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(54) SMART WEARABLE DEVICES AND METHODS FOR ACQUISITION OF SENSORIAL INFORMATION FROM WEARABLE DEVICES TO ACTIVATE FUNCTIONS IN OTHER DEVICES

(71) Applicants: **SONY CORPORATION**, Tokyo (JP); **SONY CORPORATION OF AMERICA**, New York, NY (US)

(72) Inventors: **Nobuo Tanaka**, Glen Rock, NJ (US); **Vladimir Elgort**, Staten Island, NY (US); **Jacelyn Danielson**, San Mateo, CA (US); **Anton Kalachev**, Burlingame, CA (US); **John Wong**, Morristown, NJ (US); **Behram DaCosta**, San Jose, CA (US); **Udupi Ramanath Bhat**, Mountain View, CA (US); **Ludovic Copere**, San Jose, CA (US); **Masaki Kataoka**, Port Washington, NY (US)

(73) Assignees: **SONY CORPORATION**, Tokyo (JP); **SONY CORPORATION OF AMERICA**, New York, NY (US)

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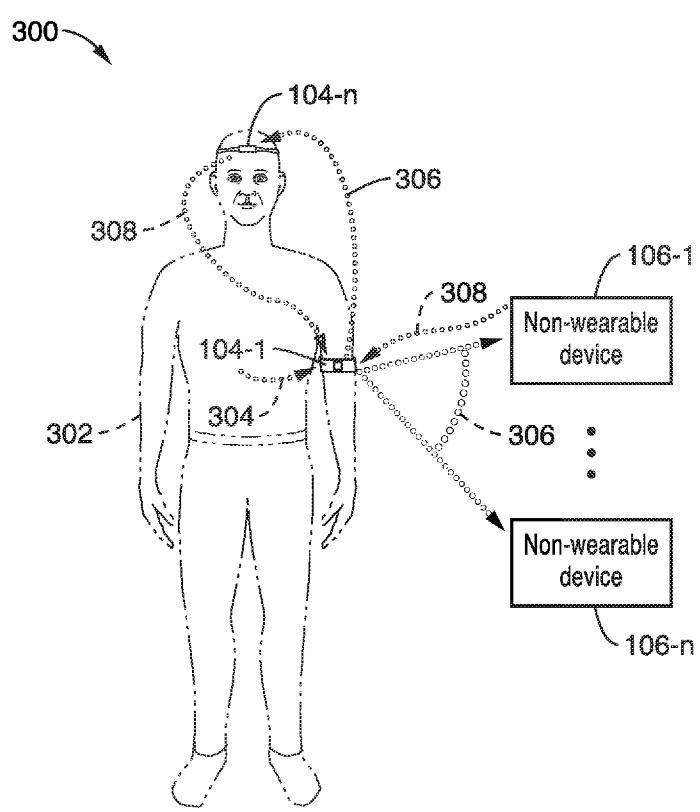
(52) **U.S. Cl.**
CPC ***G06F 3/011*** (2013.01); ***G06F 1/163*** (2013.01); ***H04L 63/0861*** (2013.01); *G06F 1/1698* (2013.01); *G08B 7/00* (2013.01)

(57) **ABSTRACT**

Smart wearable devices and methods for acquiring sensor data about a user to determine the physical and mental status of the user and automatically activate or deactivate other devices when authenticated by biometric security access specific to the wearer are presented. Specifically, the smart wearable device can automatically acquire a user's biological input, such as heart rate, breathing, body temperature, etc. and based on the input, automatically activate or deactivate a function in another device by sending a triggering signal to the other device.



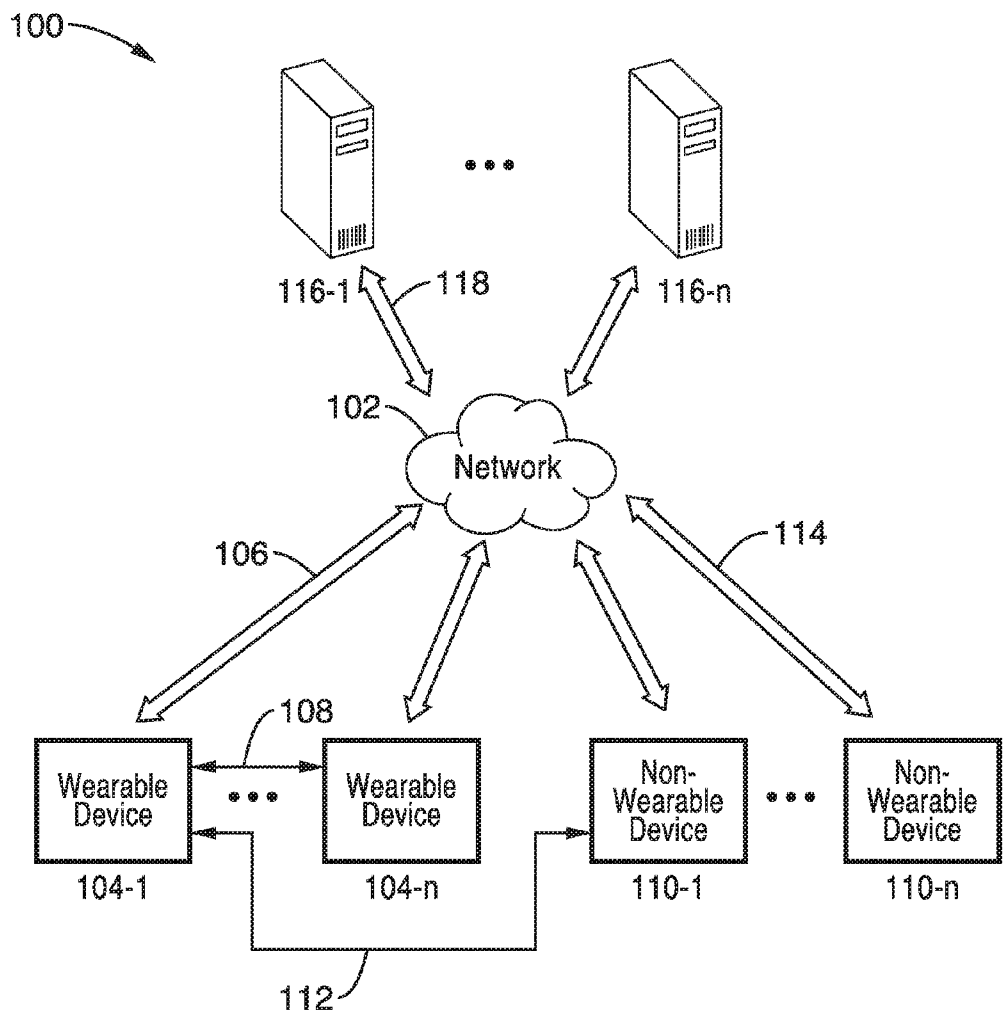

100
116-1
118
116-n
102
Network
106
114
108
Wearable Device
Wearable Device
Non-Wearable Device
Non-Wearable Device
104-1
104-n
110-1
110-n
112

