US010231629B1

(12) **United States Patent**
Pei et al.

(10) **Patent No.: US 10,231,629 B1**
(45) **Date of Patent: Mar. 19, 2019**

(54) **MOBILE INTEGRATED ELECTRODE MULTIFUNCTION SENSOR AND METHOD**

(71) Applicant: **Maxim Integrated Products, Inc.**, San Jose, CA (US)

(72) Inventors: **Cheng-Wei Pei**, Belmont, CA (US); **Richard I. Olsen**, Truckee, CA (US)

(73) Assignee: **MAXIM INTEGRATED PRODUCTS, INC.**, San Jose, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 481 days.

(21) Appl. No.: **14/799,961**

(22) Filed: **Jul. 15, 2015**

Related U.S. Application Data

(60) Provisional application No. 62/041,172, filed on Aug. 25, 2014.

(51) **Int. Cl.**

A61B 5/024	(2006.01)
A61B 5/0408	(2006.01)
A61B 5/0205	(2006.01)
A61B 5/00	(2006.01)

(52) **U.S. Cl.**
CPC ***A61B 5/02055*** (2013.01); ***A61B 5/681*** (2013.01); ***A61B 5/6898*** (2013.01); ***A61B 5/7435*** (2013.01); *A61B 5/02438* (2013.01); *A61B 5/0408* (2013.01)

(58) **Field of Classification Search**
CPC . A61B 5/0205; A61B 5/0402; A61B 5/02427; A61B 5/02444; A61B 5/681; A61B 5/0432; A61B 5/0404
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2006/0076236	A1*	4/2006	Shah	A61B 5/14532 204/403.01
2006/0163453	A1*	7/2006	Hynes	G01J 1/04 250/214 R
2008/0272446	A1*	11/2008	Haluzak	B81C 3/001 257/415
2009/0105605	A1*	4/2009	Abreu	A61B 5/0008 600/549
2015/0135310	A1*	5/2015	Lee	A61B 5/681 726/20

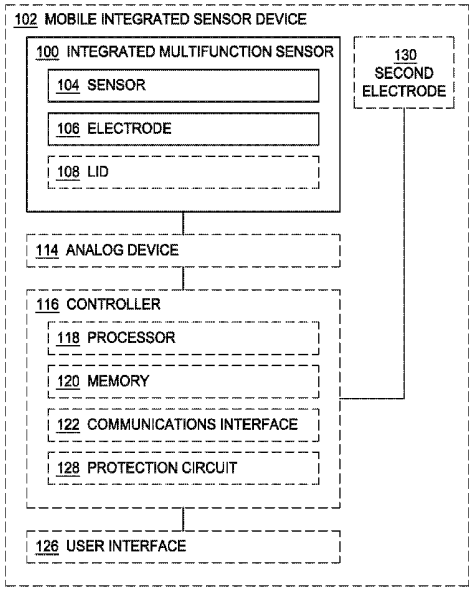
* cited by examiner

Primary Examiner — Nathan J Jenness
(74) *Attorney, Agent, or Firm* — Kevin E. West; Advent, LLP

(57) **ABSTRACT**

An integrated multifunction sensor, a mobile integrated sensor device, and process are described that include a sensor, where the sensor is used primarily for a first purpose other than as an electrode. In an implementation, an integrated multifunction sensor includes a multifunction sensor configured as a sensor and a first electrode, the multifunction sensor including a lid coupled to a first side of the sensor, where the lid includes a semi-conductive material, and an analog device connected to the lid; where the multifunction sensor is configured to couple to a controller that receives health information from the first electrode and a second electrode. In some embodiments, the integrated multifunction sensor can include an integrated optical sensor. In some implementations, a second electrode may be located elsewhere in a mobile integrated sensor device and complete a differential circuit.

