sensor 212)) are varied. Data processed by processor 204 may be stored using, for example, memory 206.

In some examples, memory 206 may be implemented using various types of data storage technologies and standards, including, without limitation, read-only memory ("ROM"), random access memory ("RAM"), dynamic random access memory ("DRAM"), static random access memory ("SRAM"), static/dynamic random access memory ("SDRAM"), magnetic random access memory ("MRAM"), solid state, two and three-dimensional memories, Flash®, and others. Memory 206 may also be implemented using one or more partitions that are configured for multiple types of data storage technologies to allow for non-modifiable (i.e., by a user) software to be installed (e.g., firmware installed on ROM) while also providing for storage of captured data and applications using, for example, RAM. Once captured and/or stored in memory 206, data may be subjected to various operations performed by other elements of band 200.

Notification facility 208, in some examples, may be implemented to provide vibratory energy, audio or visual signals, communicated through band 200. As used herein, "facility" refers to any, some, or all of the features and structures that are used to implement a given set of functions. In some examples, the vibratory energy may be implemented using a motor or other mechanical structure. In some examples, the audio signal may be a tone or other audio cue, or it may be implemented using different sounds for different purposes. The audio signals may be emitted directly using notification facility 208, or indirectly by transmission via communications facility 216 to other audio-capable devices (e.g., headphones (not shown), a headset (as described below with regard to FIGS. 11-13), mobile computing device 115, mobile communications device 118, computer 120, laptop 122, distributed sensor 124, etc.). In some examples, the visual signal may be implemented using any available display technology, such as lights, light-emitting diodes (LEDs), interferometric modulator display (IMOD), electrophoretic ink (E Ink), organic light-emitting diode (OLED), or other display technologies. As an example, an application stored on memory 206 may be configured to monitor a clock signal from processor 204 in order to provide timekeeping functions to band 200. For example, if an alarm is set for a desired time, notification facility 208 may be used to provide a vibration or an audio tone, or a series of vibrations or audio tones, when the desired time occurs. As another example, notification facility 208 may be coupled to a framework (not shown) or other structure that is used to translate or communicate vibratory energy throughout the physical structure of band 200. In other examples, notification facility 208 may be implemented differently.

Power may be stored in battery 214, which may be implemented as a battery, battery module, power management module, or the like. Power may also be gathered from local power sources such as solar panels, thermo-electric generators, and kinetic energy generators, among others that are alternatives power sources to external power for a battery. These additional sources can either power the system directly or can charge a battery, which, in turn, is used to power the system (e.g., of a band). In other words, battery 214 may include a rechargeable, expendable, replaceable, or other type of battery, but also circuitry, hardware, or software that may be used in connection with in lieu of processor 204 in order to provide power management, charge/recharging, sleep, or other functions. Further, battery 214 may be implemented using various types of battery technologies, including Lithium Ion ("LI"), Nickel Metal Hydride ("NiMH"), or others, without limitation. Power drawn as electrical current may be distributed from battery via bus 202, the latter of which may be implemented as deposited or formed circuitry or using other forms of circuits or cabling, including flexible circuitry. Electrical current distributed from battery 204 and managed by processor 204 may be used by one or more of memory 206, notification facility 208, accelerometer 210, sensor 212, or communications facility 216.

As shown, various sensors may be used as input sources for data captured by band 200. For example, accelerometer 210 may be used to gather data measured across one, two, or three axes of motion. In addition to accelerometer 210, other sensors (i.e., sensor 212) may be implemented to provide temperature, environmental, physical, chemical, electrical, or other types of sensed inputs. As presented here, sensor 212 may include one or multiple sensors and is not intended to be limiting as to the quantity or type of sensor implemented. Data captured by band 200 using accelerometer 210 and sensor 212 or data requested from another source (i.e., outside of band 200) may also be exchanged, transferred, or otherwise communicated using communications facility 216. For example, communications facility 216 may include a wireless radio, control circuit or logic, antenna, transceiver, receiver, transmitter, resistors, diodes, transistors, or other elements that are used to transmit and receive data from band 200. In some examples, communications facility 216 may be implemented to provide a "wired" data communication capability such as an analog or digital attachment, plug, jack, or the like to allow for data to be transferred. In other examples, communications facility 216 may be implemented to provide a wireless data communication capability to transmit digitally encoded data across one or more frequencies using various types of data communication protocols, without limitation. In still other examples, band 200 and the above-described elements may be varied in function, structure, configuration, or implementation and are not limited to those shown and described.

FIG. 3 illustrates sensors for use with an exemplary data-capable band. Sensor 212 may be implemented using various types of sensors, some of which are shown. Like-numbered and named elements may describe the same or substantially similar element as those shown in other descriptions. Here, sensor 212 (FIG. 2) may be implemented as accelerometer 302, altimeter/barometer 304, light/infrared ("IR") sensor 306, pulse/heart rate ("HR") monitor 308, audio sensor (e.g., microphone, transducer, or others) 310, pedometer 312, velocimeter 314, GPS receiver 316, location-based service sensor (e.g., sensor for determining location within a cellular or micro-cellular network, which may or may not use GPS or other satellite constellations for fixing a position) 318, motion detection sensor 320, environmental sensor 322, chemical sensor 324, electrical sensor 326, or mechanical sensor 328.

As shown, accelerometer 302 may be used to capture data associated with motion detection along 1, 2, or 3-axes of measurement, without limitation to any specific type of specification of sensor. Accelerometer 302 may also be implemented to measure various types of user motion and may be configured based on the type of sensor, firmware, software, hardware, or circuitry used. As another example, altimeter/barometer 304 may be used to measure environment pressure, atmospheric or otherwise, and is not limited to any specification or type of pressure-reading device. In some examples, altimeter/barometer 304 may be an altimeter, a barometer, or a combination thereof. For example, altimeter/barometer 304 may be implemented as an altimeter for measuring above ground level ("AGL") pressure in band 200, which has been configured for use by naval or military aviators. As another example, altimeter/barometer 304 may be implemented as a barometer for reading atmospheric pressure for marine-based applications. In other examples, altimeter/barometer 304 may be implemented differently.

Other types of sensors that may be used to measure light or photonic conditions include light/IR sensor 306, motion detection sensor 320, and environmental sensor 322, the latter of which may include any type of sensor for capturing data associated with environmental conditions beyond light. Further, motion detection sensor 320 may be configured to detect motion using a variety of techniques and technologies, including, but not limited to comparative or differential light analysis (e.g., comparing foreground and background lighting), sound monitoring, or others. Audio sensor 310 may be implemented using any type of device configured to record or capture sound.

In some examples, pedometer 312 may be implemented using devices to measure various types of data associated with pedestrian-oriented activities such as running or walking. Footstrikes, stride length, stride length or interval, time, and other data may be measured. Velocimeter 314 may be implemented, in some examples, to measure velocity (e.g., speed and directional vectors) without limitation to any particular activity. Further, additional sensors that may be used as sensor 212 include those configured to identify or obtain location-based data. For example, GPS receiver 316 may be used to obtain coordinates of the geographic location of band 200 using, for example, various types of signals transmitted by civilian and/or military satellite constellations in low, medium, or high earth orbit (e.g., "LEO," "MEO," or "GEO"). In other examples, differential GPS algorithms may also be implemented with GPS receiver 316, which may be used to generate more precise or accurate coordinates. Still further, location-based services sensor 318 may be implemented to obtain location-based data including, but not limited to location, nearby services or items of interest, and the like. As an example, location-based services sensor 318 may be configured to detect an electronic signal, encoded or otherwise, that provides information regarding a physical locale as band 200 passes. The electronic signal may include, in some examples, encoded data regarding the location and information associated therewith. Electrical sensor 326 and mechanical sensor 328 may be configured to include other types (e.g., haptic, kinetic, piezoelectric, piezomechanical, pressure, touch, thermal, and others) of sensors for data input to band 200, without limitation. Other types of sensors apart from those shown may also be used, including magnetic flux sensors such as solid-state compasses and the like, including gyroscopic sensors. While the present illustration provides numerous examples of types of sensors that may be used with band 200 (FIG. 2), others not shown or described may be implemented with or as a substitute for any sensor shown or described.

FIG. 4 illustrates an application architecture for an exemplary data-capable band. Here, application architecture 400 includes bus 402, logic module 404, communications module 406, security module 408, interface module 410, data management 412, audio module 414, motor controller 416, service management module 418, sensor input evaluation module 420, and power management module 422. In some examples, application architecture 400 and the above-listed elements (e.g., bus 402, logic module 404, communications module 406, security module 408, interface module 410, data management 412, audio module 414, motor controller 416, service management module 418, sensor input evaluation module 420, and power management module 422) may be implemented as software using various computer programming and formatting languages such as Java, C++, C, and others. As shown here, logic module 404 may be firmware or application software that is installed in memory 206 (FIG. 2) and executed by processor 204 (FIG. 2). Included with logic module 404 may be program instructions or code (e.g., source, object, binary executables, or others) that, when initiated, called, or instantiated, perform various functions.

For example, logic module 404 may be configured to send control signals to communications module 406 in order to transfer, transmit, or receive data stored in memory 206, the latter of which may be managed by a database management system ("DBMS") or utility in data management module 412. As another example, security module 408 may be controlled by logic module 404 to provide encoding, decoding, encryption, authentication, or other functions to band 200 (FIG. 2). Alternatively, security module 408 may also be implemented as an application that, using data captured from various sensors and stored in memory 206 (and accessed by data management module 412) may be used to provide identification functions that enable band 200 to passively identify a user or wearer of band 200. Still further, various types of security software and applications may be used and are not limited to those shown and described.

Interface module 410, in some examples, may be used to manage user interface controls such as switches, buttons, or other types of controls that enable a user to manage various functions of band 200. For example, a 4-position switch may be turned to a given position that is interpreted by interface module 410 to determine the proper signal or feedback to send to logic module 404 in order to generate a particular result. In other examples, a button (not shown) may be depressed that allows a user to trigger or initiate certain actions by sending another signal to logic module 404. Still further, interface module 410 may be used to interpret data from, for example, accelerometer 210 (FIG. 2) to identify specific movement or motion that initiates or triggers a given response. In other examples, interface module 410 may be implemented differently in function, structure, or configuration and is not limited to those shown and described.

As shown, audio module 414 may be configured to manage encoded or unencoded data gathered from various types of audio sensors. In some examples, audio module 414 may include one or more codes that are used to encode or decode various types of audio waveforms. For example, analog audio input may be encoded by audio module 414 and, once encoded, sent as a signal or collection of data packets, messages, segments, frames, or the like to logic module 404 for transmission via communications module 406. In other examples, audio module 414 may be implemented differently in function, structure, configuration, or implementation and is not limited to those shown and described. Other elements that may be used by band 200 include motor controller 416, which may be firmware or an application to control a motor or other vibratory energy source (e.g., notification facility 208 (FIG. 2)). Power used for band 200 may be drawn from battery 214 (FIG. 2) and managed by power management module 422, which may be firmware or an application used to manage, with or without user input, how power is consumer, conserved, or otherwise used by band 200 and the above-described elements, including one or more sensors (e.g., sensor 212 (FIG. 2), sensors 302-328 (FIG. 3)). With regard to data captured, sensor input evaluation module 420 may be a software engine or module that is used to evaluate and analyze data received from one or more inputs (e.g., sensors 302-328) to band 200. When received, data may be analyzed by sensor input evaluation module 420, which may include custom or "off-the-shelf" analytics packages that are configured to provide application-specific analysis of data to determine trends, patterns, and other useful information. In other examples, sensor input module 420 may also include firmware or software that enables the generation of various types and formats of reports for presenting data and any analysis performed thereupon.

Another element of application architecture 400 that may be included is service management module 418. In some examples, service management module 418 may be firmware, software, or an application that is configured to manage various aspects and operations associated with executing software-related instructions for band 200. For example, libraries or classes that are used by software or applications on band 200 may be served from an online or networked source. Service management module 418 may be implemented to manage how and when these services are invoked in order to ensure that desired applications are executed properly within application architecture 400. As discrete sets, collections, or groupings of functions, services used by band 200 for various purposes ranging from communications to operating systems to call or document libraries may be managed by service management module 418. Alternatively, service management module 418 may be implemented differently and is not limited to the examples provided herein. Further, application architecture 400 is an example of a software/system/application-level architecture that may be used to implement various software-related aspects of band 200 and may be varied in the quantity, type, configuration, function, structure, or type of programming or formatting languages used, without limitation to any given example.

FIG. 5A illustrates representative data types for use with an exemplary data-capable band. Here, wearable device 502 may capture various types of data, including, but not limited to sensor data 504, manually-entered data 506, application data 508, location data 510, network data 512, system/operating data 514, and user data 516. Various types of data may be captured from sensors, such as those described above in connection with FIG. 3. Manually-entered data, in some examples, may be data or inputs received directly and locally by band 200 (FIG. 2). In other examples, manually-entered data may also be provided through a third-party website that stores the data in a database and may be synchronized from server 114 (FIG. 1) with one or more of bands 104-112. Other types of data that may be captured including application data 508 and system/operating data 514, which may be associated with firmware, software, or hardware installed or implemented on band 200. Further, location data 510 may be used by wearable device 502, as described above. User data 516, in some examples, may be data that include profile data, preferences, rules, or other information that has been previously entered by a given user of wearable device 502. Further, network data 512 may be data is captured by wearable device with regard to routing tables, data paths, network or access availability (e.g., wireless network access availability), and the like. Other types of data may be captured by wearable device 502 and are not limited to the examples shown and described. Additional context-specific examples of types of data captured by bands 104-112 (FIG. 1) are provided below.