FIG. 1

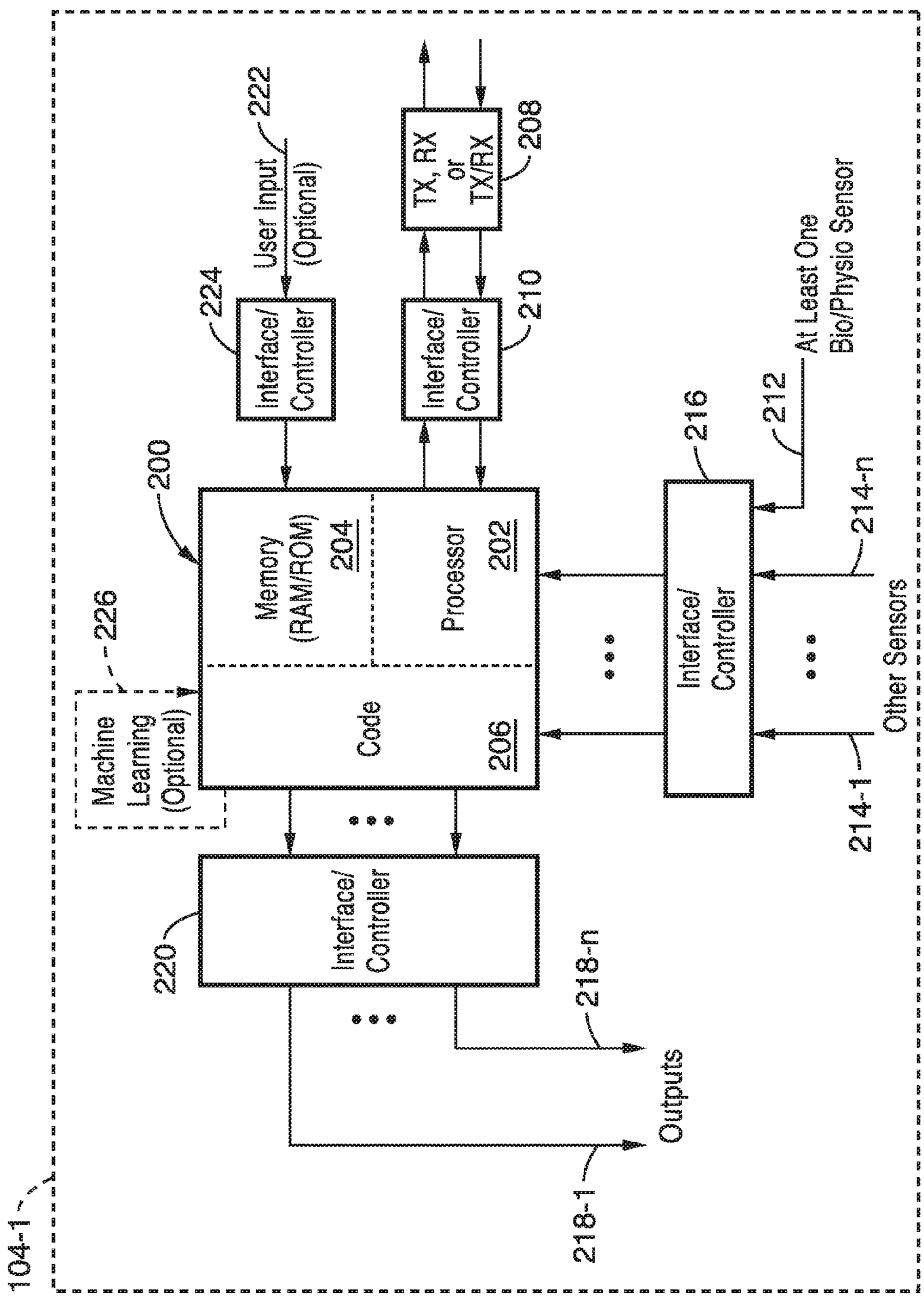

104-1
200
Memory (RAM/ROM) 204
Processor 202
Code 206
Machine Learning (Optional)
226
Interface/ Controller
224
User Input (Optional)
222
Interface/ Controller
210
TX, RX or TX/RX
208
Interface/ Controller
216
212
At Least One Bio/Physio Sensor
214-n
214-1
Other Sensors
Interface/ Controller
220
218-n
218-1
Outputs

FIG. 2

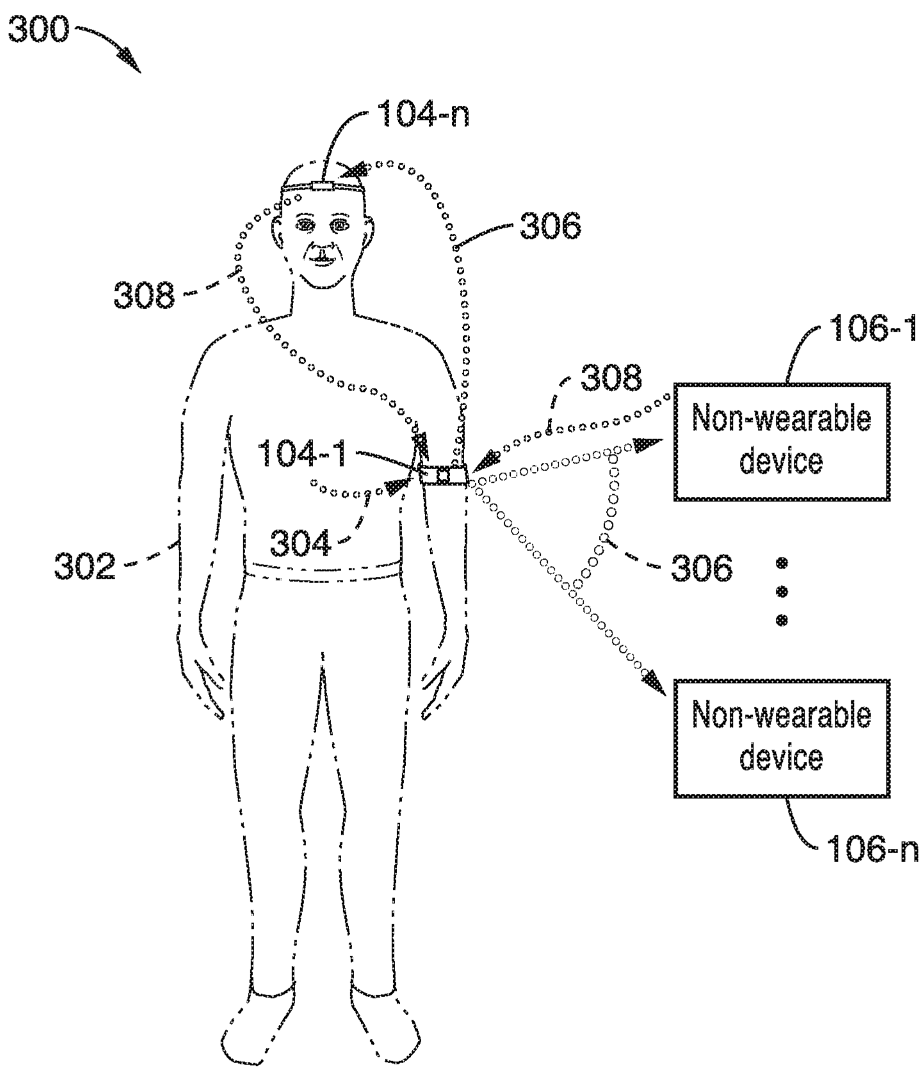

300
104-n
306
308
106-1
308
Non-wearable device
104-1
304
302
306
Non-wearable device
106-n