6 Claims, 5 Drawing Sheets



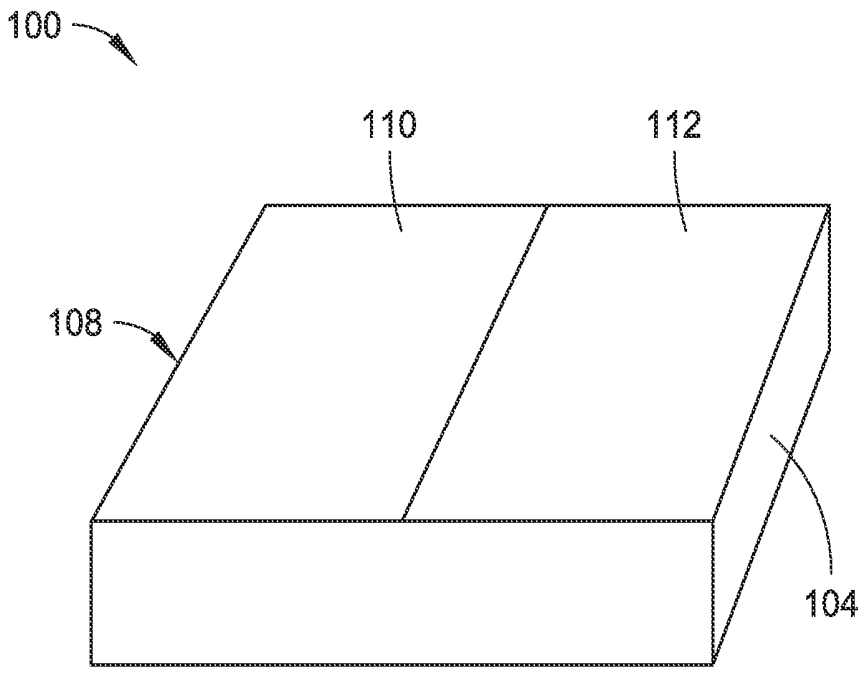


FIG. 1A

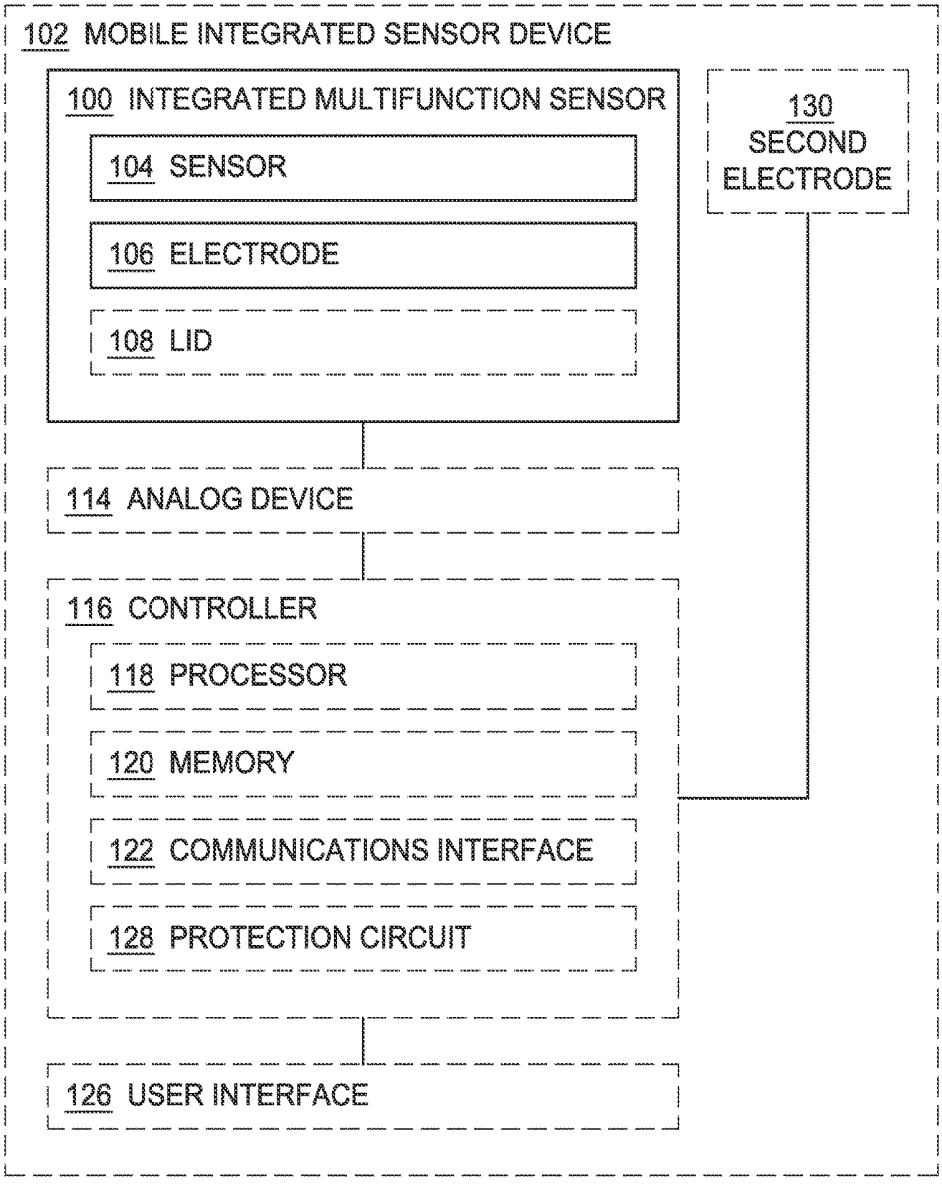

102 MOBILE INTEGRATED SENSOR DEVICE
100 INTEGRATED MULTIFUNCTION SENSOR
104 SENSOR
106 ELECTRODE
108 LID
130 SECOND ELECTRODE
114 ANALOG DEVICE
116 CONTROLLER
118 PROCESSOR
120 MEMORY
122 COMMUNICATIONS INTERFACE
128 PROTECTION CIRCUIT
126 USER INTERFACE