FIG. 5B illustrates representative data types for use with an exemplary data-capable band in fitness-related activities. Here, band 519 may be configured to capture types (i.e., categories) of data such as heart rate/pulse monitoring data 520, blood oxygen saturation data 522, skin temperature data 524, salinity/emission/outgassing data 526, location/GPS data 528, environmental data 530, and accelerometer data 532. As an example, a runner may use or wear band 519 to obtain data associated with his physiological condition (i.e., heart rate/pulse monitoring data 520, skin temperature, salinity/emission/outgassing data 526, among others), athletic efficiency (i.e., blood oxygen saturation data 522), and performance (i.e., location/GPS data 528 (e.g., distance or laps run), environmental data 530 (e.g., ambient temperature, humidity, pressure, and the like), accelerometer 532 (e.g., biomechanical information, including gait, stride, stride length, among others)). Other or different types of data may be captured by band 519, but the above-described examples are illustrative of some types of data that may be captured by band 519. Further, data captured may be uploaded to a website or online/networked destination for storage and other uses. For example, fitness-related data may be used by applications that are downloaded from a "fitness marketplace" where athletes may find, purchase, or download applications for various uses. Some applications may be activity-specific and thus may be used to modify or alter the data capture capabilities of band 519 accordingly. For example, a fitness marketplace may be a website accessible by various types of mobile and non-mobile clients to locate applications for different exercise or fitness categories such as running, swimming, tennis, golf, baseball, football, fencing, and many others. When downloaded, a fitness marketplace may also be used with user-specific accounts to manage the retrieved applications as well as usage with band 519, or to use the data to provide services such as online personal coaching or targeted advertisements. More, fewer, or different types of data may be captured for fitness-related activities.

FIG. 5C illustrates representative data types for use with an exemplary data-capable band in sleep management activities. Here, band 539 may be used for sleep management purposes to track various types of data, including heart rate monitoring data 540, motion sensor data 542, accelerometer data 544, skin resistivity data 546, user input data 548, clock data 550, and audio data 552. In some examples, heart rate monitor data 540 may be captured to evaluate rest, waking, or various states of sleep. Motion sensor data 542 and accelerometer data 544 may be used to determine whether a user of band 539 is experiencing a restful or fitful sleep. For example, some motion sensor data 542 may be captured by a light sensor that measures ambient or differential light patterns in order to determine whether a user is sleeping on her front, side, or back. Accelerometer data 544 may also be captured to determine whether a user is experiencing gentle or violent disruptions when sleeping, such as those often found in afflictions of sleep apnea or other sleep disorders. Further, skin resistivity data 546 may be captured to determine whether a user is ill (e.g., running a temperature, sweating, experiencing chills, clammy skin, and others). Still further, user input data may include data input by a user as to how and whether band 539 should trigger notification facility 208 (FIG. 2) to wake a user at a given time or whether to use a series of increasing or decreasing vibrations or audio tones to trigger a waking state. Clock data (550) may be used to measure the duration of sleep or a finite period of time in which a user is at rest. Audio data may also be captured to determine whether a user is snoring and, if so, the frequencies and amplitude therein may suggest physical conditions that a user may be interested in knowing (e.g., snoring, breathing interruptions, talking in one's sleep, and the like). More, fewer, or different types of data may be captured for sleep management-related activities.

FIG. 5D illustrates representative data types for use with an exemplary data-capable band in medical-related activities. Here, band 539 may also be configured for medical purposes and related-types of data such as heart rate monitoring data 560, respiratory monitoring data 562, body temperature data 564, blood sugar data 566 (i.e., blood glucose levels), chemical protein/analysis data 568, patient medical records data 570, and healthcare professional (e.g., doctor, physician, registered nurse, physician's assistant, dentist, orthopedist, surgeon, and others) data 572. Band 539 may also be configured for use with other data types (not shown), including blood pressure, oxygen saturation and skin conductance response (SCR, also known as skin conductance level, psychogalvanic reflex, electrodermal response or galvanic skin response). In some examples, data may be captured by band 539 directly from wear by a user. For example, band 539 may be able to sample and analyze sweat through a salinity or moisture detector to identify whether any particular chemicals, proteins, hormones, or other organic or inorganic compounds are present, which can be analyzed by band 539 or communicated to server 114 to perform further analysis. If sent to server 114, further analyses may be performed by a hospital or other medical facility using data captured by band 539. In other examples, more, fewer, or different types of data may be captured for medical-related activities.

Band 539 may be used to diagnose a wide range of medical conditions and diseases. For example, the types of sensor data described above may be useful for diagnosing or monitoring medical conditions and diseases such as sleep disorders, diabetes, heart attack, stroke, hyperthermia, hypothermia, shock, Parkinson's Disease or other disorders (e.g., disorders involving movement-related symptoms). In some examples, band 539 may be implemented with multiple temperature sensors (e.g., one to gather body temperature data 564 and another to gather ambient temperature (i.e., environmental data 530)) in order to isolate changes to a user's body temperature, which may be useful for numerous medical reasons. For example, dramatic changes in body temperature may indicate various types of illnesses (e.g., cold, flu, etc.) or life-threatening events (e.g., heart attack, stroke, hyperthermia, hypothermia, shock, etc.). In another example, changes in a person's body temperature may be used to monitor a menstrual cycle and determine ovulation times (or failure to ovulate). In some examples, band 539 may be implemented to gather SCR data using two or more sensors. SCR data is known to measure arousal due to emotional intensity or cognitive effort. As such, SCR data may also be gathered to determine if a user is experiencing sympathetic stress, poor sleep quality or psychopathic tendencies. In another example, heart rate monitoring data 560, respiratory monitoring data 562, alone or along with other data types (e.g., motion sensor data 542, accelerometer data 544, etc.) may be gathered by band 539 to aid in determining when a baby stops breathing, if a baby has irregular breathing patterns when sleeping, or whether the baby is otherwise in danger of suffering from sudden infant death syndrome (SIDS). In other examples, band 539 may gather similar, or additional, data types to diagnose and monitor sleep disorders in adults. In other examples, various types of data gathered by band 539 may be useful in determining negative reactions to food, drink, or environmental influences (e.g., allergies, indigestion, intoxication, etc.). In yet other examples, band 539 may be implemented with different data types to diagnose or monitor other medical conditions and diseases. In some examples, the analysis of the above-described data types to diagnose and monitor medical conditions and diseases may be carried out using an application (i.e., software application), which may be stored in a memory (i.e., memory 206) and executed by a processor (i.e., processor 204). The application may be implemented using application architecture 400, as described in more detail above (see FIG. 4).

In response to the diagnosis and monitoring of medical conditions and diseases described above, band 539 may be implemented to provide notifications to a user (i.e., using notification facility 208) for treatment or prevention purposes. In some examples, patient medical records data 570 and healthcare professional (e.g., doctor, physician, registered nurse, physician's assistant, dentist, orthopedist, surgeon, and others) data 572 may be used in conjunction with the sensor-gathered data types described above to determine types of notifications for treatment and prevention of medical conditions and diseases. This determination may be made by an application (i.e., software application), which may be stored in a memory (i.e., memory 206) and executed by a processor (i.e., processor 204). The application may be implemented using application architecture 400, as described in more detail above (see FIG. 4). Various types of signals may be used to indicate various treatments and preventative measures. For example, a diabetic user may be prompted using one signal to eat if their blood glucose level falls below a certain threshold. A diabetic user may also be prompted using another signal to take insulin or other medication. In another example, band 539 may gather data associated with symptoms of anaphylactic shock, or other types of allergic reactions (e.g., hay fever, hives, etc.), and in response, provide a signal (e.g., vibratory, audio or visual signal via notification facility 208) to prompt the user to use an epinephrine autoinjector (e.g., EpiPen™), to take a prescribed dose of medication (e.g., an antihistamine (e.g., Benadryl™), a corticosteroid (e.g. Prednisone™), or other drug), or to take other prescribed treatment actions. In another example, band 539 may gather data indicating irregular breathing patterns (e.g., no breaths, distressed breathing patterns, etc.) or other signs of distress or illness (e.g., SIDS warning signs) in a baby, and in response, provide a signal (e.g., vibratory, audio or visual signal via notification facility 208) to prompt the baby to move or wake. In some examples, a band 539 worn by a baby may communicate with another band (not shown) worn by a parent, guardian or other caretaker (collectively referred to herein as "parent") that provides the parent with monitoring information or alerts (e.g., that the baby has stopped breathing, that the baby is awake, that the baby is experiencing distressed breathing, etc.). The monitoring information or alerts may be presented using any type of user interface, as described herein or may otherwise be implemented on the parent's band. The monitoring information or alerts may be communicated using a wired or wireless connection. In other examples, the monitoring information or alerts may be provided to the parent by any of the data and communications capable devices described herein. Similarly, band 539 may gather data indicating snoring, irregular breathing patterns, or other sleep disorder symptoms in an adult, and in response, provide a signal (e.g., vibratory, audio or visual signal via notification facility 208) to prompt the adult to move or wake. In yet other examples, band 539 may be implemented with different types of notification schemes to treat or prevent other medical conditions and diseases.

As described in more detail below, band 539 may be implemented in communication with other bands and other devices. The data types described above may be gathered by multiple bands and devices to obtain a more comprehensive set of data for analysis by an application. In some examples, one band (e.g., band 539) may be worn by a non-human subject, such as an animal (e.g., a pet, a zoo animal, a trained animal, etc.) to gather various types of data, as described above, and notification may be provided to a person associated with the non-human subject (e.g., a pet owner, a zookeeper, an animal trainer, etc.) for the administration of various treatments or preventative measures.

FIG. 6 illustrates a transition between modes of operation for a band in accordance with various embodiments. A band can transition between modes by either entering a mode at 602 or exiting a mode at 660. The flow to enter a mode begins at 602 and flows downward, whereas the flow to exit the mode begins at 660 and flows upward. A mode can be entered and exited explicitly 603 or entered and exited implicitly 605. In particular, a user can indicate explicitly whether to enter or exit a mode of operation by using inputs 620. Examples of inputs 620 include a switch with one or more positions that are each associated with a selectable mode, and a display I/O 624 that can be touch-sensitive for entering commands explicitly to enter or exit a mode. Note that entry of a second mode of operation can extinguish implicitly the first mode of operation. Further, a user can explicitly indicate whether to enter or exit a mode of operation by using motion signatures 610. That is, the motion of the band can facilitate transitions between modes of operation. A motion signature is a set of motions or patterns of motion that the band can detect using the logic of the band, whereby the logic can infer a mode from the motion signature. Examples of motion signatures are discussed below in FIG. 11. A set of motions can be predetermined, and then can be associated with a command to enter or exit a mode. Thus, motion can select a mode of operation. In some embodiments, modes of operation include a "normal" mode, an "active mode," a "sleep mode" or "resting mode," among other types of modes. A normal mode includes usual or normative amount of activities, whereas, an "active mode" typically includes relatively large amounts of activity. Active mode can include activities, such as running and swimming, for example. A "sleep mode" or "resting mode" typically includes a relatively low amount of activity that is indicative of sleeping or resting can be indicative of the user sleeping.

A mode can be entered and exited implicitly 605. In particular, a band and its logic can determine whether to enter or exit a mode of operation by inferring either an activity or a mode at 630. An inferred mode of operation can be determined as a function of user characteristics 632, such as determined by user-relevant sensors (e.g., heart rate, body temperature, etc.). An inferred mode of operation can be determined using motion matching 634 (e.g., motion is analyzed and a type of activity is determined). Further, an inferred mode of operation can be determined by examining environmental factors 636 (e.g., ambient temperature, time, ambient light, etc.). To illustrate, consider that: (1.) user characteristics 632 specify that the user's heart rate is at a resting rate and the body temperature falls (indicative of resting or sleeping), (2.) motion matching 634 determines that the user has a relatively low level of activity, and (3.) environment factors 636 indicate that the time is 3:00 am and the ambient light is negligible. In view of the foregoing, an inference engine or other logic of the band likely can infer that the user is sleeping and then operate to transition the band into sleep mode. In this mode, power may be reduced. Note that while a mode may transition either explicitly or implicitly, it need not exit the same way.

FIG. 7A illustrates a perspective view of an exemplary data-capable band configured to receive overmolding. Here, band 700 includes framework 702, covering 704, flexible circuit 706, covering 708, motor 710, coverings 714-724, plug 726, accessory 728, control housing 734, control 736, and flexible circuits 737-738. In some examples, band 700 is shown with various elements (i.e., covering 704, flexible circuit 706, covering 708, motor 710, coverings 714-724, plug 726, accessory 728, control housing 734, control 736, and flexible circuits 737-738) coupled to framework 702. Coverings 708, 714-724 and control housing 734 may be configured to protect various types of elements, which may be electrical, electronic, mechanical, structural, or of another type, without limitation. For example, covering 708 may be used to protect a battery and power management module from protective material formed around band 700 during an injection molding operation. As another example, housing 704 may be used to protect a printed circuit board assembly ("PCBA") from similar damage. Further, control housing 734 may be used to protect various types of user interfaces (e.g., switches, buttons (e.g., control 736), lights, light-emitting diodes, or other control features and functionality) from damage. In other examples, the elements shown may be varied in quantity, type, manufacturer, specification, function, structure, or other aspects in order to provide data capture, communication, analysis, usage, and other capabilities to band 700, which may be worn by a user around a wrist, arm, leg, ankle, neck or other protrusion or aperture, without restriction. Band 700, in some examples, illustrates an initial unlayered device that may be protected using the techniques for protective overmolding as described above. Alternatively, the number, type, function, configuration, ornamental appearance, or other aspects shown may be varied without limitation.

FIG. 7B illustrates a side view of an exemplary data-capable band. Here, band 740 includes framework 702, covering 704, flexible circuit 706, covering 708, motor 710, battery 712, coverings 714-724, plug 726, accessory 728, button/switch/LED 730-732, control housing 734, control 736, and flexible circuits 737-738 and is shown as a side view of band 700. In other examples, the number, type, function, configuration, ornamental appearance, or other aspects shown may be varied without limitation.