FIG. 3

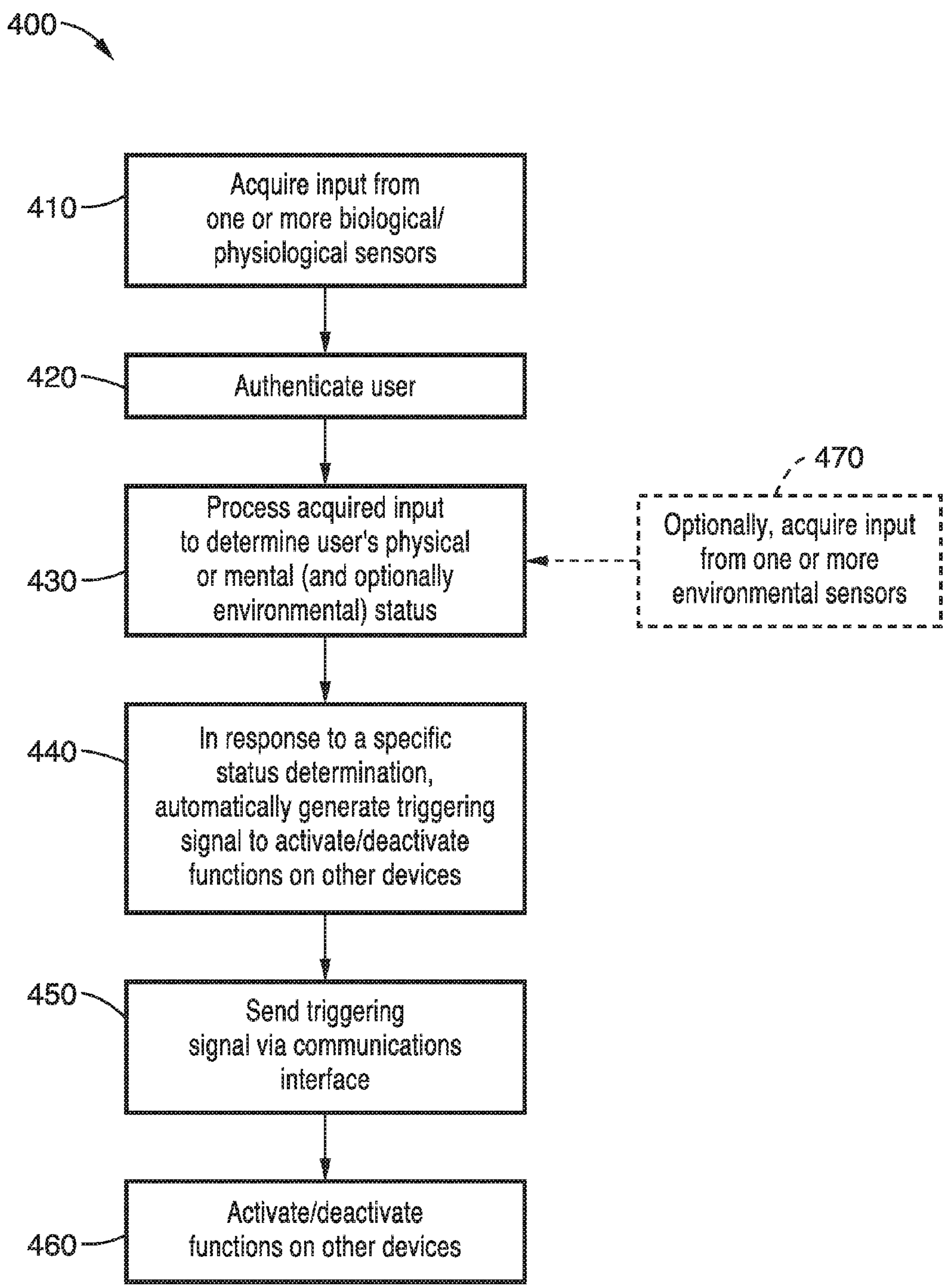

400
410
Acquire input from one or more biological/ physiological sensors
420
Authenticate user
430
Process acquired input to determine user's physical or mental (and optionally environmental) status
470
Optionally, acquire input from one or more environmental sensors
440
In response to a specific status determination, automatically generate triggering signal to activate/deactivate functions on other devices
450
Send triggering signal via communications interface
460
Activate/deactivate functions on other devices

FIG. 4

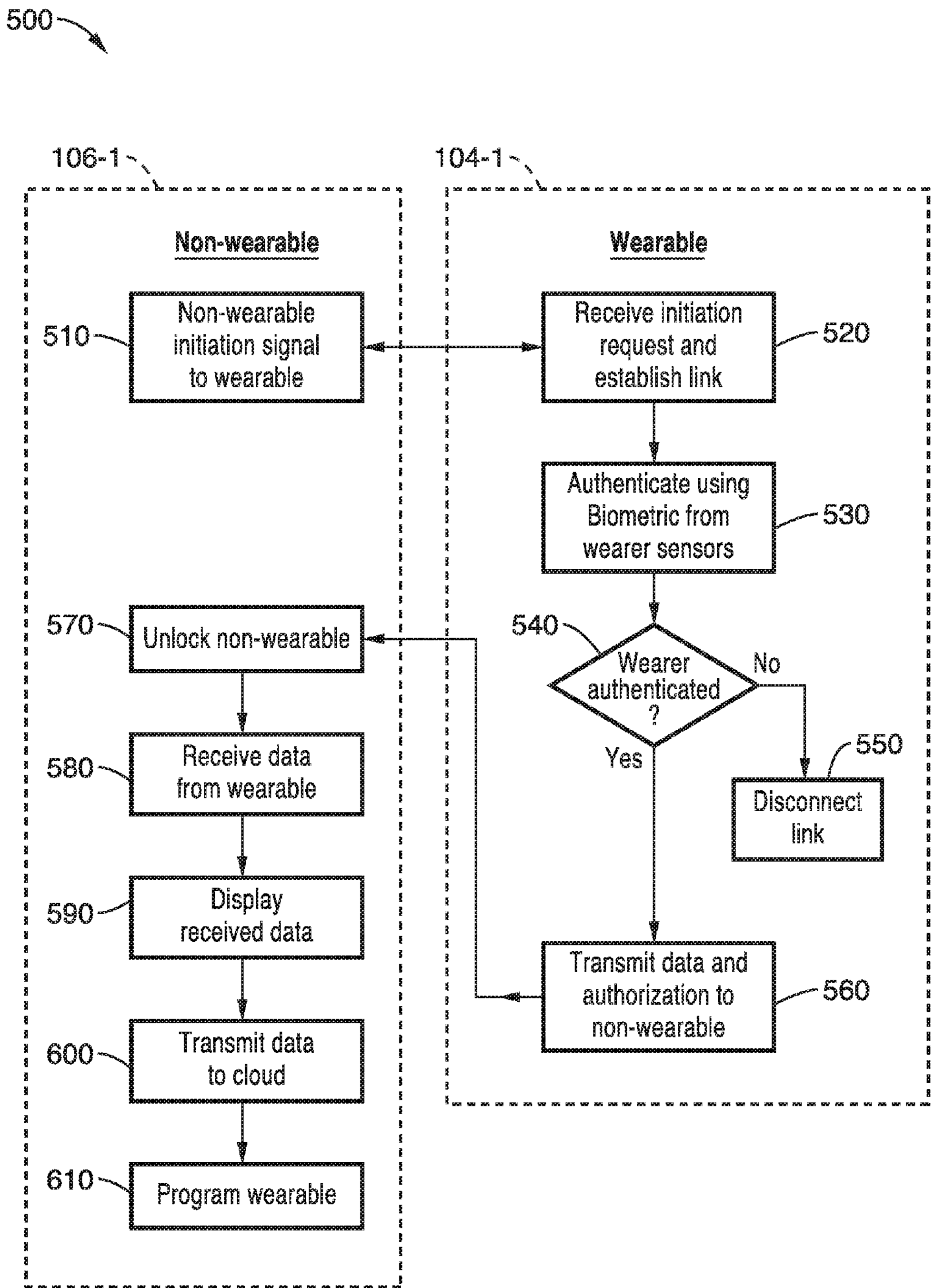

500
106-1
104-1
Non-wearable
Wearable
510
Non-wearable initiation signal to wearable
Receive initiation request and establish link
520
Authenticate using Biometric from wearer sensors
530
570
Unlock non-wearable
540
Wearer authenticated ?
No
550
Yes
Disconnect link
580
Receive data from wearable
590
Display received data
Transmit data and authorization to non-wearable
560
600
Transmit data to cloud
610
Program wearable

FIG. 5

SMART WEARABLE DEVICES AND METHODS FOR ACQUISITION OF SENSORIAL INFORMATION FROM WEARABLE DEVICES TO ACTIVATE FUNCTIONS IN OTHER DEVICES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a 35 U.S.C. §111(a) continuation of PCT international application number PCT/US2015/016713 filed on Feb. 19, 2015, incorporated herein by reference in its entirety, which claims priority to, and the benefit of, U.S. provisional patent application Ser. No. 61/943,837 filed on Feb. 24, 2014, incorporated herein by reference in its entirety. Priority is claimed to each of the foregoing applications.

[0002] The above-referenced PCT international application was published as PCT International Publication No. WO 2015/127142 A1 on Aug. 27, 2015, which publication is incorporated herein by reference in its entirety.

INCORPORATION-BY-REFERENCE OF COMPUTER PROGRAM APPENDIX

[0003] Not Applicable

NOTICE OF MATERIAL SUBJECT TO COPYRIGHT PROTECTION

BACKGROUND

[0005] 1. Field of the Technology

[0006] This technology pertains generally to smart wearable devices and sensor networks and more particularly to a system of non-wearable and wearable sensor and processing devices that are capable of acquiring sensorial information and activating functions in other devices where the function activation and access to wearable sensor data and to programming are authenticated by a biometric feature of an authorized wearer.

[0007] 2. Discussion

[0008] The availability of reasonably priced wearable devices means that most wearers will not be limited to the use of only a single device at a given time and many users will be able to wear a number of wearable devices at the same time. Some devices can connect to the Internet or other wireless communications network to transmit and receive data to and from a remote location. Other devices can interconnect with non-wearable devices such as a smart phone or to other wearable devices.