FIG. 1B

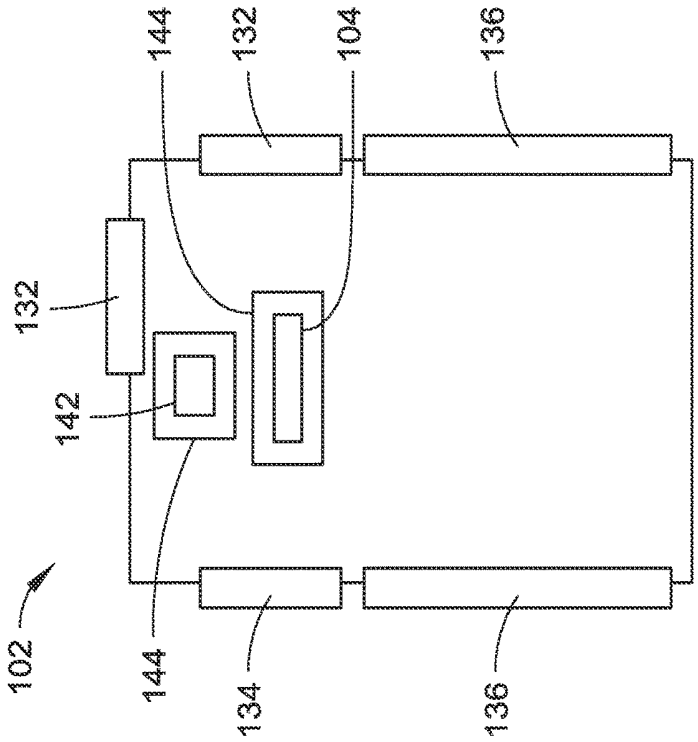

144
132
104
136
132
142
102
144
134
136

FIG. 1D

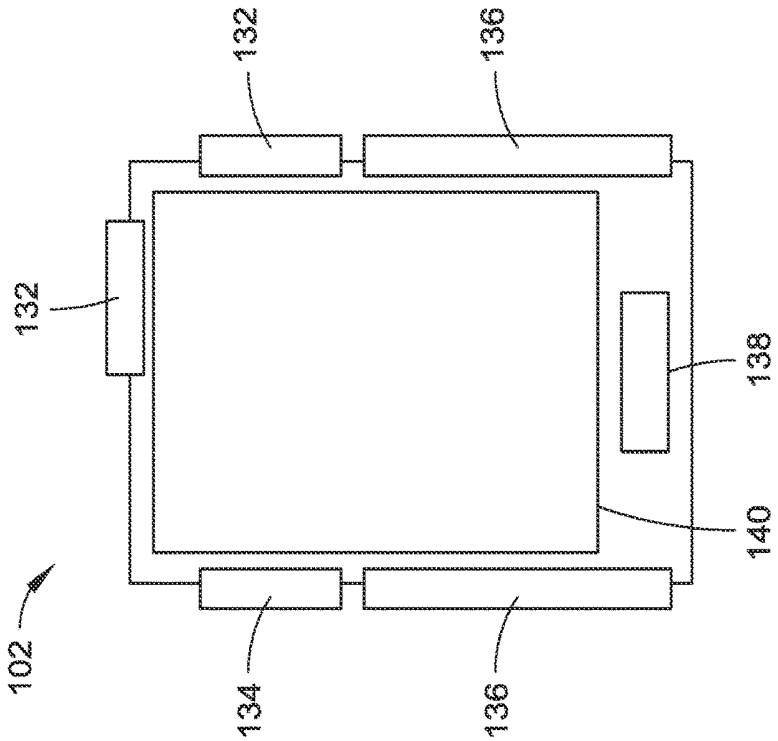

132
136
132
138
140
102
134
136

FIG. 1C

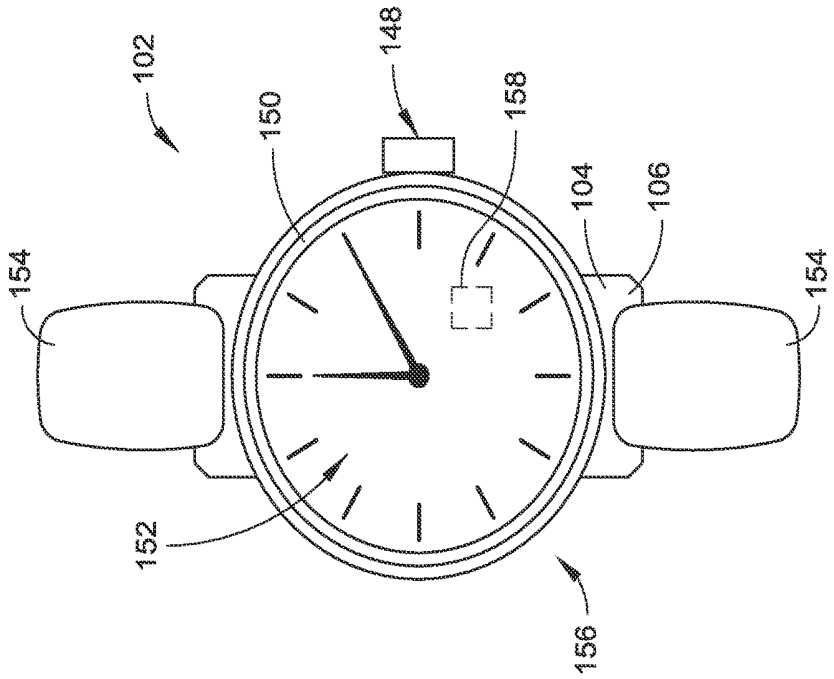

102
148
150
158
104
106
154
154
152
156

FIG. 1F

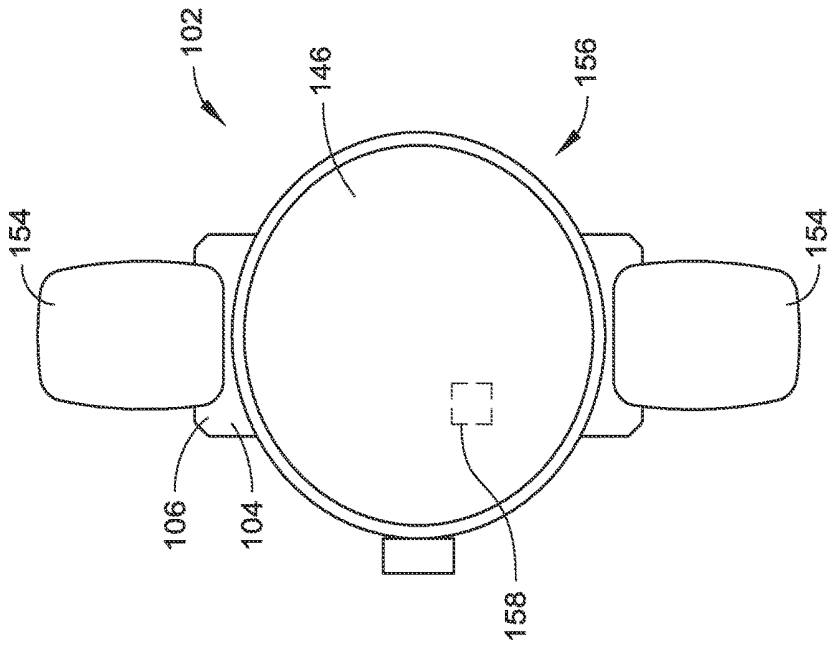

102
146
156
154
154
106
104
158

FIG. 1E

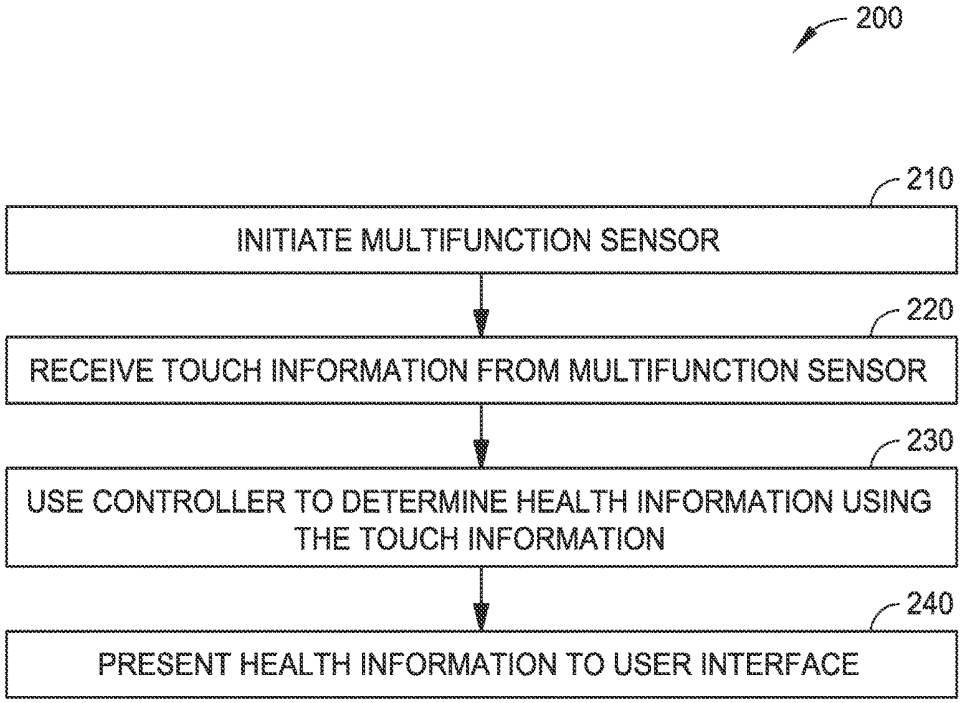

200
210
INITIATE MULTIFUNCTION SENSOR
220
RECEIVE TOUCH INFORMATION FROM MULTIFUNCTION SENSOR
230
USE CONTROLLER TO DETERMINE HEALTH INFORMATION USING THE TOUCH INFORMATION
240
PRESENT HEALTH INFORMATION TO USER INTERFACE

FIG. 2

MOBILE INTEGRATED ELECTRODE MULTIFUNCTION SENSOR AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims the benefit under 35 U.S.C. § 119(e) of U.S. Provisional Application Ser. No. 62/041,172, filed Aug. 25, 2014, and