FIG. 8A illustrates a perspective of an exemplary data-capable band having a first molding. Here, an alternative band (i.e., band 800) includes molding 802, analog audio TRRS-type plug (hereafter "plug") 804, plug housing 806, button 808, framework 810, control housing 812, and indicator light 814. In some examples, a first protective overmolding (i.e., molding 802) has been applied over band 700 (FIG. 7) and the above-described elements (e.g., covering 704, flexible circuit 706, covering 708, motor 710, coverings 714-724, plug 726, accessory 728, control housing 734, control 736, and flexible circuit 738) leaving some elements partially exposed (e.g., plug 804, plug housing 806, button 808, framework 810, control housing 812, and indicator light 814). However, internal PCBAs, flexible connectors, circuitry, and other sensitive elements have been protectively covered with a first or inner molding that can be configured to further protect band 800 from subsequent moldings formed over band 800 using the above-described techniques. In other examples, the type, configuration, location, shape, design, layout, or other aspects of band 800 may be varied and are not limited to those shown and described. For example, TRRS plug 804 may be removed if a wireless communication facility is instead attached to framework 810, thus having a transceiver, logic, and antenna instead being protected by molding 802. As another example, button 808 may be removed and replaced by another control mechanism (e.g., an accelerometer that provides motion data to a processor that, using firmware and/or an application, can identify and resolve different types of motion that band 800 is undergoing), thus enabling molding 802 to be extended more fully, if not completely, over band 800. In other examples, the number, type, function, configuration, ornamental appearance, or other aspects shown may be varied without limitation.

FIG. 8B illustrates a side view of an exemplary data-capable band. Here, band 820 includes molding 802, plug 804, plug housing 806, button 808, control housing 812, and indicator lights 814 and 822. In other examples, the number, type, function, configuration, ornamental appearance, or other aspects shown may be varied without limitation.

FIG. 9A illustrates a perspective view of an exemplary data-capable band having a second molding. Here, band 900 includes molding 902, plug 904, and button 906. As shown another overmolding or protective material has been formed by injection molding, for example, molding 902 over band 900. As another molding or covering layer, molding 902 may also be configured to receive surface designs, raised textures, or patterns, which may be used to add to the commercial appeal of band 900. In some examples, band 900 may be illustrative of a finished data-capable band (i.e., band 700 (FIG. 7), 800 (FIG. 8) or 900) that may be configured to provide a wide range of electrical, electronic, mechanical, structural, photonic, or other capabilities.

Here, band 900 may be configured to perform data communication with one or more other data-capable devices (e.g., other bands, computers, networked computers, clients, servers, peers, and the like) using wired or wireless features. For example, plug 900 may be used, in connection with firmware and software that allow for the transmission of audio tones to send or receive encoded data, which may be performed using a variety of encoded waveforms and protocols, without limitation. In other examples, plug 904 may be removed and instead replaced with a wireless communication facility that is protected by molding 902. If using a wireless communication facility and protocol, band 900 may communicate with other data-capable devices such as cell phones, smart phones, computers (e.g., desktop, laptop, notebook, tablet, and the like), computing networks and clouds, and other types of data-capable devices, without limitation. In still other examples, band 900 and the elements described above in connection with FIGs. 1-9, may be varied in type, configuration, function, structure, or other aspects, without limitation to any of the examples shown and described.

FIG. 9B illustrates a side view of an exemplary data-capable band. Here, band 910 includes molding 902, plug 904, and button 906. In other examples, the number, type, function, configuration, ornamental appearance, or other aspects shown may be varied without limitation.

FIG. 10 illustrates an exemplary computer system suitable for use with a data-capable band. In some examples, computer system 1000 may be used to implement computer programs, applications, methods, processes, or other software to perform the above-described techniques. Computer system 1000 includes a bus 1002 or other communication mechanism for communicating information, which interconnects subsystems and devices, such as processor 1004, system memory 1006 (e.g., RAM), storage device 1008 (e.g., ROM), disk drive 1010 (e.g., magnetic or optical), communication interface 1012 (e.g., modem or Ethernet card), display 1014 (e.g., CRT or LCD), input device 1016 (e.g., keyboard), and cursor control 1018 (e.g., mouse or trackball).

According to some examples, computer system 1000 performs specific operations by processor 1004 executing one or more sequences of one or more instructions stored in system memory 1006. Such instructions may be read into system memory 1006 from another computer readable medium, such as static storage device 1008 or disk drive 1010. In some examples, hard-wired circuitry may be used in place of or in combination with software instructions for implementation.

The term "computer readable medium" refers to any tangible medium that participates in providing instructions to processor 1004 for execution. Such a medium may take many forms, including but not limited to, non-volatile media and volatile media. Non-volatile media includes, for example, optical or magnetic disks, such as disk drive 1010. Volatile media includes dynamic memory, such as system memory 1006.

Common forms of computer readable media includes, for example, floppy disk, flexible disk, hard disk, magnetic tape, any other magnetic medium, CD-ROM, any other optical medium, punch cards, paper tape, any other physical medium with patterns of holes, RAM, PROM, EPROM, FLASH-EPROM, any other memory chip or cartridge, or any other medium from which a computer can read.

Instructions may further be transmitted or received using a transmission medium. The term "transmission medium" may include any tangible or intangible medium that is capable of storing, encoding or carrying instructions for execution by the machine, and includes digital or analog communications signals or other intangible medium to facilitate communication of such instructions. Transmission media includes coaxial cables, copper wire, and fiber optics, including wires that comprise bus 1002 for transmitting a computer data signal.

In some examples, execution of the sequences of instructions may be performed by a single computer system 1000. According to some examples, two or more computer systems 1000 coupled by communication link 1020 (e.g., LAN, PSTN, or wireless network) may perform the sequence of instructions in coordination with one another. Computer system 1000 may transmit and receive messages, data, and instructions, including program, i.e., application code, through communication link 1020 and communication interface 1012. Received program code may be executed by processor 1004 as it is received, and/or stored in disk drive 1010, or other non-volatile storage for later execution.

FIG. 11 depicts a representative implementation of one or more bands and equivalent devices, as wearable devices, to form unique motion profiles, according to various embodiments. In diagram 1100, bands and an equivalent device are disposed on locomotive members of the user, whereby the locomotive members facilitate motion relative to and about a center point 1130 (e.g., a reference point for a position, such as a center of mass). A headset 1110 is configured to communicate with bands 1111, 1112, 1113 and 1114 and is disposed on a body portion 1102 (e.g., the head), which is subject to motion relative to center point 1130. Bands 1111 and 1112 are disposed on locomotive portions 1104 of the user (e.g., the arms or wrists), whereas bands 1113 and 1114 are disposed on locomotive portion 1106 of the user (e.g., the legs or ankles). As shown, headset 1110 is disposed at distance 1120 from center point 1130, bands 1111 and 1112 are disposed at distance 1122 from center point 1130, and bands 1113 and 1114 are disposed at distance 1124 from center point 1130. A great number of users have different values of distances 1120, 1122, and 1124. Further, different wrist-to-elbow and elbow-to-shoulder lengths for different users affect the relative motion of bands 1111 and 1112 about center point 1130, and similarly, different hip-to-knee and knee-to-ankle lengths for different users affect the relative motion of bands 1113 and 1114 about center point 1130. Moreover, a great number of users have unique gaits and styles of motion. The above-described factors, as well as other factors, facilitate the determination of a unique motion profile for a user per activity (or in combination of a number of activities). The uniqueness of the motion patterns in which a user performs an activity enables the use of motion profile data to provide a "motion fingerprint." A "motion fingerprint" is unique to a user and can be compared against detected motion profiles to determine, for example, whether a use of the band by a subsequent wearer is unauthorized. In some cases, unauthorized users do not typically share common motion profiles. Note that while four are shown, fewer than four can be used to establish a "motion fingerprint," or more can be shown (e.g., a band can be disposed in a pocket or otherwise carried by the user). For example, a user can place a single band at different portions of the body to capture motion patterns for those body parts in a serial fashion. Then, each of the motions patterns can be combined to form a "motion fingerprint." In some cases, a single band 1111 is sufficient to establish a "motion fingerprint." In other examples, one or more of bands 1111, 1112, 1113 and 1114 can be configured to operate with multiple users, including non-human users, such as pets or other animals.

FIGS. 12-13 are diagrams representing examples of networks formed using one or more bands, according to some embodiments. Diagram 1200 of FIG. 12 depicts a personal, wearable network including a number of bands 1211, 1212, 1213, and 1214 (more or less) disposed on locomotive bodily members of a user or an entity (e.g., a human, an animal, such as a pet, etc.), according to one example. In some embodiments, bands 1211, 1212, 1213, and 1214 can communicate with each other via, for example, Bluetooth® to form a peer-to-peer network. Further, a wearable communication device 1210 configured for aural communication, such as a headset, can communicate with bands 1211, 1212, 1213, and 1214, and can serve as a router to route data among bands 1211, 1212, 1213, and 1214, and with a mobile communications device 1216 (e.g., a mobile phone). As shown, wearable communication device 1210 forms communication links 1217 with one or more bands 1211, 1212, 1213, and 1214. Any of bands 1211, 1212, 1213, and 1214 can communicate on communication link 1219 via networks 1220 to a remote band 1230. Or, bands 1211, 1212, 1213, and 1214 can communicate via communication links 1218 and networks 1220 to a remote band 1230. Note that in some embodiments, bands 1211, 1212, 1213, and 1214 form a secured personal, wearable network based on security keys that consider, for example, motion (e.g., all bands 1211, 1212, 1213, and 1214 are moving in the same direction and can be indicative of a single person using bands 1211, 1212, 1213, and 1214).

Diagram 1300 of FIG. 13 depicts a number of bands that form a local network between the bands, according to one example. A band 1312 is associated with a user 1301. Bands 1312 can communicate via communication links 1317 and 1318 to communication device 1316, and, in turn, to one or more network 1320. Note that group 1302 of users 1301 may be engaging in a common event, such as a yoga class or a marathon. Given this common activity, and some other optional activity or information, a secured (or unsecured) local network can be established, for example, without explicit request by users 1301. Rather, the common activity and general permissions can facilitate establishment of an ad hoc network among band 1312, which, for example, can cease to operate as network once users cease to participate in the common activity.

In at least some examples, the structures and/or functions of any of the above-described features can be implemented in software, hardware, firmware, circuitry, or a combination thereof. Note that the structures and constituent elements above, as well as their functionality, may be aggregated with one or more other structures or elements. Alternatively, the elements and their functionality may be subdivided into constituent sub-elements, if any. As software, the above-described techniques may be implemented using various types of programming or formatting languages, frameworks, syntax, applications, protocols, objects, or techniques. As hardware and/or firmware, the above-described techniques may be implemented using various types of programming or integrated circuit design languages, including hardware description languages, such as any register transfer language ("RTL") configured to design field-programmable gate arrays ("FPGAs"), application-specific integrated circuits ("ASICs"), or any other type of integrated circuit. These can be varied and are not limited to the examples or descriptions provided.

Although the foregoing examples have been described in some detail for purposes of clarity of understanding, the above-described inventive techniques are not limited to the details provided. There are many alternative ways of implementing the above-described invention techniques. The disclosed examples are illustrative and not restrictive.

What is claimed:

1. A medical band, comprising:

one or more sensors configured to gather data associated with at least one symptom of a medical condition;

a memory configured to store the data and an application, the application being configured to determine the medical condition using the data;

a processor configured to execute the application; and

a notification facility configured to provide a notification upon receiving from the application an instruction associated with the notification.

2. The medical band of claim 1, wherein the notification is associated with a drug regimen.

3. The medical band of claim 1, wherein the notification is associated with a diet.

4. The medical band of claim 1, wherein the notification is configured to prompt movement.

5. The medical band of claim 1, wherein the notification comprises an alarm.

6. The medical band of claim 1, wherein the one or more sensors comprises a plurality of temperature sensors, one of the plurality of temperature sensors configured to gather data associated with body temperature, another of the plurality of temperature sensors configured to gather data associated with ambient temperature.

7. The medical band of claim 1, wherein the notification facility is configured to provide a vibratory energy.

8. The medical band of claim 1, wherein the notification facility is configured to provide an audio signal.

9. The medical band of claim 1, wherein the notification facility is configured to provide a visual signal.

10. The medical band of claim 1, wherein the medical band is configured to be worn by an animal.

11. The medical band of claim 1, wherein the one or more sensors is configured to gather data associated with an indicator of an animal's health.

12. The medical band of claim 1, wherein the application is configured to determine a medical condition associated with an animal.

13. The medical band of claim 1, wherein the medical band is configured to provide a notification using another device.

14. A medical diagnosis and monitoring system, comprising:

a medical band comprising one or more sensors configured to gather data associated with at least one symptom of a medical condition and a communications facility configured to communicate with another device;

a memory configured to store the data;

notification facility configured to provide a notification; and

an application implemented on the another device, the application configured to determine the medical condition using the data and to provide an instruction to the medical band.

15. The medical diagnosis and monitoring system of claim 13, wherein the another device comprises a computer.

16. The medical diagnosis and monitoring system of claim 13, wherein the another device comprises another medical band.

17. The medical diagnosis and monitoring system of claim 13, wherein the another device comprises a mobile communication device.

18. The medical diagnosis and monitoring system of claim 13, wherein the another device comprises a mobile computing device.

19. The medical diagnosis and monitoring system of claim 13, wherein the instruction is associated with the notification.

20. The medical diagnosis and monitoring system of claim 13, wherein the notification facility is configured to provide a notification using a remote device.

21. The medical diagnosis and monitoring system of claim 20, wherein the notification is provided using an application implemented on the remote device.

22. The medical diagnosis and monitoring system of claim 20, wherein the medical band is configured to be worn by a child and the remote device is operable by a caretaker.

23. A medical diagnosis and monitoring system, comprising:

a plurality of medical bands, each of the plurality of medical bands comprising one or more sensors configured to gather data associated with at least one symptom of a medical condition and a communications facility configured to communicate with another of the plurality of medical bands;

a memory configured to store the data;

a notification facility configured to provide a notification; and

an application implemented on one of the plurality of medical bands, the application configured to determine the medical condition using the data and to provide to another of the plurality of medical bands an instruction associated with the notification.