[0009] However, the transmission of sensitive medical sensor data over wireless communication systems creates privacy and security concerns. Security is an important part of privacy. Therefore, a non-wearable device such as mobile phone may use a pin code or pattern, etc. in order to protect the device from being accessed by unauthorized people. At the same time, it is also important for the users of a wearable device to be able to quickly access the relevant information from the non-wearable device without too much difficulty.

[0010] Currently, there is no suitable system that allows a user to activate a specific function on a smart device without the user manually instructing the smart device directly. For example, the user of a smart wearable device may have a particular physical or mental health condition that makes it difficult or impossible to manually operate other desired or necessary devices. There is a need for a smart wearable device that is able to monitor the physical and mental status of a user and, where appropriate, automatically activate or deactivate a specific function on other relevant devices.

[0011] Accordingly, there is a need for smart wearable devices that can automatically sense when a device, such as a non-wearable or media rendering device, is in communication range and automatically verify that a particular device has authorization or access rights to associate with the device. There is also a need for wearable devices and systems that are secure and private that ensure that the availability of sensor data from wearable and associated wearable and non-wearable devices is under the control of an authorized wearer.

BRIEF SUMMARY

[0012] A secure network of wearable and non-wearable devices and status monitoring methods is provided that authenticates the identity of the user of the smart wearable device using biometrics, such as a user's heart rate signature.

[0013] Access authorization between devices may also require authentication of the user. For example, activation or deactivation of other devices may occur only if the user of the wearable device is authenticated using some biometric signature of the user from a wearable device. Sensitive sensor data would not be transferred to another device without the proper biometric authentication. Authentication does not require any affirmative action on the part of the user such as entering a password.

[0014] In one embodiment, a smart wearable device is provided that includes at least one biological or physiological sensor for acquiring biological input about the user. This input may be acquired through automatically sensing and collecting biological information about the user and may be supplemented with user input or input from other health care providers.

[0015] Sensors placed on or around an individual can acquire biological or physical data in real time. Both non-invasive and invasive sensors, alone or collectively, can produce data that can be processed to determine the physical or mental status of the user at an instant or to identify trends over time. Multiple sensors with the capability of collecting biological or physical data (heart rate, blood oxygen and sugar levels, body temperature and etc.) of a user can be applied with the use of wearable devices.

[0016] Other associated sensors can collect data on the environment including location, altitude, air pollution, pollen count, distance traveled, and external temperature etc. that can be considered within the context of the sensor data obtained from a particular user of sensors of a wearable device. Information regarding the location and environmental context of the wearer of wearable sensor devices can be relevant to the function of the sensors of each device and the interpretation of the data that is produced by the device sensors. The collection and processing of sensor data from multiple sensors of a wearer can also be accomplished with wired or wireless transmissions.

[0017] In one embodiment, the smart wearable device may be programmed to determine the physical and mental status of the user. When a given status is determined from the sensor data, the smart wearable device may automatically generate a triggering signal that can be sent to other devices. The triggering signal may then activate a desired functionality in the other devices.

[0018] The device or devices that receive the triggering signal from the smart wearable device may be another smart wearable device, a mobile device, such as a smart phone, a tablet, a lap top computer or desk top computer. Optionally, the device that receives the triggering signal from the smart wearable device can send a return signal to the smart wearable device acknowledging that the initial signal was received and the desired function has been activated or deactivated.

[0019] In another embodiment, a computer implemented method for enabling a smart wearable device to automatically generate a triggering signal to active a certain functionality of another device (wearable or non-wearable) includes using the smart wearable device's biological sensors to collect biological data about the user and then processing this data to determine the physical or mental status of the user. A triggering signal may be generated in response to the physical or mental status determination and the triggering signal may be sent to another device in order to activate a desired function on the other device.

[0020] In yet another embodiment, a system is described for automatically activating devices by a smart wearable device to collect physical and mental input about a user, sending a triggering signal that triggers another device to activate a desired function in response to analyzed sensor data.

[0021] Another embodiment of the wearable sensor includes environmental sensors that may act in conjunction with the biological sensors to initiate functions in other devices. Also, user input may also be used to cause the smart wearable device to generate the triggering signal.

[0022] A biometric characteristic of the wearer of the wearable device is used as a security element to authenticate the identity of the wearer and to unlock communications without the manual entry of an authentication code or other conventional security entry. For example, in one embodiment, a biometric sensor that has been placed in a wearable device, such as heart ID from Bionym or other sensor provider, can be used to secure the identification of wearer.

[0023] Without the right heart ID, for example, the data from the wearable device cannot be accessed or transferred. The wearable device will be given the access right to unlock the non-wearable device after these two devices have been paired through Bluetooth or other communications system.

[0024] In another embodiment, a method is provided for a user of a wearable device to obtain quick access to the relevant information based on a notification event from a non-wearable device to the wearable. Using the authentications of the wearable device to unlock the non-wearable device and the non-wearable device can automatically receive raw sensor data or processed sensor data as well as contextual information, including timing and proximity.

[0025] When the non-wearable device receives an incoming event, a notification can be sent to the wearable device through the Bluetooth or other device communications system. The notification could be a haptic feedback in form of vibrations or heating or cooling elements. The optional notification could also be in the form of a light signal or an audible noise created by the wearable device to alert the wearer of the event.

[0026] In another embodiment, when the wearer of the wearable device picks up a non-wearable device, the proximity of the non-wearable device to the wearable device will inform the non-wearable that the wearable is in close range and to initiate a request for communication. The non-wearable device can then let the wearable device unlock the lock of the non-wearable device and receive sensor data from the wearable device. In addition, based on the timing of the notification event that has been sent from the non-wearable device to the wearable device, the sensor information can then be displayed on the non-wearable device to the wearer. The connected non-wearable device can also record, process or transmit the sensor data from the wearable device in this illustration. The authenticated non-wearable device can also program the wearable device in another embodiment.

[0027] Further aspects of the technology will be brought out in the following portions of the specification, wherein the detailed description is for the purpose of fully disclosing preferred embodiments of the technology without placing limitations thereon.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0028] The technology described herein will be more fully understood by reference to the following drawings which are for illustrative purposes only:

[0029] FIG. **1** is a schematic diagram of an embodiment of a smart wearable network described herein.

[0030] FIG. **2** is a functional block diagram of an embodiment of a smart wearable device described herein.

[0031] FIG. **3** is a schematic diagram of an embodiment of a smart wearable device and system that can acquire sensor input and in response send a triggering signal to activate or deactivate other devices.

[0032] FIG. **4** is a flow diagram of a method for acquiring sensorial data on a smart wearable device, and in response, activating functions on other devices.

[0033] FIG. **5** is a schematic flow diagram processing flow and the data used for one embodiment of an authentication method of the present disclosure.

DETAILED DESCRIPTION

[0034] The present disclosure generally pertains to wearable devices that are capable of, for example, performing an action based on one or more biological or physiological characteristics of the user wearing the device. Using one or more sensors, a processor, and code executable on the processor, a wearable device can be configured to sense and process characteristics that include, but are not limited to, a wearer's physical characteristics such as gender, weight, height, body temperature, skin temperature, heart rate, respiration, blood sugar level, blood glucose level, stress/fatigue, galvanic skin response, ingestion (protein), digestion rate, metabolic rate, blood chemistry, sweat, core and skin temperature, vital signs, eye dryness, tooth decay, gum disease, energy storage, calorie burn rate, mental alertness, cardiac rhythm, sleep patterns, caffeine content, vitamin content, hydration, blood oxygen saturation, blood coritsol level, blood pressure, cholesterol, lactic acid level, body fat, protein level, hormone level, muscle mass, pH, etc. Such conditions may also include, but are not limited to, position (e.g., prone, upright), movement, or physical state (e.g., sleeping, exercising), etc.

[0035] A wearable device may include one or more output devices that include, but are not limited to, haptic output devices (e.g., offset motors, electroactive polymers, capacitive voltage generators, Peltier temperature elements, contracting materials, Braille coding actuators), telemetry devices, visual devices, audible devices, and other output devices.