titled "ECG ELECTRODE INTEGRATED IN A MULTIFUNCTION PACKAGE LID OF A MOBILE DEVICE SENSOR." U.S. Provisional Application Ser. No. 62/041,172 is herein incorporated by reference in its entirety.

BACKGROUND

Electronic devices, such as smart phones, tablet computers, digital media players, and so forth, increasingly employ sensors to control the manipulation of a variety of functions provided by the device. For example, sensors can be used by electronic devices to detect ambient lighting conditions in order to control the brightness of the device's display screen or detect a fingerprint, etc. Additionally, sensors may be used to detect heat, sound, energy, magnetic fields, etc. Sensors can convert received information into an electrical signal (e.g., a current or voltage).

SUMMARY

An integrated multifunction sensor, a mobile integrated sensor device, and process are described that include a sensor, where the sensor is used primarily for a first purpose other than as an electrode. In an implementation, an integrated multifunction sensor includes a multifunction sensor configured as a sensor and a first electrode, the multifunction sensor including a lid coupled to a first side of the sensor, where the lid includes a semi-conductive material, and an analog device connected to the lid; where the multifunction sensor is configured to couple to a controller that receives health information from the first electrode and a second electrode. In some embodiments, the integrated multifunction sensor can include an integrated optical sensor. In some implementations, a second electrode may be located elsewhere in a mobile integrated sensor device and complete a differential circuit.