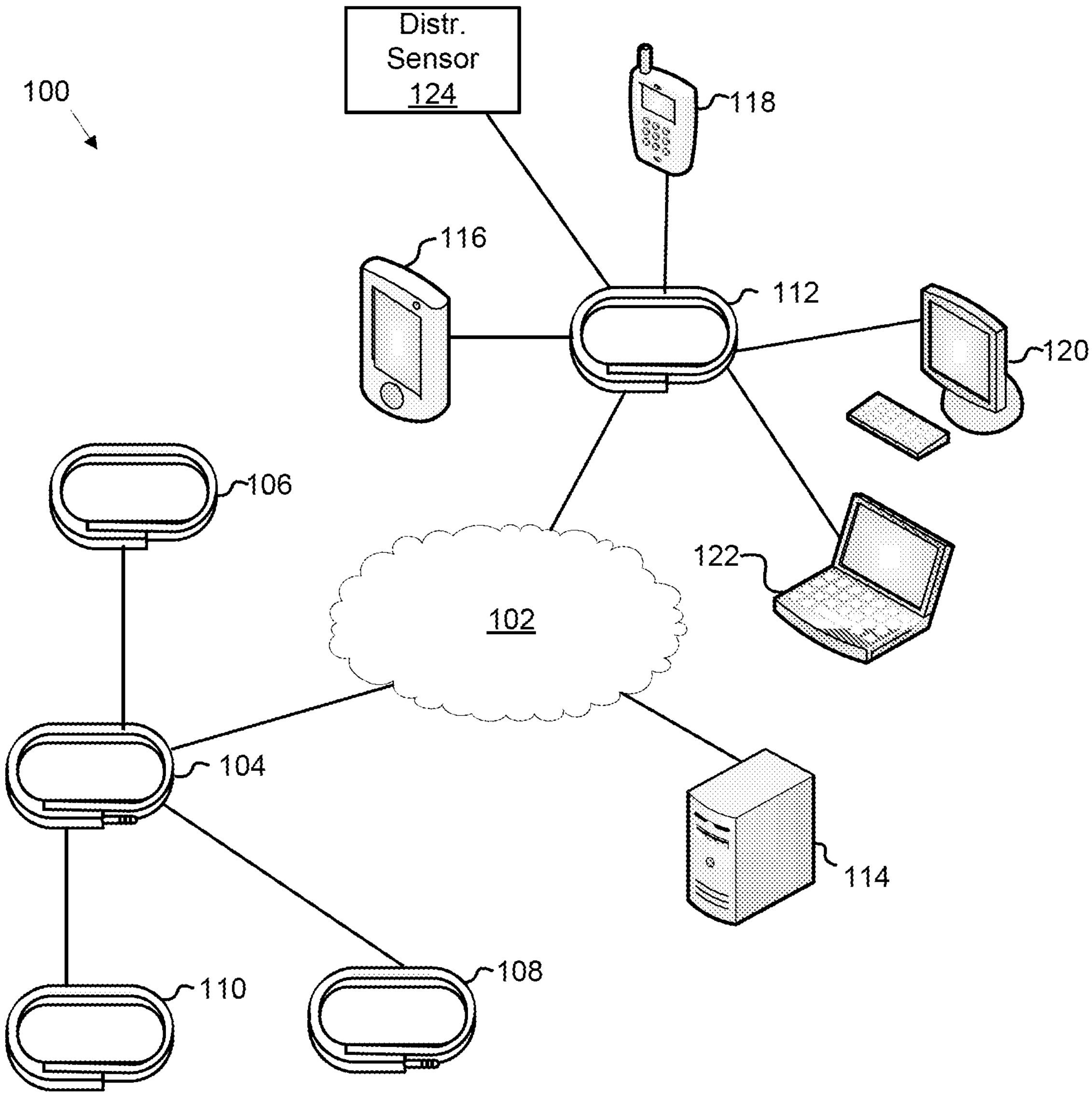

Distr.
Sensor
124
100
118
116
112
120
106
122
102
104
114
110
108

FIG. 1

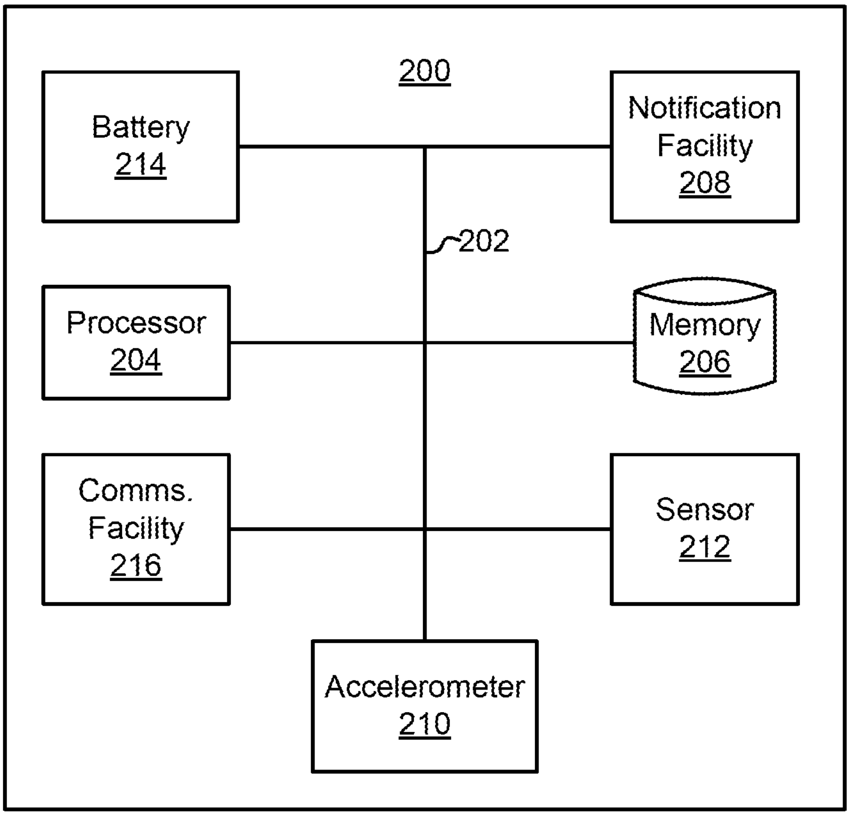

200
Battery
214
Notification
Facility
208
202
Processor
204
Memory
206
Comms.
Facility
216
Sensor
212
Accelerometer
210

FIG. 2

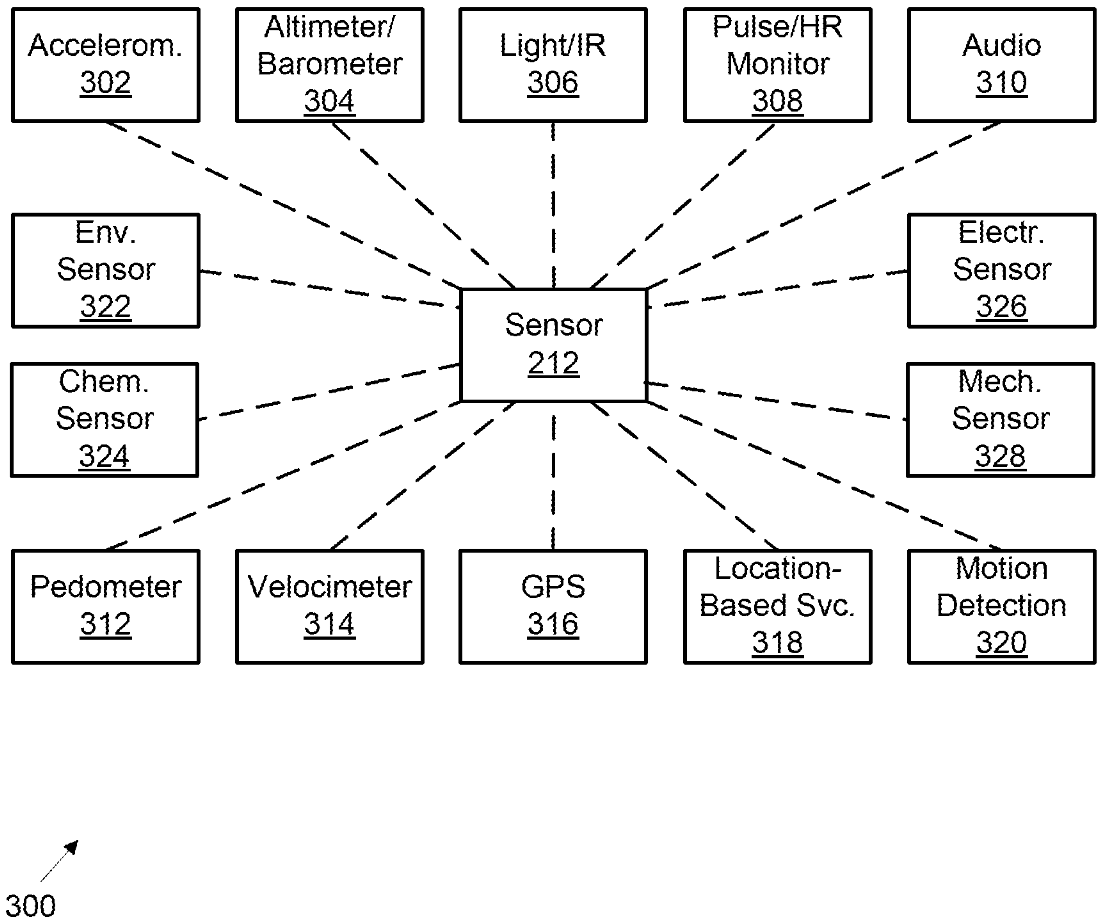

Accelerom.
302
Altimeter/
Barometer
304
Light/IR
306
Pulse/HR
Monitor
308
Audio
310
Env.
Sensor
322
Electr.
Sensor
326
Sensor
212
Chem.
Sensor
324
Mech.
Sensor
328
Pedometer
312
Velocimeter
314
GPS
316
Location-
Based Svc.
318
Motion
Detection
320
300

FIG. 3

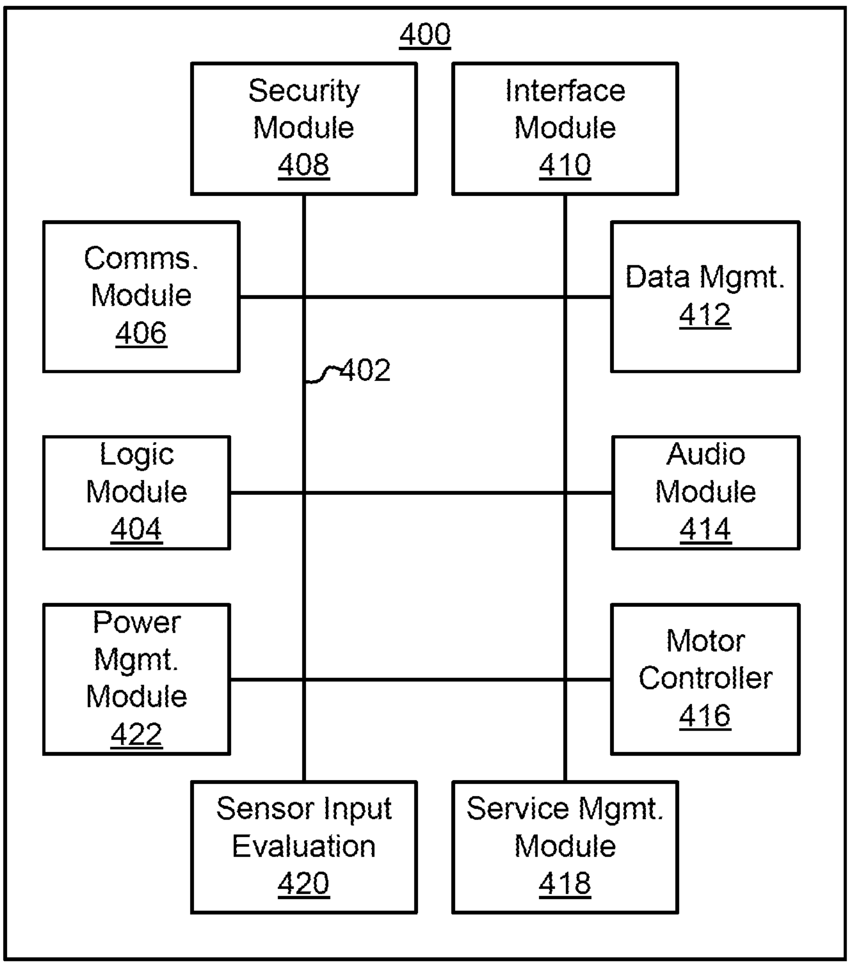
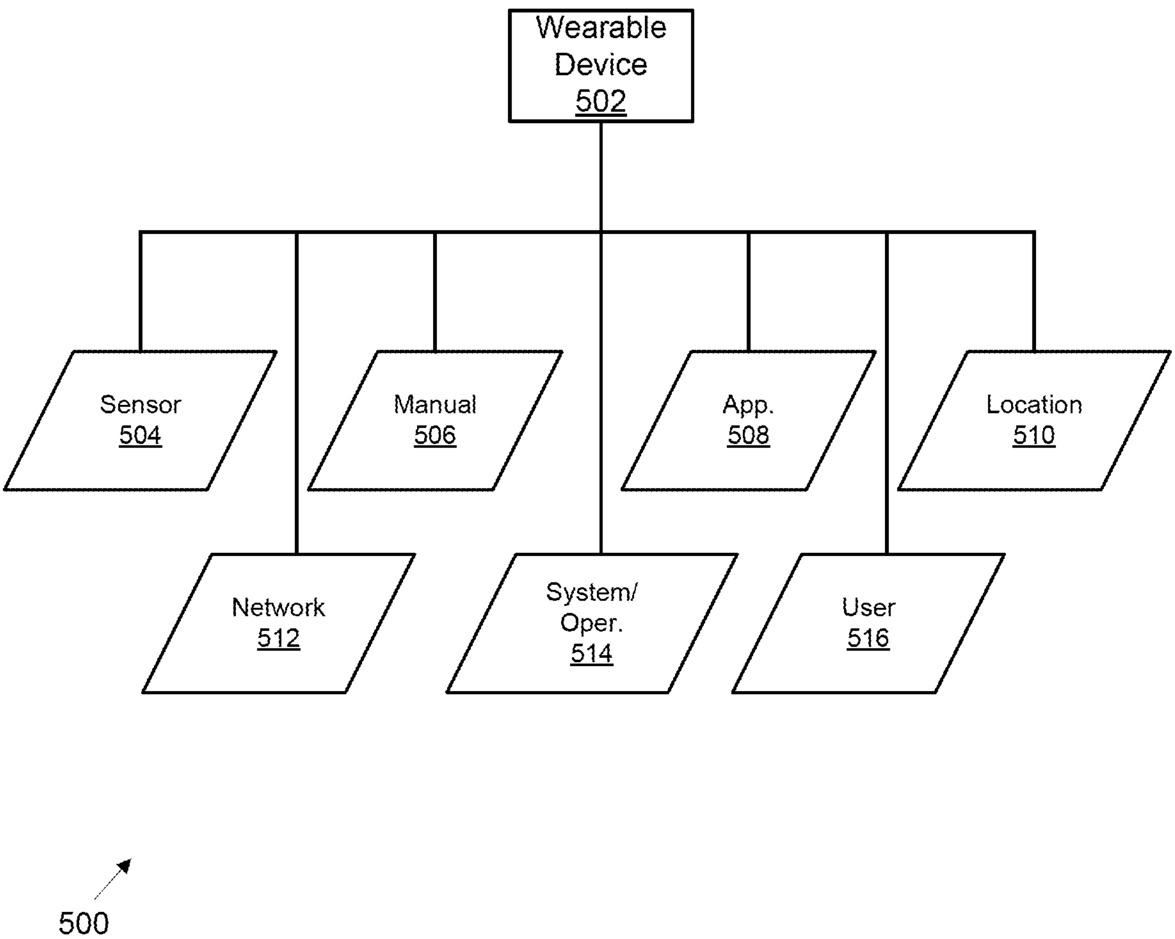