[0036] A wearable device may include an artificial intelligence so that the device can learn and adapt to an individual wearer. The device may be configured to accurately discriminate between erroneous (accidental, unintended, etc.) and valid sensory inputs, thereby developing accurate conclusions about a wearer's physical state or characteristics (e.g., the device does not interpret a wearer rolling over in their sleep as the wearer exercising). The device may also include one or more cameras or other visual sensors for facial, user, or other image recognition. A wearable device may also be configured to transmit information to and/or retrieve information from a wearer's digital health history.

[0037] A wearable device may be configured to output information to a user, to another wearable device, to a non-wearable device, or to a network according to the particular features and function of the device.

[0038] A. Generalized System Implementation.

[0039] FIG. **1** illustrates a generalized networked infrastructure (e.g., system) **100** that includes a network **102**. The network could, for example, be a local area network or a wide area network such as the Internet. One or more smart wearable devices **104-1** through **104-*n*** according to embodiments of the technology described herein may be enabled to communicate with the network **102** through a wired or wireless connection **106**. Further, one or more of the smart wearable devices may be enabled to communicate with another smart wearable device through the network **102** or by means of a direct wired or wireless connection **108**.

[0040] One or more of the smart wearable devices **104-1** through **104-*n*** also may be enabled to communicate with one or more non-wearable devices **110-1** through **110-*n***. The non-wearable devices, which are beyond the scope of this disclosure, may be any conventional "smart" device with a processor, associated operating system, and communications interface. Examples of non-wearable devices include conventional Smartphones, tablet computers, laptop computers, desktop computers, and set top boxes. Any of the non-wearable devices may be of a type enabled to communicate with an external device through a wired or wireless connection. In that case, one or more of the smart wearable devices may be enabled to communicate with one or more of the non-wearable devices by means of a direct wired or wireless connection **112**. Further, one or more of the non-wearable devices may be of a type enabled to communicate with the network **102** through a standard wired or wireless connection **114**. In that case, one or more of the smart wearable devices may be enabled to communicate with one or more of the non-wearable devices through the network **102**.

[0041] One or more servers **116-1** through **116-*n*** may be provided in a client-server configuration and connected to the network by means of a wired or wireless connection **118**. The servers may include standalone servers, cluster servers, networked servers, or servers connected in an array to function like a large computer. In that case, one or more of the smart wearable devices may be enabled to communicate with one or more of the servers.

[0042] FIG. **2** illustrates a generalized embodiment of a smart wearable device according to the technology described herein. It will be appreciated that the embodiment shown may be modified or customized to enable performing the functions described herein. In the exemplary embodiment shown, the smart wearable device includes an "engine" **200** having a processor **202**, memory **204**, and application software code **206**. The processor **202** can be any suitable conventional processor. The memory **204** may include any suitable conventional RAM type memory and/or ROM type memory with associated storage space for storing the application programming code **206**.

[0043] A conventional wired or wireless communications module **208** (e.g., transmitter or receiver or transceiver) may be included as needed for performing one or more of the functions of the smart wearable device described herein. Examples of wireless communication capabilities that can be provided include, but are not limited to, Bluetooth, Wi-Fi, infrared, cellular, and near field communication. One or more conventional interfaces or controllers **210** may also be provided if needed. Examples of interfaces or controllers include, but are not limited to, analog to digital converters, digital to analog converters, buffers, etc.

[0044] The device may include at least one input **212** for a biological or physiological sensor for providing input to the device to perform one or more of the functions described herein. Sensor inputs **214-1** through **214-*n*** for optional sensors may be included as well. These optional input sensors may include, but are not limited to, accelerometers, temperature sensors, altitude sensors, motion sensors, position sensors, and other sensors to perform the function(s) described herein. One or more conventional interfaces or controllers **216** may be provided if needed for the sensors. Examples of interfaces or controllers include, but are not limited to, analog to digital converters, digital to analog converters, buffers, etc.

[0045] Additionally, the device may include one or more outputs **218-1** through **218-*n*** to drive one or more output devices (and include those output devices). These output devices may include, but are not limited to, haptic output devices, telemetry devices, visual devices, audible devices, and other output devices to perform the functions described herein. One or more conventional interfaces or controllers **220** may be provided if needed for the output devices. Examples of interfaces or controllers include, but are not limited to, analog to digital converters, digital to analog converters, buffers, etc.

[0046] A user input **222** may be provided according to the functions described herein. The user input may, for example, initiate one or more functions, terminate one or more functions, or intervene in a running process. The user input can be any conventional input device, including but not limited to, manual switches, touch sensors, magnetic sensors, proximity sensors, etc. One or more conventional interfaces or controllers **224** may be provided if needed for the output devices. Examples of interfaces or controllers include, but are not limited to, analog to digital converters, digital to analog converters, buffers, etc.

[0047] Depending on the function(s) described herein, the engine **200** may also include a feedback loop **226** for machine learning or other adaptive functions. The feedback loop may also provide for device calibration.

[0048] It will be appreciated that a smart wearable device as described herein would necessarily include a housing or carrier for the above-described components. It will further be appreciated that, as used herein, the term "smart wearable device" means a device that would be worn or otherwise associated with the body of a user and be "connected" to the user by means of at least one sensor for sensing one or more biological or physiological conditions of the user.

[0049] The particular form of the housing or carrier (i.e., wearable platform) can vary according to choice and suitability for performing the functions described herein. Examples of wearable platforms include, but are not limited to, hand worn devices, finger worn devices, wrist worn devices, head worn devices, arm worn devices, leg worn devices, ankle worn devices, foot worn devices, toe worn devices, watches, eyeglasses, rings, bracelets, necklaces, articles of jewelry, articles of clothing, shoes, hats, contact lenses, gloves, etc.

[0050] It will further be appreciated that the input sensors and output devices may be integrated into the wearable platform, or may be external to the wearable platform, as is desired and/or suitable for the function(s) of the smart wearable device.

[0051] B. Smart Wearable Devices and Methods for the Acquisition of Sensorial Information to Automatically Activate Functions on Other Devices.

[0052] Referring now to FIG. **3**, a schematic diagram **300** is shown representing an embodiment of a smart wearable device **104-1** and system that allows a user **302** to automatically activate other devices, given a determined physical, mental, environmental, etc. status from acquired sensor data. For security, the wearable device **104-1** may activate another device or transfer data only if the user of the wearable is authenticated using some biometric signature of the user.

[0053] In this illustration, a user **302** is shown wearing a smart wearable device **104-1** on their arm. As shown in FIG. **2**, this smart wearable device includes at least one biological (i.e. physiological) sensor **212** which can acquire biological input **304** about the user. Examples of biological input that may be acquired by a biological sensor **212** include, but are not limited to, blood sugar, stress, fatigue, anxiety, alertness, heart rate, galvanic skin response, weight, nutrition, digestion rate, metabolic rate, body temperature, skin temperature, respiration, allergies, sleep patterns, hydration, drug levels, sweat production and blood analysis. The input that is acquired by the one or more biological and other sensors may be supplemented by manually entering input into the smart wearable device **104-1** by the user or the user's caretaker or healthcare professional.

[0054] After input **304** is acquired by the smart wearable device **104-1**, the physical or mental and environmental, etc. status of user **302** may be determined. In response to a specific status determination, a triggering signal **306** can be automatically generated that can activate or deactivate functions on other devices, including another smart wearable device **104-*n*** or non-wearable devices **106-1**, **106-*n*** such as a mobile device, a tablet, a lap top computer or a desk top computer or other non-wearable device. The non-wearable devices **106-1**, **106-*n*** may be remotely located and may receive a triggering signal from the wearable smart device **104-1** through a communication network such as the network **102** shown in FIG. **1**. Examples of other smart wearable devices **104-*n*** may include a glasses type device with camera functionality which may receive a triggering signal from the smart wearable device **104-1** instructing the device to activate camera functionality to capture images or video.

[0055] In one embodiment, the smart wearable device **104-1** may be equipped and programmed to receive an acknowledgement signal **308** from the other devices **104-*n***, **106-1**, **106-*n*** that have received a triggering signal **306**, acknowledging that the triggering signal **306** was indeed received.

[0056] FIG. **4** is a block diagram **400** illustrating an exemplary computer implemented method for activating or deactivating a function on a device in response to input received by a smart wearable device. The smart wearable device may acquire input from one or more biological or physiological sensors at block **410**. The biological sensors preferably include a sensor that will provide a biometric signature specific to the user.