In an implementation, a mobile integrated sensor device comprises a mobile device including a multifunction sensor configured as a sensor and an electrode; an amplifier coupled to the multifunction sensor, where the amplifier is configured to detect body electrical potential changes; a controller coupled to the amplifier and the multifunction sensor; and a user interface coupled to the controller.

In an implementation, a process includes initiating a multifunction sensor configured as a sensor and an electrode, where the multifunction sensor is disposed in a mobile device; receiving touch information from the multifunction sensor; using a controller to determine health information using the touch information from the multifunction sensor; and presenting the health information to a user interface.

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

DRAWINGS

The detailed description is described with reference to the accompanying figures. The use of the same reference numbers in different instances in the description and the figures may indicate similar or identical items.

FIG. **1**A is an isometric view illustrating an embodiment of an integrated multifunction sensor that integrates a sensor and an electrode within the same device, in accordance with an example implementation of the present disclosure.

FIG. **1**B is an environmental view illustrating an embodiment of a mobile integrated sensor device including an integrated multifunction sensor that integrates a sensor and an electrode within the same device, in accordance with an example implementation of the present disclosure.

FIG. **1**C is a side elevation view illustrating an embodiment of a mobile integrated sensor device including an integrated multifunction sensor that integrates a sensor and an electrode within the same device, in accordance with an example implementation of the present disclosure.

FIG. **1**D is a side elevation view illustrating an embodiment of a mobile integrated sensor device including an integrated multifunction sensor that integrates a sensor and an electrode within the same device, in accordance with an example implementation of the present disclosure.

FIG. **1**E is a side elevation view illustrating an embodiment of a mobile integrated sensor device including an integrated multifunction sensor that integrates a sensor and an electrode within the same device, in accordance with an example implementation of the present disclosure.

FIG. **1**F is a side elevation view illustrating an embodiment of a mobile integrated sensor device including an integrated multifunction sensor that integrates a sensor and an electrode within the same device, in accordance with an example implementation of the present disclosure.

FIG. **2** is a flow diagram illustrating a process in an example implementation for operating a mobile integrated sensor device with an integrated multifunction sensor in accordance with the present disclosure, such as the mobile integrated sensor device and integrated multifunction sensor shown in FIGS. **1**A through **1**F.

DETAILED DESCRIPTION

Overview

Electrocardiography (ECG/EKG) can be used to measure the heart's electrical conduction system. In a typical ECG/EKG circuit, electrodes may be connected to a person and an electronic circuit with patient protection and/or a sensitive amplifier. Some EKG devices may use two electrodes integrated into a mobile device case, not the device itself. Some of these devices can dry electrodes, which include a conductive metal (e.g., platinum, nickel, copper, aluminum, iron, or silver) and conduct a signal from the body through contact only, as opposed to wet electrodes that require a conductive gel to be disposed on the electrodes.

A controller can receive and/or detect subtle electrical potential changes in the body when the heart polarizes and depolarizes and can translate these resulting electrical impulses into a waveform. The waveform can be used to measure the rate and regularity of heartbeats, the size and position of the heart chambers, the presence of damage to the heart, and/or the effects of drugs or devices used to regulate the heart, such as a pacemaker, etc. By measuring electrical signals on the skin in certain locations on the body, it is possible to monitor the health and activity of the heart using these waveforms.

In order for ECG circuits to be integrated into a mobile device, such as a wearable electronic device or a mobile phone, electrodes can be integrated within the device itself. However, space and noise considerations may limit the

number and/or location of electrodes that may be incorporated into the device. Challenges in developing sensor devices with an electrode include space considerations integrating an electrode into the end device itself.

Accordingly, an integrated multifunction sensor, a mobile integrated sensor device, and process are described that include a sensor, where the sensor is used primarily for a first purpose other than as an electrode. In an implementation, an integrated multifunction sensor includes a multifunction sensor configured as a sensor and a first electrode, the multifunction sensor including a lid coupled to a first side of the sensor, where the lid includes a semi-conductive material, and an analog device connected to the lid; where the multifunction sensor is configured to couple to a controller that receives health information from the first electrode and a second electrode. In some embodiments, the integrated multifunction sensor can include an integrated optical sensor. In some implementations, a second electrode may be located elsewhere in a mobile integrated sensor device and complete a differential circuit.