400
Security Module 408
Interface Module 410
Comms. Module 406
Data Mgmt. 412
402
Logic Module 404
Audio Module 414
Power Mgmt. Module 422
Motor Controller 416
Sensor Input Evaluation 420
Service Mgmt. Module 418

FIG. 4



Wearable Device 502
Sensor 504
Manual 506
App. 508
Location 510
Network 512
System/ Oper. 514
User 516
500

FIG. 5A

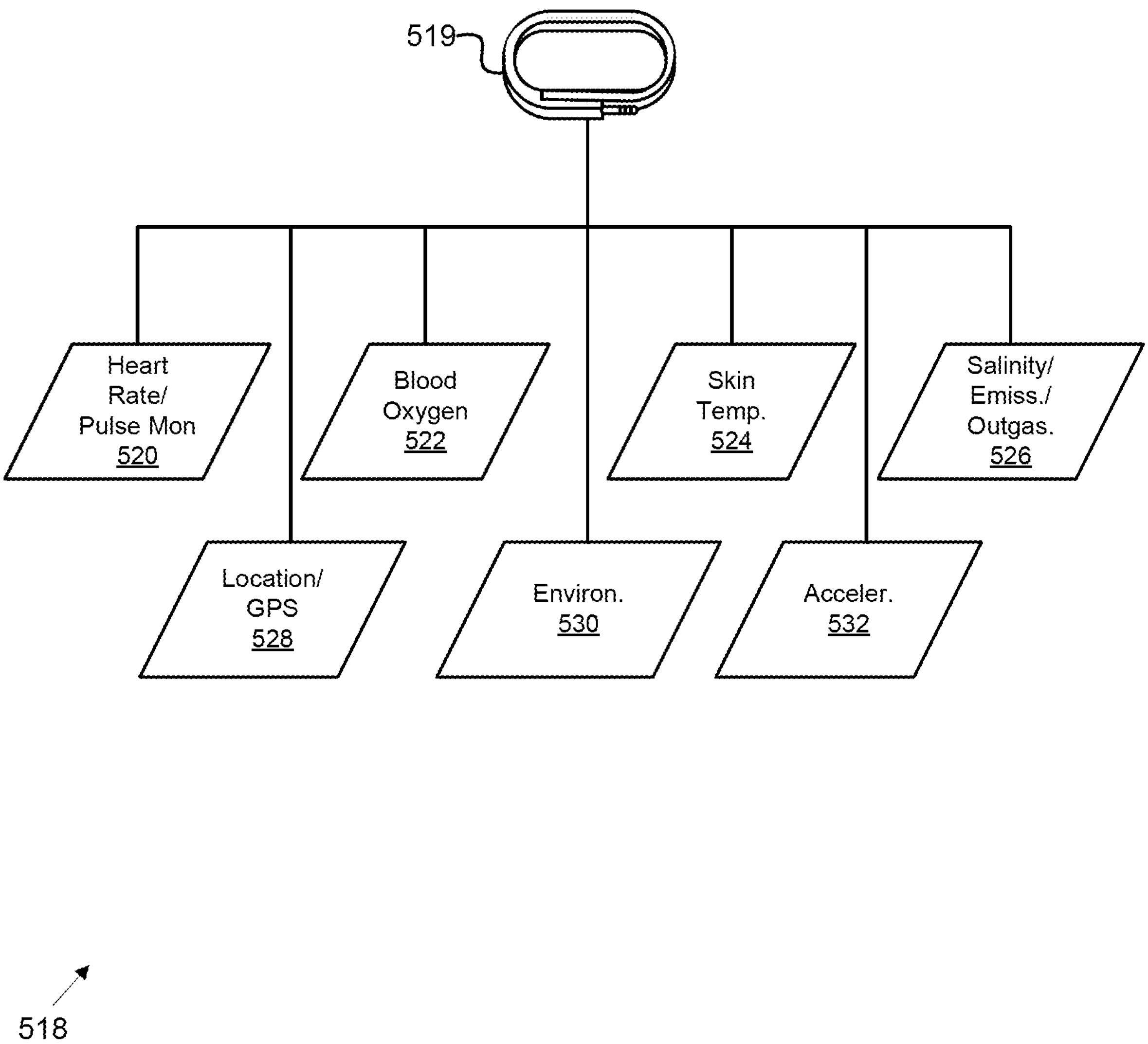

519
Heart
Rate/
Pulse Mon
520
Blood
Oxygen
522
Skin
Temp.
524
Salinity/
Emiss./
Outgas.
526
Location/
GPS
528
Environ.
530
Acceler.
532
518

FIG. 5B

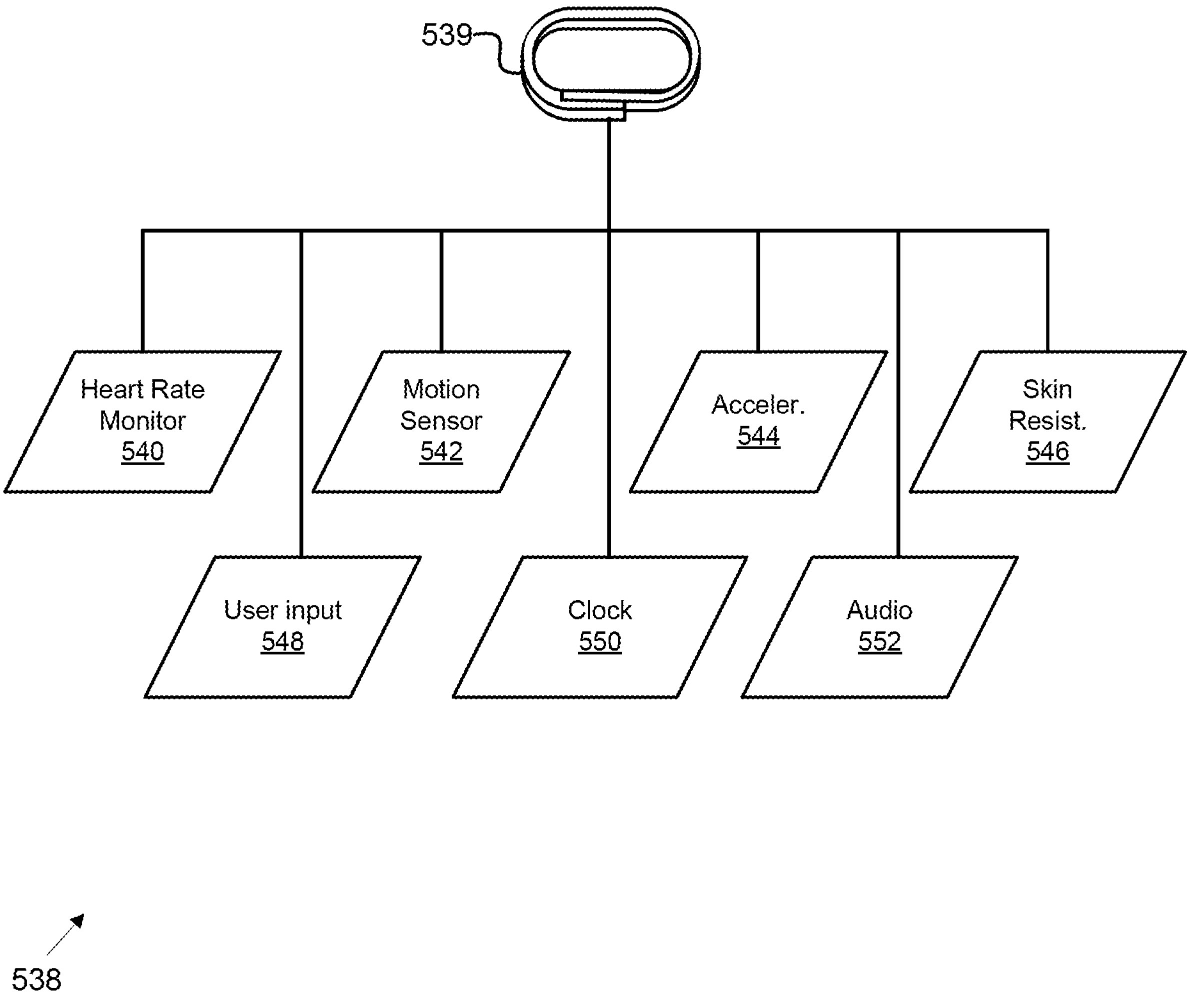

539
Heart Rate
Monitor
540
Motion
Sensor
542
Acceler.
544
Skin
Resist.
546
User input
548
Clock
550
Audio
552
538

FIG. 5C

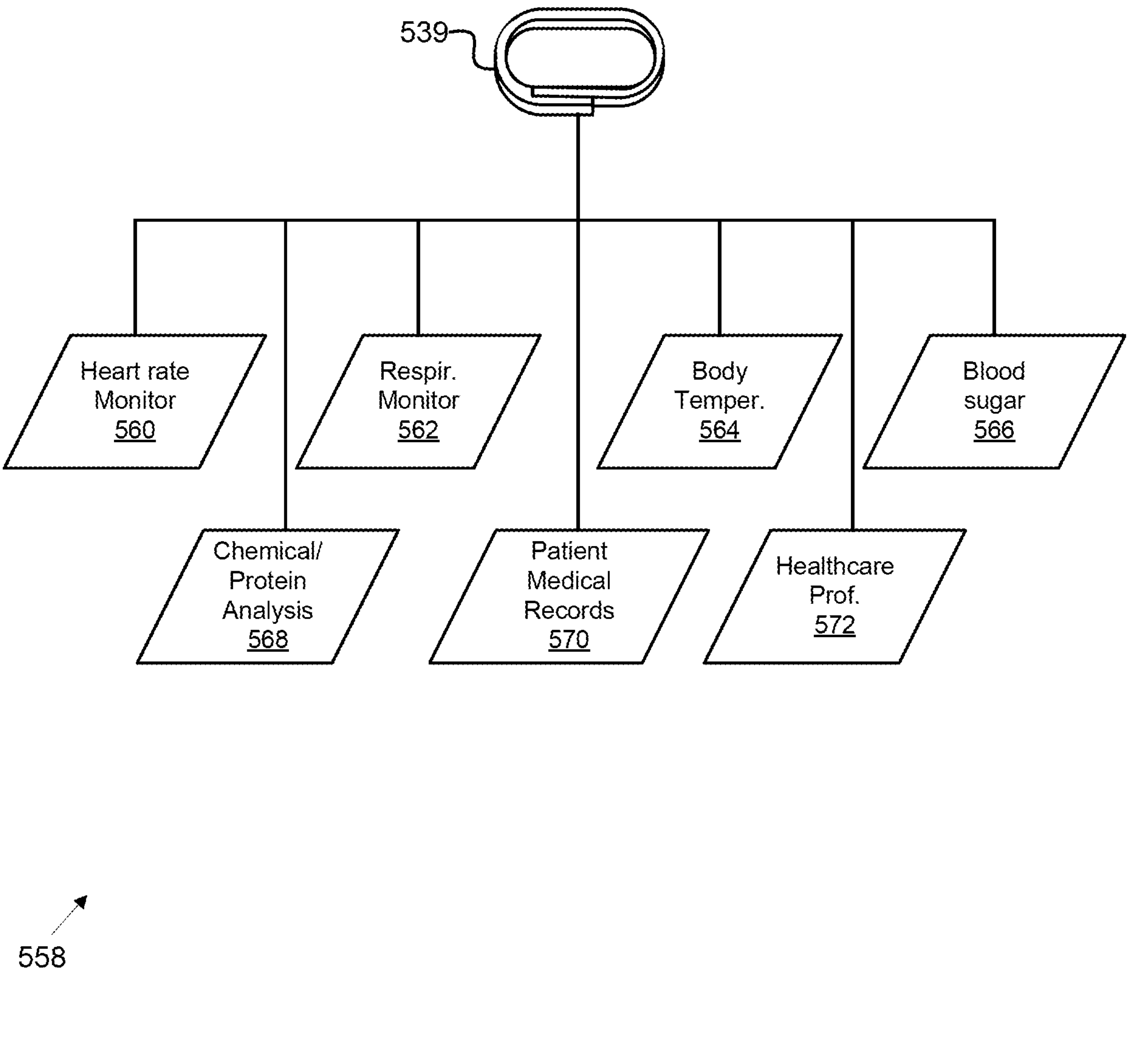

539
Heart rate
Monitor
560
Respir.
Monitor
562
Body
Temper.
564
Blood
sugar
566
Chemical/
Protein
Analysis
568
Patient
Medical
Records
570
Healthcare
Prof.
572
558