[0057] At block **420** of FIG. **4**, the user is authenticated by biometric authentication. One preferred method of biometric authentication is shown in FIG. **5**. Access to the data of the wearable sensor, for example, is restricted unless the user is properly authenticated at block **420**. User authentication is a prerequisite to the activation of another device.

[0058] Optionally, input from additional sensors, such as environmental sensors, may also be acquired at block **470**. The smart wearable device **104-1** may then process the acquired input to determine the status of a user's physical or mental state at block **430**.

[0059] In response to a specific status determination, the smart wearable device may then generate a triggering signal designed to activate or deactivate functions on other associated devices at block **440**. The smart wearable device may then send the triggering signal **450** via a communications interface to another device. The sent triggering signal may then activate or deactivate relevant functions on other devices **460** which may be other smart wearable devices or non-wearable devices as described above.

[0060] Turning now to FIG. **5**, one embodiment **500** of high-level programming for biometric authentication and data transfer between a wearable device and a non-wearable device is shown schematically. In the illustration shown in FIG. **5**, a specific biometric and sensor type are selected and the sensor is incorporated in the wearable device **104-1**. At least one non-wearable device **106** is also configured to communicate with the wearable device that has been personalized to be worn by a particular user.

[0061] When transfer and evaluation of sensor information from the wearable device is desired, for example, the non-wearable device initiates a signal to the wearable device at block **510** to establish a communications link with the wearable device.

[0062] The signal is received by the wearable device at block **520** and a preliminary communications link is established between the wearable and non-wearable devices. The wearable device then checks the identity and authorization of the non-wearable device as being authorized to communicate with the wearable device. The user of the wearable device is authenticated by the wearable by obtaining a biometric from the sensors of the wearable device at block **530**. The acquired biometric from the sensor is compared with a pre-defined standard biometric identifier or set of identifiers at block **540**.

[0063] If the user is not authenticated at decision block **540**, because the biometric identifiers do not match, the communications link between the wearable device and the non-wearable device or devices is disconnected at block **550**. If the user is authenticated at decision block **540**, the data and authorization to view new or existing sensor data obtained for the wearer on the wearable device is transmitted to the non-wearable device at block **560**, for example.

[0064] In one embodiment, the initiation request at block **520**, the authentication process at block **530**, the link disconnect at block **550** and the authorization transmission at block **560** can each be accompanied by a specific haptic, audible or other notification to the wearer of the wearable device. Vibrations, buzzes, chirps or lights can alert the wearer corresponding specific events.

[0065] The non-wearable device receives the authentication signal that was sent from the wearable at block **560** and unlocks the non-wearable device at block **570**. The unlocked non-wearable device can then receive raw data, processed data or other communications or instructions from the wearable device at block **580**.

[0066] The received data can also be processed and displayed on the non-wearable device at block **590**. Reports, graphs, tables or other compiled data can also be displayed to observe trends or variances at block **590** as well.

[0067] The raw or processed sensor data and other information obtained from the wearable device can be transferred from the non-wearable device to remote locations or to the cloud for storage or review at block **600**. For example, processed medical sensor data can be transmitted directly or through the cloud and made part of medical records of the authenticated wearer at a remote location.

[0068] In another embodiment, the authenticated connection between the wearable device and the non-wearable device can be used for programming the wearable device at block **610**. The non-wearable device can be used as an interface to introduce new code **206** or to turn wearable sensors on or off or to calibrate the sensors of the wearable device. This process is user specific and changes to the programming of the wearer device can only take place when a specific user is identified and avoids the situation where sensor changes are made or private data is transferred to an unauthorized user of either the wearable or non-wearable devices.

[0069] It can be seen that the system for secure quick access to raw or processed sensor data can be adapted to many different circumstances. For example, in one setting the smart wearable device can be attached to the user's body when the device is in use and the smart wearable device continuously monitors the bio-physiological condition of the wearer and may continuously acquire sensorial information. As a result, the smart wearable device may detect the presence of adverse health conditions or may also detect predetermined health conditions such as heart rate, high stress level, phase of sleep, level of appetite, etc. The smart wearable device may then react automatically to the detection of the health condition by sending a notification to contact a physician or take a certain medication.

[0070] In another implementation, the user of the smart wearable device can specifically configure the device to automatically send a triggering signal to activate or deactivate desired functions on other devices, in response to detection of a predetermined health condition. As an illustrative example, a user of the smart wearable device may also be wearing a pair of glasses that include a camera function. If the user should have an allergic reaction without realizing what has caused it, the smart wearable device, which could be monitoring his or her bio-physiological condition, could detect the allergic reaction, could automatically send a triggering signal to the camera on the glasses to activate the camera on the glasses to start recording the current environment of the user. This recording could then be used by a healthcare provider to determine what may have caused the user's allergic reaction.

[0071] Another example implementation includes a smart wearable device that can detect a high stress level for a particular user. In response to the specific determined stress level status, the smart wearable device may generate and send a triggering signal to an audio device, activating the device to play a particular piece of music or the smart wearable device may signal the lights to dim or the smart wearable device may set a notification to schedule a massage, etc. Alternatively, in response to such a status determination, the smart wearable device may disable certain predetermined notifications, such as those occurring on a user's smart phone.

[0072] Similarly, the stress level of a police officer can be continuously or regularly sensed by a wearable device. If the stress level exceeds a threshold level (e.g., during traffic stop, confronting a potential suspect) the dashboard camera of the police cruiser is turned on automatically. A camera on the uniform of the police officer can also be turned on automatically any time the stress level exceeds a threshold when something out of the ordinary is happening to the officer. In addition, other external devices or systems can also be activated in the alternative or in addition to the cameras. For example, an alert can be sent to the dispatch center (or officer's command center, etc) to notify other patrol cars in the vicinity to provide back up or to be on the alert for potential developments where the officer is in need of assistance.

[0073] In another implementation, elderly or physically challenged individuals can be monitored by the use of wearable devices. For example, the user could be living alone or in an area where there is no human supervision. If user stress is sensed and the stress level exceeds a threshold, then the call center is alerted to send help or to intervene (call user to check in) or some other action. Similarly, if accelerometer sensor input can sense that the user is lying down and other sensors determine that that the stress level is high, then the call center (or other medical service provider) can be automatically notified to investigate.

[0074] Embodiments of the present technology may be described with reference to flowchart illustrations of methods and systems according to embodiments of the technology, and/or algorithms, formulae, or other computational depictions, which may also be implemented as computer program products. In this regard, each block or step of a flowchart, and combinations of blocks (and/or steps) in a flowchart, algorithm, formula, or computational depiction can be implemented by various means, such as hardware, firmware, and/or software including one or more computer program instructions embodied in computer-readable program code logic. As will be appreciated, any such computer program instructions may be loaded onto a computer, including without limitation a general purpose computer or special purpose computer, or other programmable processing apparatus to produce a machine, such that the computer program instructions which execute on the computer or other programmable processing apparatus create means for implementing the functions specified in the block(s) of the flowchart(s).

[0075] Accordingly, blocks of the flowcharts, algorithms, formulae, or computational depictions support combinations of means for performing the specified functions, combinations of steps for performing the specified functions, and computer program instructions, such as embodied in computer-readable program code logic means, for performing the specified functions. It will also be understood that each block of the flowchart illustrations, algorithms, formulae, or computational depictions and combinations thereof described herein, can be implemented by special purpose hardware-based computer systems which perform the specified functions or steps, or combinations of special purpose hardware and computer-readable program code logic means.

[0076] Furthermore, these computer program instructions, such as embodied in computer-readable program code logic, may also be stored in a computer-readable memory that can direct a computer or other programmable processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable memory produce an article of manufacture including instruction means which implement the function specified in the block(s) of the flowchart(s). The computer program instructions may also be loaded onto a computer or other programmable processing apparatus to cause a series of operational steps to be performed on the computer or other programmable processing apparatus to produce a computer-implemented process such that the instructions which execute on the computer or other programmable processing apparatus provide steps for implementing the functions specified in the block(s) of the flowchart(s), algorithm(s), formula(e), or computational depiction(s).