In an implementation, a mobile integrated sensor device comprises a mobile device including a multifunction sensor configured as a sensor and an electrode; an amplifier coupled to the multifunction sensor, where the amplifier is configured to detect body electrical potential changes; a controller coupled to the amplifier and the multifunction sensor; and a user interface coupled to the controller.

In an implementation, a process includes initiating a multifunction sensor configured as a sensor and an electrode, where the multifunction sensor is disposed in a mobile device; receiving touch information from the multifunction sensor; using a controller to determine health information using the touch information from the multifunction sensor; and presenting the health information to a user interface.

Example Implementations

FIGS. **1**A through **1**F illustrate an integrated multifunction sensor **100** and a mobile integrated sensor device **102** in accordance with an example implementation of the present disclosure. As shown in FIGS. **1**A through **1**F, the integrated multifunction sensor **100** can include an integrated sensor, such as sensor **104**, and an integrated electrode, such as electrode **106**. Some examples of an integrated multifunction sensor **100** and/or components of an integrated multifunction sensor **100** can include a mobile device, such as a handheld sensor (e.g., a blood pressure cuff, a pulse monitor, etc.), a mobile phone with sensing technology, and/or a wearable, such as a watch, jewelry (e.g., a ring).

In implementations, the sensor **104** can include a temperature sensor, an optical sensor, a gas sensor, an infrared sensor, a pulse sensor, a flash sensor, and/or a proximity sensor. It is contemplated that other types of sensors may be utilized for the integrated sensor **104**. In some embodiments, the sensor **104** may include a device input button (e.g., on a smart phone), which can also serve as an electrode **106**, or other device. In implementations, electrode **106** can include an electrical conductor used to make contact with a nonmetallic part of a circuit (e.g. a person's finger). In some examples, an electrode **106** can include a silicon or silicon-based portion of the integrated multifunction sensor **100** that can conduct electrical signals. In other examples, the electrode **106** can include metal (e.g., a watch clasp on a wearable smart watch). In implementations, the integrated multifunction sensor **100** is simultaneously a sensor **104** and an electrode **106**. For example, the integrated multifunction sensor **100** can be a sensor **104** (e.g., an optical sensor) and simultaneously be an electrode **106** that detects and/or conducts electrical signals when touched by a person's finger.

In some embodiments, the integrated multifunction sensor **100** may include a lid **108**, which can be coupled to a side of the integrated multifunction sensor **100**. In embodiments, the lid **108** can include materials that are temperature sensing, transmissive, electrically insulating, and/or electrically non-insulating and the lid **108** may be divided into at least two sections. For example, a first section **110** may include a material capable of transmitting visible and near-IR wavelengths (e.g., 400 nm to 1100 nm). In this example, a second section **112** may include a semi-conductive material capable of transmitting IR wavelengths and electrically non-insulating. In other examples, the lid **108** can include glass (e.g., a first section **110**) and can include at least one of silicon or germanium (e.g., a second section **112**). Silicon and/or germanium may be used for temperature sensing purposes and/or for transmission of mid-IR and long-IR wavelengths (e.g., 1 um to 20 um). In some implementations, the lid **108** may include semiconductor alloys (e.g., gallium arsenide, indium phosphide, arsenic trisulfide, barium fluoride, cadmium sulfide, cadmium telluride, selenium, and so forth). In yet other implementations, the lid **108** may include a metal (e.g., platinum, nickel, copper, aluminum, iron, silver, and so forth). It is contemplated that the lid **106** may include other materials configured to be an electrode and/or a sensor.

In the specific example shown in FIG. **1**A, the integrated multifunction sensor **100** includes a sensor **104** with a lid **108**, where a first section **110** of the lid **108** is configured for sensing (e.g., a glass section for optical sensing) and a second section **112** (e.g., a silicon and/or germanium section that is an electrode **106**) of the lid **108** for conducting an electrical signal (e.g., from a person's finger). In another specific example, the integrated multifunction sensor **100** may not include a lid **108** (e.g., the integrated multifunction sensor **100** may be entirely functional as a sensor **104** and an electrode **106**). In this specific example, the integrated multifunction sensor **100** may include a fingerprint sensor, which may also include a pressable input button, where the pressable input button includes a conductive layer (e.g., a thin layer of silicon) configured to receive and/or transmit an electrical signal (e.g., from a finger).