FIG. 5D

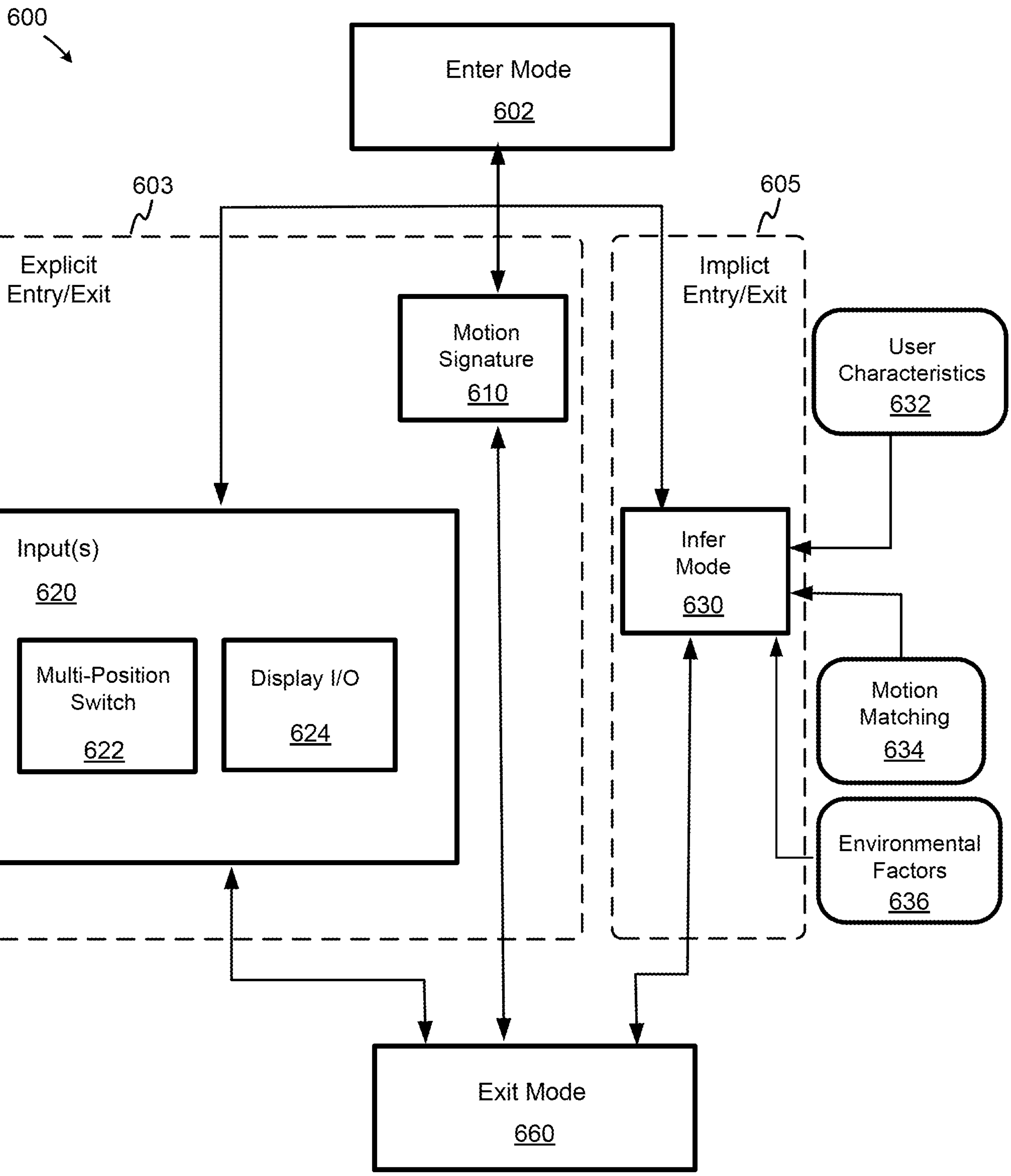

600
Enter Mode
602
603
605
Explicit
Entry/Exit
Motion
Signature
610
Implict
Entry/Exit
User
Characteristics
632
Input(s)
620
Multi-Position
Switch
622
Display I/O
624
Infer
Mode
630
Motion
Matching
634
Environmental
Factors
636
Exit Mode
660

FIG. 6

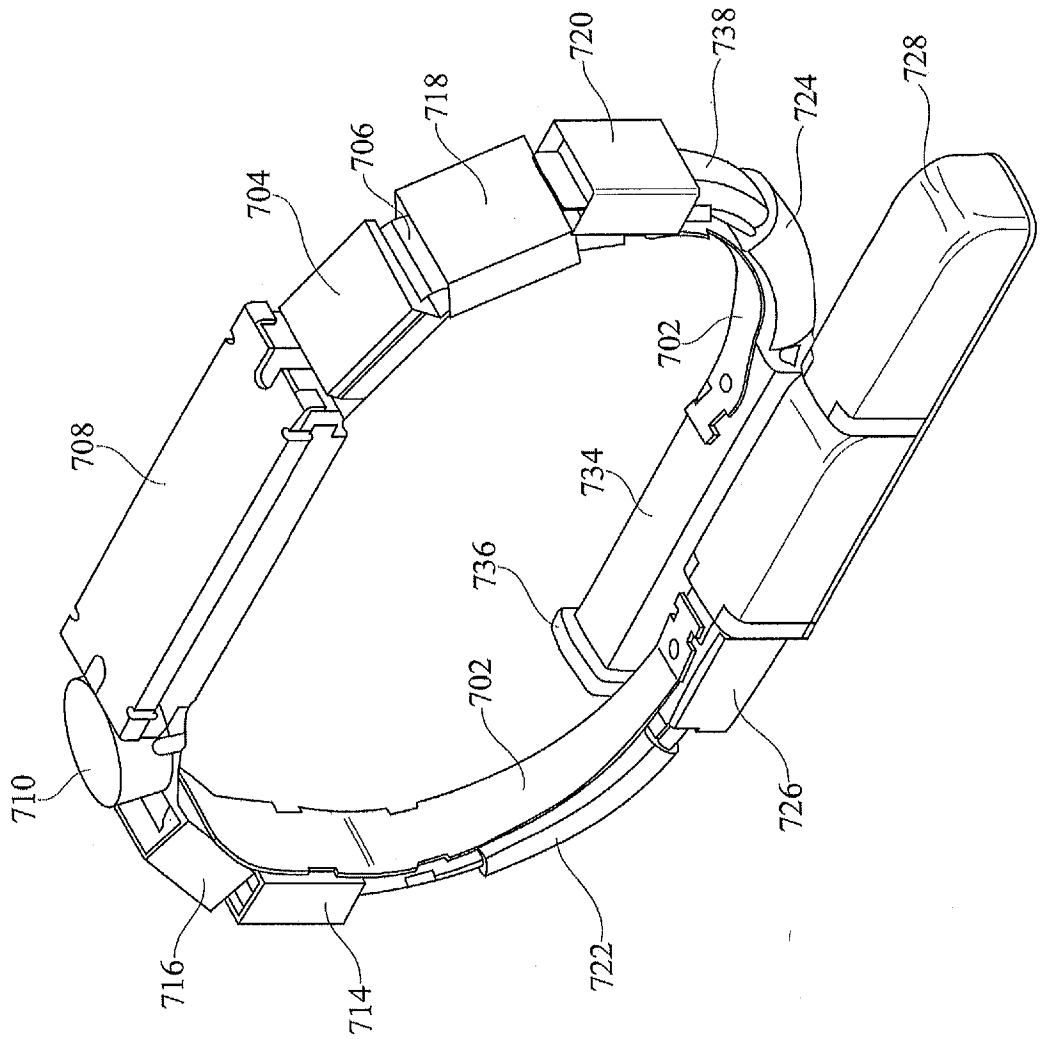

720
738
728
718
706
724
704
702
708
734
736
702
710
726
716
714
722

FIG. 7A

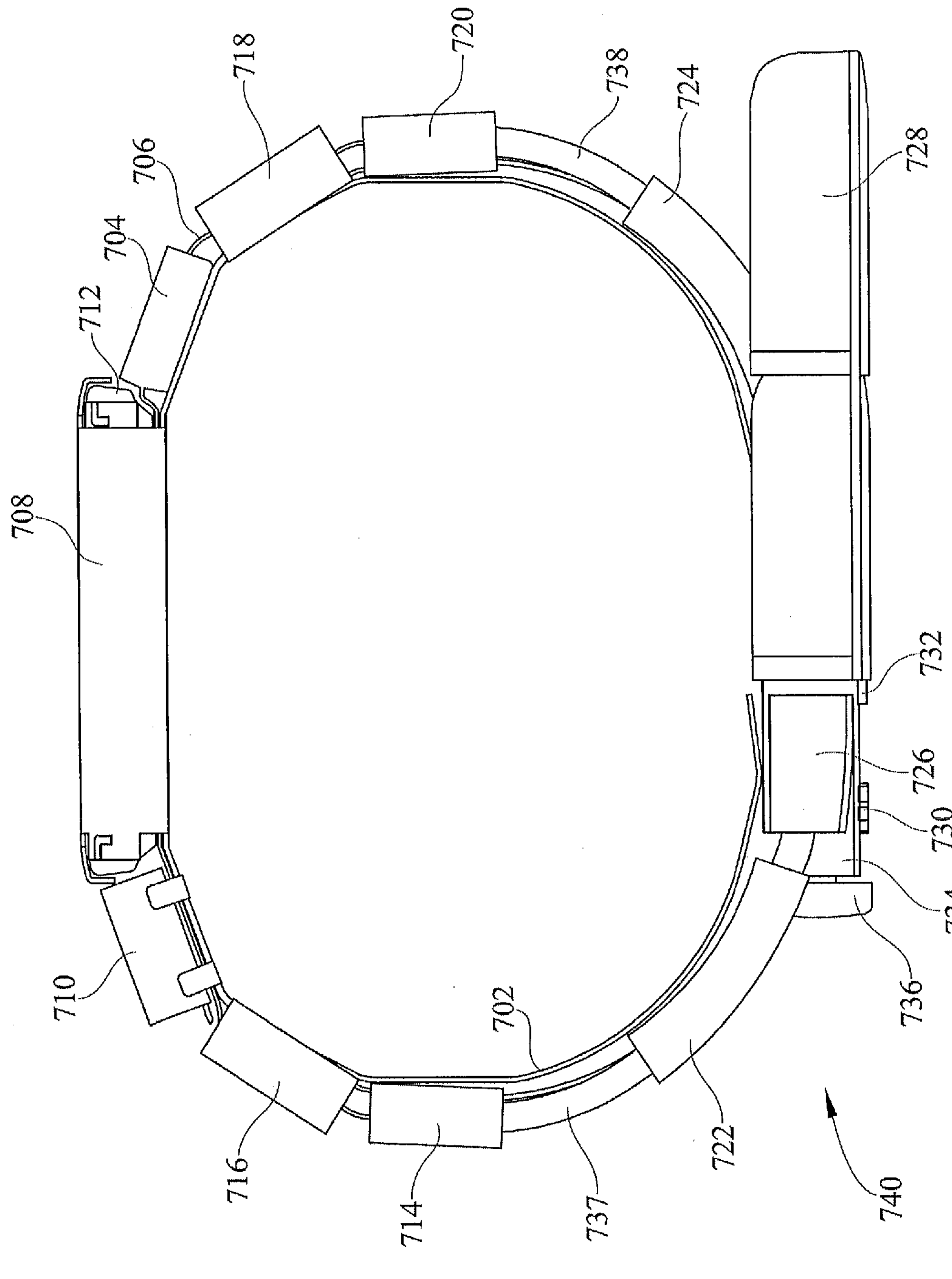

720
718
738
724
706
728
704
712
708
732
726
730
734
710
736
702
716
722
714
737
740