[0077] It will further be appreciated that "programming" as used herein refers to one or more instructions that can be executed by a processor to perform a function as described herein. The programming can be embodied in software, in firmware, or in a combination of software and firmware. The programming can be stored local to the device in non-transitory media, or can be stored remotely such as on a server, or all or a portion of the programming can be stored locally and remotely. Programming stored remotely can be downloaded (pushed) to the device by user initiation, or automatically based on one or more factors, such as, for example, location, a timing event, detection of an object, detection of a facial expression, detection of location, detection of a change in location, or other factors. It will further be appreciated that as used herein, that the terms processor, central processing unit (CPU), and computer are used synonymously to denote a device capable of executing the programming and communication with input/output interfaces and/or peripheral devices.

[0078] From the discussion above it will be appreciated that the technology can be embodied in various ways, including but not limited to the following:

[0079] 1. A smart wearable device, the device comprising: (a) one or more sensors, wherein at least one sensor is a biological sensor configured to acquire biological input; (b) a memory; (c) one or more communications interfaces; (d) a processor; and (e) programming residing in a non-transitory computer readable medium, wherein the programming is executable by the computer processor and configured to: (i) determine a physical or mental status of a user from input acquired by the one or more sensors, wherein at least one sensor is a biological sensor; (ii) in response to a specific physical or mental status determination, automatically generate a triggering signal to activate or deactivate a function of another device; and (iii) send the triggering signal to the other device.

[0080] 2. The device of any preceding embodiment, wherein the other device is a device selected from the group of devices consisting of a wearable smart device, a mobile device, a tablet, a lap top computer and a desk top computer.

[0081] 3. The device of any preceding embodiment, wherein said programming is further configured to receive a signal from the other device acknowledging the triggering signal was received by the other device.

[0082] 4. The device of any preceding embodiment, wherein the one or more communications interfaces are selected from the group consisting of a wired communications interface, a wireless communications interface, a cellular communications interface, a WiFi communications interface, a near field communications interface, an infrared communications interface, and a Bluetooth communications interface.

[0083] 5. The device of any preceding embodiment, wherein the physical or mental status of the user includes information related to one or more of blood sugar, stress, fatigue, anxiety, alertness, heart rate, galvanic skin response, weight, nutrition, digestion rate, metabolic rate, body temperature, skin temperature, respiration, allergies, sleep patterns, hydration, drug levels, sweat production and blood analysis.

[0084] 6. The device of any preceding embodiment, further comprising programming residing in the non-transitory computer readable medium, wherein the programming is executable by the computer processor and configured to: (a) determine an environmental status of a user from the input acquired by one or more environmental sensors configured to acquire contextual input; (b) in response to the environmental status determination, automatically generate a triggering signal to activate a function of another device; and (c) send the triggering signal to the other device.

[0085] 7. A computer implemented method for enabling a smart wearable device to automatically generate a triggering signal to active a certain functionality of another device, the method comprising: (a) providing a smart wearable device, wherein the smart wearable device comprises: (i) one or more sensors, wherein at least one sensor is a biological sensor configured to acquire biological input; (ii) a memory; (iii) one or more communications interfaces; and (iv) a processor; (b) acquiring biological input from one or more biological sensors; (c) processing the acquired biological input to determine a physical or mental status of the user; (d) responding to a specific determined physical or mental status of the user by automatically generating a triggering signal to activate a function of another device; and (e) sending the triggering signal to the other device using a communications interface; (f) wherein said method is performed by executing programming on at least one computer processor, said programming residing on a non-transitory medium readable by the computer processor.

[0086] 8. The method of any preceding embodiment, wherein the other device is a device selected from the group of devices consisting of a wearable smart device, a mobile device, a tablet, a lap top computer and a desk top computer.

[0087] 9. The method of any preceding embodiment, further comprising receiving a signal from the other device acknowledging the triggering signal was received by the other device.

[0088] 10. The method of any preceding embodiment, wherein the one or more communications interfaces are selected from the group consisting of a wired communications interface, a wireless communications interface, a cellular communications interface, a WiFi communications interface, a near field communications interface, an infrared communications interface, and a Bluetooth communications interface.

[0089] 11. The method of any preceding embodiment, wherein the physical or mental status of the user includes information related to one or more of blood sugar, stress, fatigue, anxiety, alertness, heart rate, galvanic skin response, weight, nutrition, digestion rate, metabolic rate, body temperature, skin temperature, respiration, allergies, sleep patterns, hydration, drug levels, sweat production and blood analysis.

[0090] 12. The method of any preceding embodiment, further comprising: (a) acquiring environmental input from one or more environmental sensors; (b) processing the acquired environmental input to determine an environmental status of the user; (c) responding to the determined environmental status of the user by automatically generating a triggering signal to activate a function of another device; and (d) sending the triggering signal to the other device using a communications interface.

[0091] 13. A system for automatically generating a triggering signal by a smart wearable device to active a certain functionality of another device, the system comprising: (a) a first smart device, wherein said first smart device is wearable or non-wearable and wherein said first smart device comprises: (i) one or more sensors; (ii) a memory; (iii) one or more communications interfaces; (iv) a processor; and (v) programming residing in a non-transitory computer readable medium, wherein the programming is executable by the computer processor and configured to receive and send signals; (b) a second smart device, wherein said second smart device is wearable and wherein said second smart device comprises: (i) one or more sensors, wherein at least one sensor is a biological sensor configured to acquire biological input; (ii) a memory; (iii) one or more communications interfaces; (iv) a processor; and (v) programming residing in a non-transitory computer readable medium, wherein the programming is executable by the computer processor and configured to: 1. determine a physical or mental status of a user from the input acquired by the one or more biological sensors; 2. in response to the physical or mental status determination, automatically generate a triggering signal to activate a function of said first smart device; and 3. send the triggering signal to said first smart device.

[0092] 14. The system of any preceding embodiment, wherein said programming of said second smart device is further configured to receive a signal from said first smart device acknowledging the triggering signal was received by said first smart device.

[0093] 15. The system of any preceding embodiment, wherein the one or more communications interfaces are selected from the group consisting of a wired communications interface, a wireless communications interface, a cellular communications interface, a WiFi communications interface, a near field communications interface, an infrared communications interface, and a Bluetooth communications interface.

[0094] 16. The system of any preceding embodiment, wherein an additional triggering signal is programmed to occur in response to criteria established and input by a user of the wearable device.

[0095] 17. The system of any preceding embodiment, wherein the physical or mental status of the user includes information related to one or more of blood sugar, stress, fatigue, anxiety, alertness, heart rate, galvanic skin response, weight, nutrition, digestion rate, metabolic rate, body temperature, skin temperature, respiration, allergies, sleep patterns, hydration, drug levels, sweat production and blood analysis.

[0096] 18. The system of any preceding embodiment, wherein said second smart device further comprises: programming residing in a non-transitory computer readable medium, wherein the programming is executable by the computer processor and configured to: (a) determine an environmental status of a user from the input acquired by the one or more environmental sensors configured to acquire environmental input; (b) in response to the environmental status determination, automatically generate a triggering signal to activate a function of said first smart device; and (c) send the triggering signal to said first smart device.

[0097] 19. The system of any preceding embodiment, wherein said programming is further configured to: (a) acquire a biometric identifier from at least one sensor worn by a user; (b) authenticate the user of the secure wearable apparatus by the biometric identifier; and (c) communicate with a remote device through the communications interface only if the user is authenticated.

[0098] 20. A secure wearable sensor apparatus, comprising: (a) a computer processor with memory; (b) a plurality of sensors operably coupled to the processor; (c) a communications link; and (d) programming in a non-transitory computer readable medium and executable on the computer processor for performing steps comprising: (i) acquiring a biometric identifier from at least one sensor worn by a user; (ii) comparing the acquired biometric identifier with a biometric identifier standard designated by the user; and (iii) communicating with a remote device through the communications link if the biometric identifiers match.

[0099] 21. The apparatus of any preceding embodiment, further comprising: at least one haptic output coupled to the computer processor; the haptic output programmed to activate when a communications link is established with a remote device.

[0100] 22. The apparatus of any preceding embodiment, further comprising: at least one sound generator output coupled to the computer processor; the sound generator output programmed to activate when a communications link is established with a remote device.

[0101] 23. The apparatus of any preceding embodiment, further comprising: at least one light output coupled to the computer processor; the light output programmed to activate when a communications link is established with a remote device.