FIG. 7B

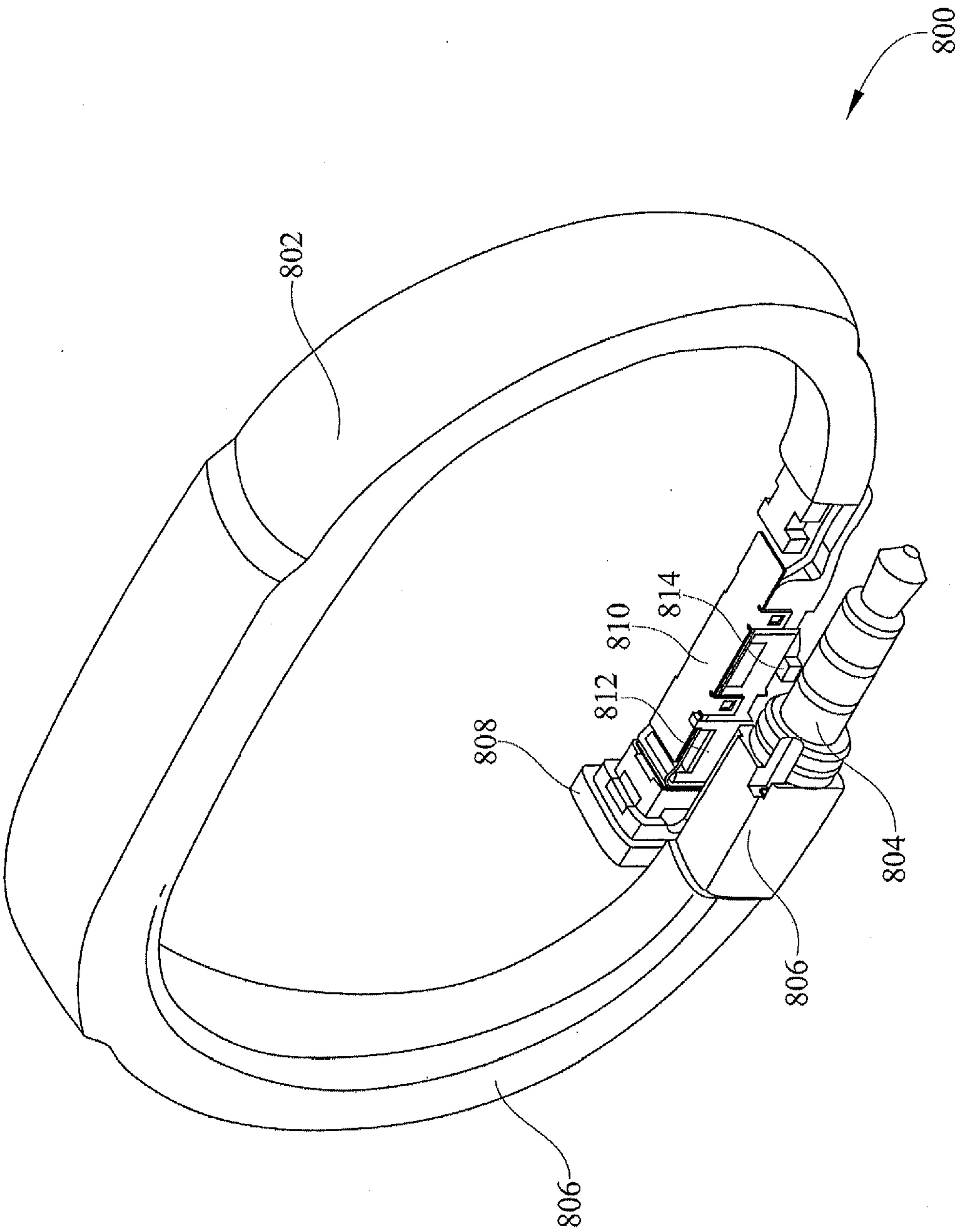


FIG. 8A

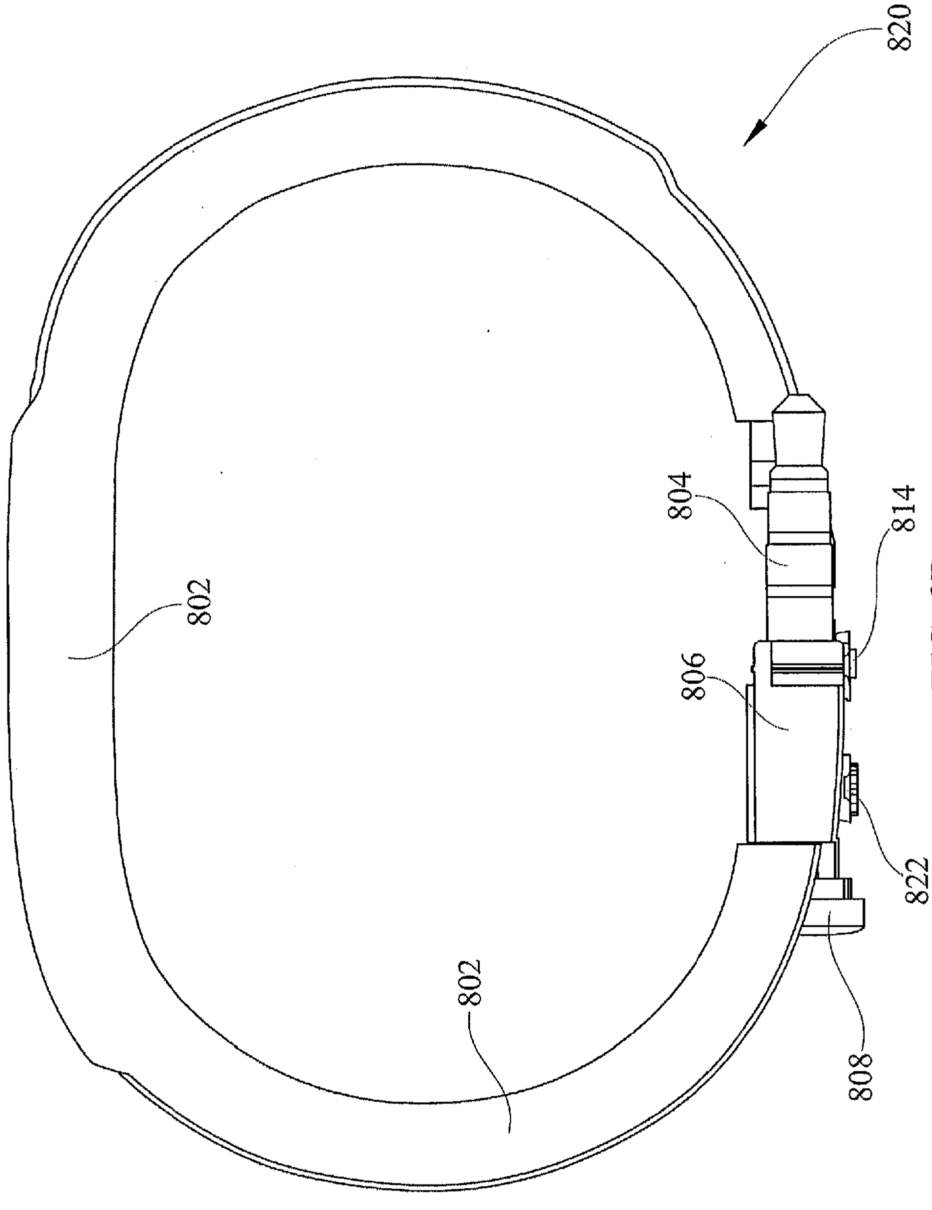


FIG. 8B

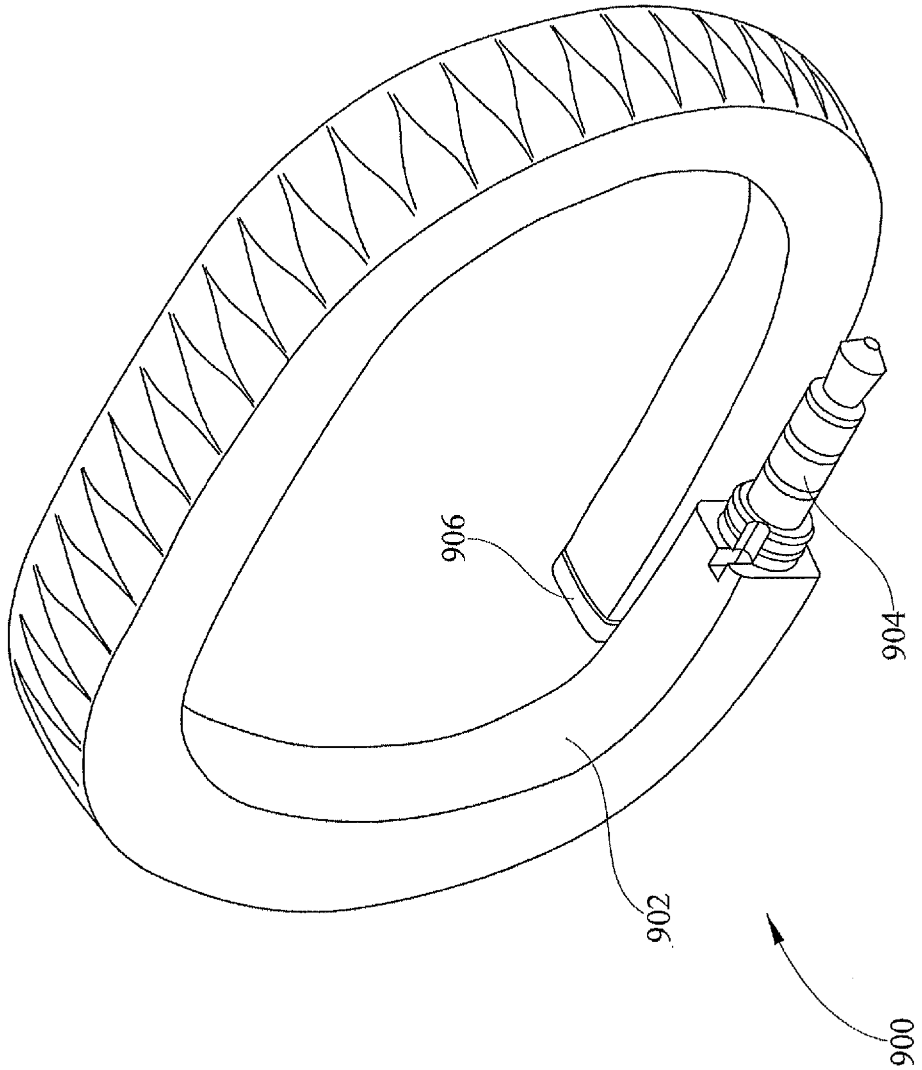


FIG. 9A

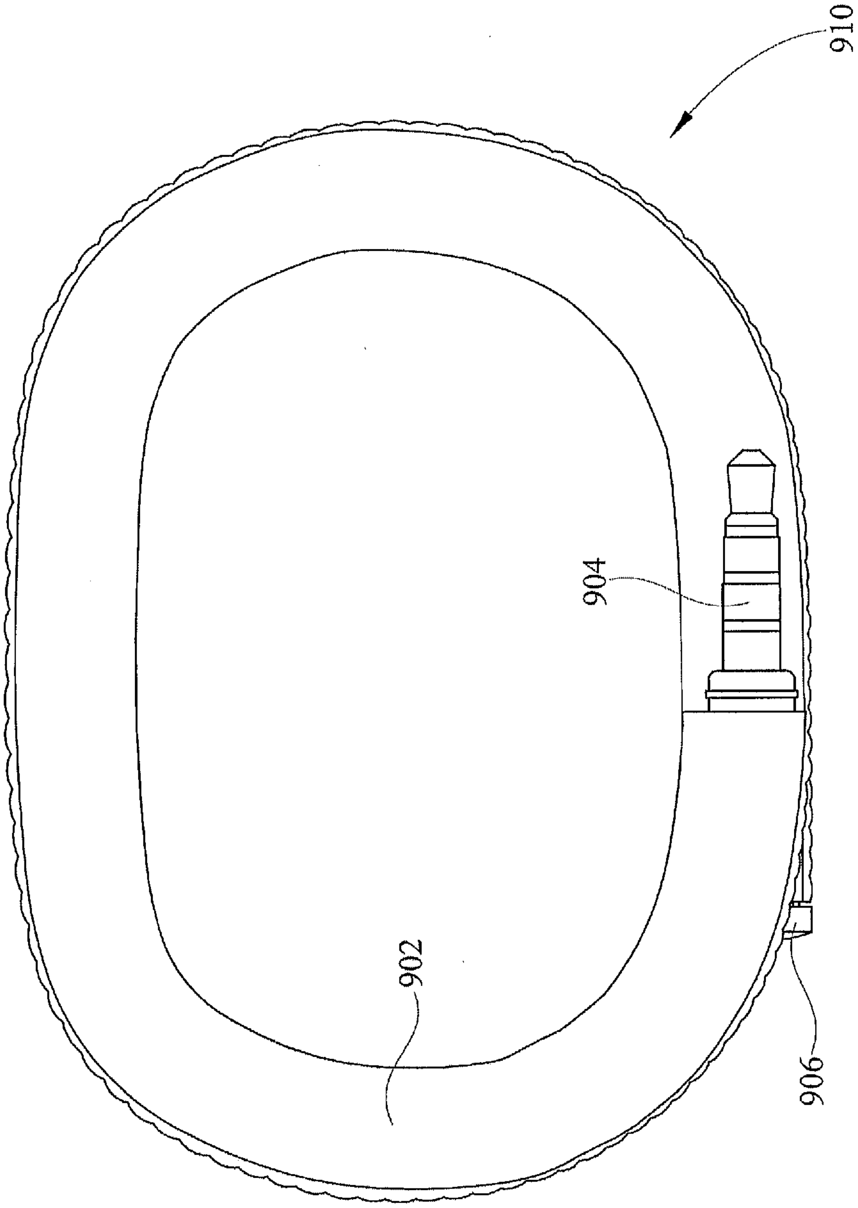


FIG. 9B

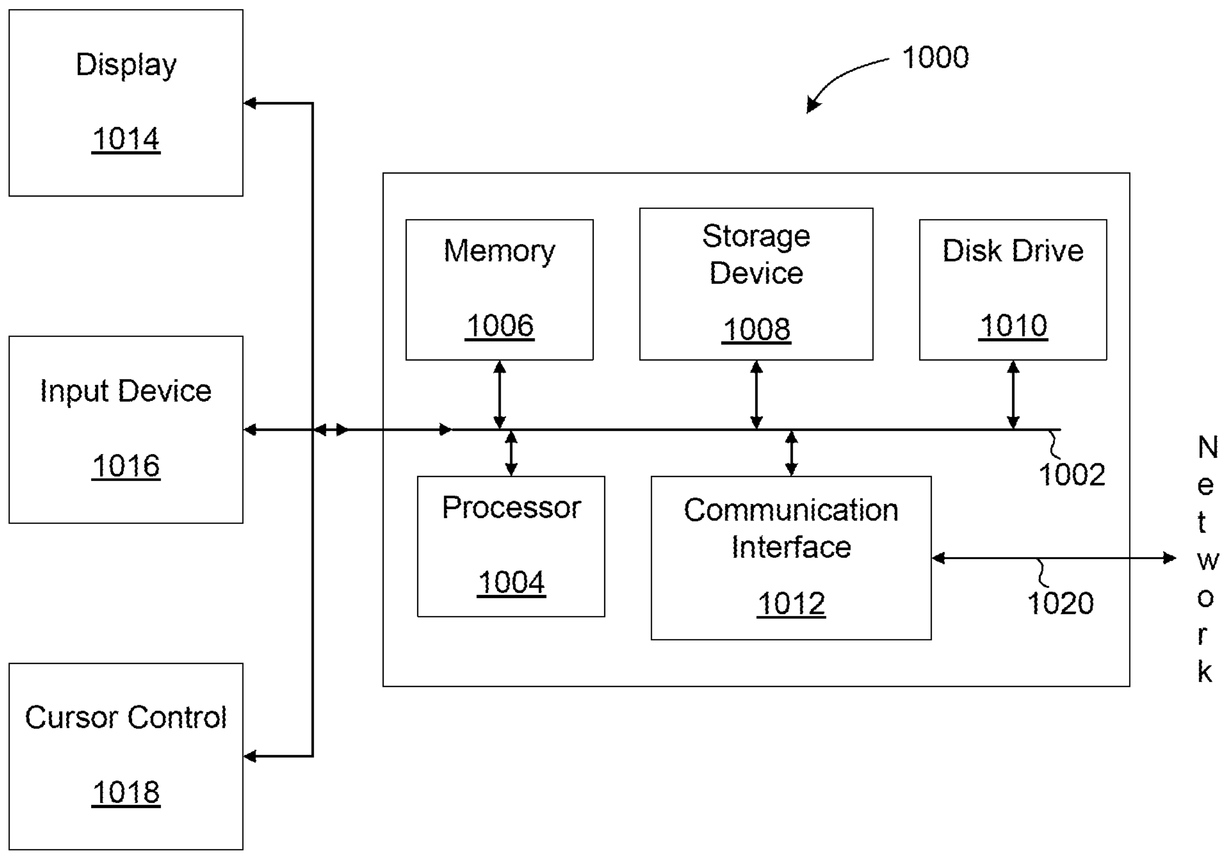

1000
Display
1014
Input Device
1016
Cursor Control
1018
Memory
1006
Storage Device
1008
Disk Drive
1010
1002
Processor
1004
Communication Interface
1012
1020
Network

FIG. 10

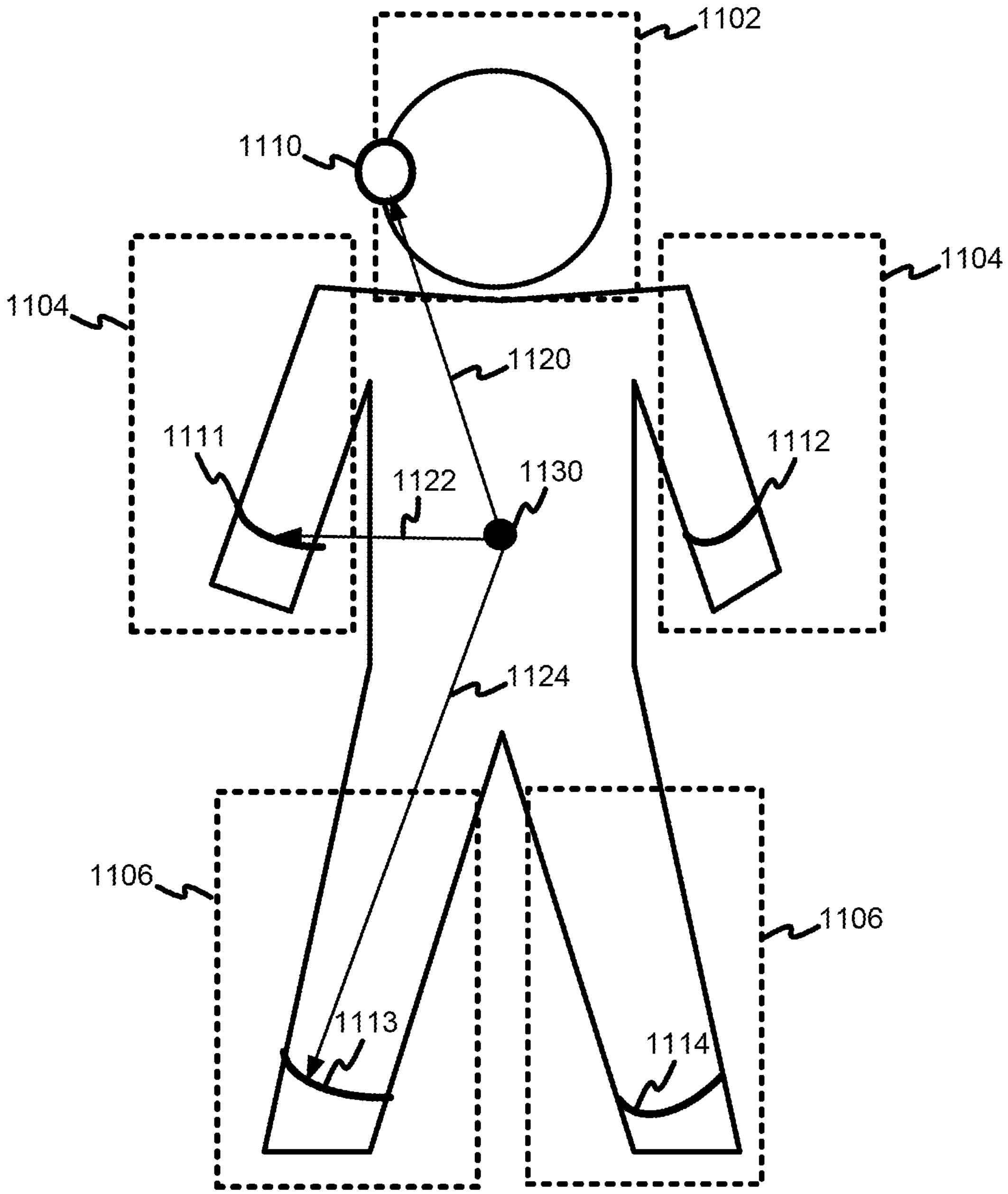

1102
1110
1104
1104
1120
1111
1122
1130
1112
1124
1106
1106
1113
1114

FIG. 11

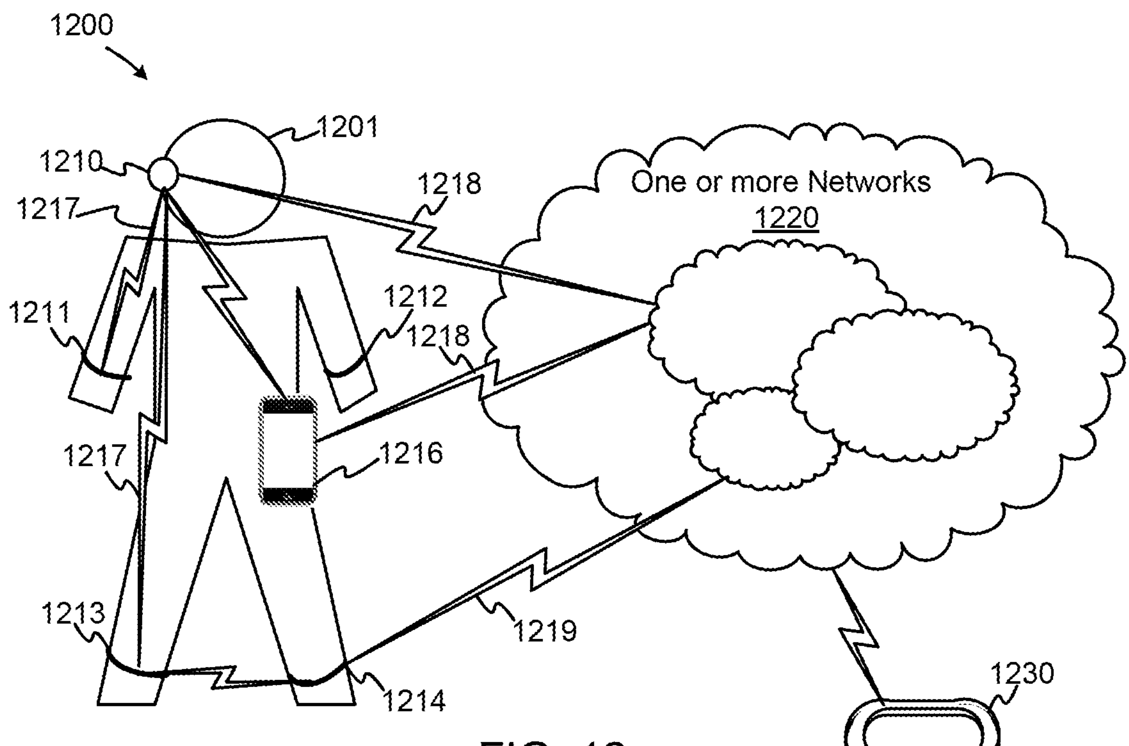

1200
1201
1210
1217
1218
One or more Networks
1220
1211
1212
1218
1217
1216
1213
1219
1214
1230

FIG. 12

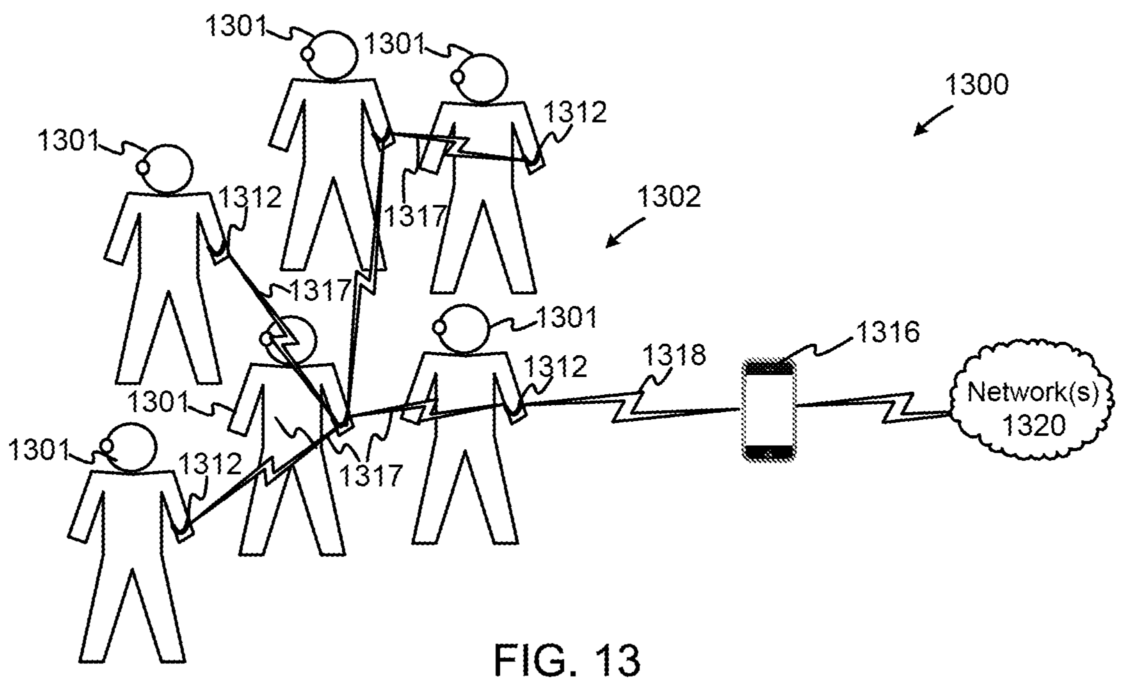

1301
1301
1300
1312
1301
1312
1317
1302
1317
1301
1312
1318
1316
Network(s)
1320
1301
1301
1312
1317

FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/038410

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61B 5/00 (2012.01)
USPC - 600/301
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - A61B 5/00, 5/02, 5/08, 10/00, 19/00; A61J 7/00; G05B 19/00; G06F 1/00, 15/00, 15/16, 17/00, 19/00; G06K 17/00 (2012.01)
USPC - 63/1.11; 128/903, 920, 921; 206/39.6; 221/2, 9; 235/375, 380, 487; 340/3.1, 500, 539.12, 573.1, 573.4; 368/10, 278; 600/301

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,819,860 A (HARGROVE et al) 11 April 1989 (11.04.1989) entire document	1, 4-5, 8-12
Y		2, 3, 6-7, 13-23
Y	US 7,733,224 B2 (TRAN) 08 June 2010 (08.06.2010) entire document	2-3, 6
Y	US 7,196,972 B2 (PITOCCO et al) 27 March 2007 (27.03.2007) entire document	7
Y	US 2009/0163774 A1 (THATHA et al) 25 June 2009 (25.06.2009) entire document	13-22
Y	US 2010/0315225 A1 (TEAGUE) 16 December 2010 (16.12.2010) entire document	16-18, 23

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 August 2012	07 SEP 2012

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

专利名称(译)	具有数据功能的频段，用于医疗诊断，监测和治疗		
公开(公告)号	EP2717758A1	公开(公告)日	2014-04-16
申请号	EP2012797428	申请日	2012-05-17
[标]申请(专利权)人(译)	艾利佛公司 RAHMAN HOSAIN SADEQUR DRYSDALE李泽楷 LUNA MICHAEL EDWARD SMITH FULLAM SCOTT 博加德TRAVIS AUSTIN 罗宾逊JEREMIAH 绝对最大 DONALDSON ALAN THOMAS		
申请(专利权)人(译)	Alifak 拉赫曼HOSAIN SADEQUR DRYSDALE，李泽楷 LUNA，MICHAEL EDWARD SMITH FULLAM，SCOTT 博加德，TRAVIS AUSTIN 罗宾逊，JEREMIAH 乱说，MAX DONALDSON，ALAN THOMAS		
当前申请(专利权)人(译)	Alifak 拉赫曼HOSAIN SADEQUR DRYSDALE，李泽楷 LUNA，MICHAEL EDWARD SMITH FULLAM，SCOTT 博加德，TRAVIS AUSTIN 罗宾逊，JEREMIAH 乱说，MAX DONALDSON，ALAN THOMAS		
[标]发明人	RAHMAN HOSAIN SADEQUR DRYSDALE RICHARD LEE LUNA MICHAEL EDWARD SMITH FULLAM SCOTT BOGARD TRAVIS AUSTIN ROBISON JEREMIAH UTTER MAX EVERETT II DONALDSON THOMAS ALAN		
发明人	RAHMAN, HOSAIN SADEQUR DRYSDALE, RICHARD LEE LUNA, MICHAEL EDWARD SMITH FULLAM, SCOTT BOGARD, TRAVIS AUSTIN ROBISON, JEREMIAH UTTER, MAX, EVERETT, II DONALDSON, THOMAS ALAN		
IPC分类号	A61B5/00 A61B5/01 G06F1/16 G06F1/32		

CPC分类号	G06F1/163 A61B5/01 A61B5/6802 A61B5/681 A61B5/6831 A61B2560/0209 G06F1/3206 G06F1/324 Y02D10/126
代理机构(译)	JOHNSON，RICHARD ALAN
优先权	61/495997 2011-06-11 US 61/495996 2011-06-11 US 13/158372 2011-06-10 US 13/158416 2011-06-11 US 61/495995 2011-06-11 US 61/495994 2011-06-11 US 13/180000 2011-07-11 US
其他公开文献	EP2717758A4
外部链接	Espacenet

摘要(译)

描述了用于医疗诊断，监测和治疗的具有数据能力的带，包括被配置为收集与诊断，监测或治疗医学病症相关联的数据的一个或多个传感器，被配置为使用由以下方式收集的数据来确定医疗状况的应用。传感器，配置成存储数据和应用程序的存储器，以及配置成提供与监测和治疗医疗状况有关的通知阵列的通知设施。通知可以是警报，可以被设计为促进运动，或者可以与药物方案相关联。