[0102] 24. The apparatus of any preceding embodiment, wherein said biometric identifier comprises a heart identifier.

[0103] 25. The apparatus of any preceding embodiment, said programming further configured to: receive a request to initiate communications from the remote device; transmit sensor data to the remote device; and activate a haptic output notifying the user of the transmission.

[0104] 26. The apparatus of any preceding embodiment, said programming further configured to: transmit commands to the remote device; and receive command code from the remote device through the communications link.

[0105] 27. A secure wearable sensor system, comprising: (a) a wearable sensor device, comprising: (i) a computer processor with memory; (ii) a plurality of sensors operably coupled to the processor; (iii) a communications link; and (iv) programming in a non-transitory computer readable medium and executable on the computer processor for performing steps comprising: 1. acquiring a biometric identifier from at least one sensor worn by a user; 2. comparing the acquired biometric identifier with a biometric identifier standard designated by the user; and 3. communicating with a non-wearable device through the communications link if the biometric identifiers match; and (b) a non-wearable device, comprising: (i) a communications link; (ii) a computer processor with memory; (iii) programming in a non-transitory computer readable medium and executable on the computer processor for performing steps comprising: 1. sending and receiving communications from a wearable sensor device; and 2. processing sensor data received from the wearable sensor.

[0106] 28. The system of any preceding embodiment, wherein said biometric identifier comprises a heart identifier.

[0107] 29. The system of any preceding embodiment, said programming of the wearable device further configured to unlock a programming lock in the non-wearable device to process and display sensor data received from the wearable device.

[0108] 30. The system of any preceding embodiment, said wearable device further comprising: at least one haptic output coupled to the computer processor; the haptic output programmed to activate when a communications link is established with the non-wearable device.

[0109] 31. The system of any preceding embodiment, said wearable device further comprising: at least one sound generator output coupled to the computer processor; the sound generator output programmed to activate when a communications link is established with the non-wearable device.

[0110] 32. The system of any preceding embodiment, said wearable device further comprising: at least one light output coupled to the computer processor; the light output programmed to activate when a communications link is established with the non-wearable device.

[0111] 33. The system of any preceding embodiment, said non-wearable device computer processor further comprising a programming interface configured to control the sensors and computer processor of the wearable device over the communications link.

[0112] 34. A computer implemented method for securing a wearable device, the method comprising: (a) acquiring a biometric identifier from at least one sensor worn by a user; (b) comparing the acquired biometric identifier with a biometric identifier standard designated by the user; and (c) restricting access to a wearable device if the biometric identifiers do not match; (d) wherein said method is performed by executing programming on at least one computer processor, said programming residing on a non-transitory medium readable by the computer processor.

[0113] Although the description above contains many details, these should not be construed as limiting the scope of the technology but as merely providing illustrations of some of the presently preferred embodiments of this technology. Therefore, it will be appreciated that the scope of the present technology fully encompasses other embodiments which may become obvious to those skilled in the art, and that the scope of the present technology is accordingly to be limited by nothing other than the appended claims, in which reference to an element in the singular is not intended to mean "one and only one" unless explicitly so stated, but rather "one or more." All structural, chemical, and functional equivalents to the elements of the above-described preferred embodiment that are known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the present claims. Moreover, it is not necessary for a device or method to address each and every problem sought to be solved by the present technology, for it to be encompassed by the present claims. Furthermore, no element, component, or method step in the present disclosure is intended to be dedicated to the public regardless of whether the element, component, or method step is explicitly recited in the claims. No claim element herein is to be construed under the provisions of 35 U.S.C. 112 unless the element is expressly recited using the phrase "means for" or "step for".

1. A smart wearable device, the device comprising:

(a) one or more sensors, wherein at least one sensor is a biological sensor configured to acquire biological input;

(b) a memory;

(c) one or more communications interfaces;

(d) a processor; and

(e) programming residing in a non-transitory computer readable medium, wherein the programming is executable by the computer processor and configured to:

(i) determine a physical or mental status of a user from input acquired by the one or more sensors, wherein at least one sensor is a biological sensor;

(ii) in response to a specific physical or mental status determination, automatically generate a triggering signal to activate or deactivate a function of another device; and

(iii) send the triggering signal to the other device.

2. The device of claim **1**, wherein the other device is a device selected from the group of devices consisting of a wearable smart device, a mobile device, a tablet, a lap top computer and a desk top computer.

3. The device of claim **1**, wherein said programming is further configured to receive a signal from the other device acknowledging the triggering signal was received by the other device.

4. The device of claim **1**, wherein the one or more communications interfaces are selected from the group consisting of a wired communications interface, a wireless communications interface, a cellular communications interface, a WiFi communications interface, a near field communications interface, an infrared communications interface, and a Bluetooth communications interface.

5. The device of claim 1, wherein the physical or mental status of the user includes information related to one or more of blood sugar, stress, fatigue, anxiety, alertness, heart rate, galvanic skin response, weight, nutrition, digestion rate, metabolic rate, body temperature, skin temperature, respiration, allergies, sleep patterns, hydration, drug levels, sweat production and blood analysis.

6. The device of claim 1, further comprising programming residing in the non-transitory computer readable medium, wherein the programming is executable by the computer processor and configured to:

(a) determine an environmental status of a user from the input acquired by one or more environmental sensors configured to acquire contextual input;

(b) in response to the environmental status determination, automatically generate a triggering signal to activate a function of another device; and

(c) send the triggering signal to the other device.

7-19. (canceled)

20. A secure wearable sensor apparatus, comprising:

(a) a computer processor with memory;

(b) a plurality of sensors operably coupled to the processor;

(c) a communications link; and

(d) programming in a non-transitory computer readable medium and executable on the computer processor for performing steps comprising:

(i) acquiring a biometric identifier from at least one sensor worn by a user;

(ii) comparing the acquired biometric identifier with a biometric identifier standard designated by the user; and

(iii) communicating with a remote device through the communications link if the biometric identifiers match.

21. The apparatus of claim 20, further comprising:

at least one haptic output coupled to the computer processor;

the haptic output programmed to activate when a communications link is established with a remote device.

22. The apparatus of claim 20, further comprising:

at least one sound generator output coupled to the computer processor;

the sound generator output programmed to activate when a communications link is established with a remote device.

23. The apparatus of claim 20, further comprising:

at least one light output coupled to the computer processor;

the light output programmed to activate when a communications link is established with a remote device.

24. The apparatus of claim 20, wherein said biometric identifier comprises a heart identifier.

25. The apparatus of claim 20, said programming further configured to:

receive a request to initiate communications from the remote device;

transmit sensor data to the remote device; and

activate a haptic output notifying the user of the transmission.

26. The apparatus of claim 20, said programming further configured to:

transmit commands to the remote device; and

receive command code from the remote device through the communications link.

27. A secure wearable sensor system, comprising:

(a) a wearable sensor device, comprising:

(i) a computer processor with memory;

(ii) a plurality of sensors operably coupled to the processor;

(iii) a communications link; and

(iv) programming in a non-transitory computer readable medium and executable on the computer processor for performing steps comprising:

1. acquiring a biometric identifier from at least one sensor worn by a user;

2. comparing the acquired biometric identifier with a biometric identifier standard designated by the user; and

3. communicating with a non-wearable device through the communications link if the biometric identifiers match; and

(b) a non-wearable device, comprising:

(i) a communications link;

(ii) a computer processor with memory;

(iii) programming in a non-transitory computer readable medium and executable on the computer processor for performing steps comprising:

1. sending and receiving communications from a wearable sensor device; and

2. processing sensor data received from the wearable sensor.

28. The system of claim 27, wherein said biometric identifier comprises a heart identifier.

29. The system of claim 27, said programming of the wearable device further configured to unlock a programming lock in the non-wearable device to process and display sensor data received from the wearable device.

30. The system of claim 27, said wearable device further comprising:

at least one haptic output coupled to the computer processor;

the haptic output programmed to activate when a communications link is established with the non-wearable device.

31. The system of claim 27, said wearable device further comprising:

at least one sound generator output coupled to the computer processor;

the sound generator output programmed to activate when a communications link is established with the non-wearable device.

32. The system of claim 27, said wearable device further comprising:

at least one light output coupled to the computer processor;

the light output programmed to activate when a communications link is established with the non-wearable device.

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