As illustrated in FIG. **1**B, the mobile integrated sensor device **102** can include a mobile device having an integrated multifunction sensor **100**, an analog device **114**, a controller **116**, a user interface **126**, and/or a second electrode **130**. In implementations, a mobile device and/or a mobile integrated sensor device **102** may include a small computing device, typically small enough to be handheld having a display screen with touch input and/or a miniature keyboard and weighing less than about two pounds. Some specific examples of a mobile device and/or a mobile integrated sensor device **102** may include a smartphone, a watch (e.g., a smart watch), a computer tablet, etc.

In implementations, the analog device **114** may include an amplifier, which can be used to receive an electrical signal and/or an indication of a body electrical potential change from the integrated multifunction sensor **100** and/or the electrode **106**. In such embodiments, the analog device **114** and/or amplifier can be configured to detect subtle changes in electrical potential in the body (e.g. ECG/EKG), which may be used to determine an electrocardiogram waveform. In some implementations, the amplifier **114** may be a portion of the integrated multifunction sensor **100**. For example, the amplifier **114** may be disposed within the integrated multi-

function sensor **100** and/or coupled to the lid **108** (e.g., electrode **106** and/or semi-conductive section). In other embodiments, the amplifier **114** may be disposed external to the integrated multifunction sensor **100** but internal to the mobile integrated sensor device **102** and coupled to the integrated multifunction sensor **100** and/or a controller **116**.

As shown in FIG. **1**B, mobile integrated sensor device **102** can include a controller **116** coupled to the integrated multifunction sensor **100**, analog device **114**, and/or user interface **126** and configured to control and operate the mobile integrated sensor device **102**. Referring to FIG. **1**B, a mobile integrated sensor device **102**, including some or all of its components, can operate under computer control. For example, a processor **118** can be included with or in a mobile integrated sensor device **102** and/or controller **116** to control the components and functions of the mobile integrated sensor device **102** described herein using software, firmware, hardware (e.g., fixed logic circuitry), manual processing, or a combination thereof. The terms "controller," "functionality," "service," and "logic" as used herein generally represent software, firmware, hardware, or a combination of software, firmware, or hardware in conjunction with controlling the mobile integrated sensor device **102**. In the case of a software implementation, the module, functionality, or logic represents program code that performs specified tasks when executed on a processor (e.g., central processing unit (CPU) or CPUs). The program code can be stored in one or more computer-readable memory devices (e.g., internal memory and/or one or more tangible media), and so on. The structures, functions, approaches, and techniques described herein can be implemented on a variety of commercial computing platforms having a variety of processors.

As illustrated in FIG. **1**B, the controller **116** may include a processor **118**, a memory **120**, a communications interface **122**, and/or a protection circuit **128**. A protection circuit **128** can include a circuit configured to protect the mobile integrated sensor device **102** and/or a user from an electrical shock. For example, a protection circuit **128** can include a fuse. The processor **118** provides processing functionality for at least the mobile integrated sensor device **102**/controller **116** and can include any number of processors, microcontrollers, or other processing systems, and resident or external memory for storing data and other information accessed or generated by the mobile integrated sensor device **102**/controller **116**. The processor **118** can execute one or more software programs that implement techniques described herein. The processor **118** is not limited by the materials from which it is formed or the processing mechanisms employed therein and, as such, can be implemented via semiconductor(s) and/or transistors (e.g., using electronic integrated circuit (IC) components), and so forth.

The controller **116** may include a memory **120**. The memory **120** can be an example of tangible, computer-readable storage medium that provides storage functionality to store various data associated with operation of the mobile integrated sensor device **102**/controller **116**, such as software programs and/or code segments, or other data to instruct the processor **118**, and possibly other components of the mobile integrated sensor device **102**/controller **116**, to perform the functionality described herein. Thus, the memory **120** can store data, such as a program of instructions for operating the mobile integrated sensor device **102** (including its components), and so forth. It should be noted that while a single memory **120** is described, a wide variety of types and combinations of memory (e.g., tangible, non-transitory memory) can be employed. The memory **120** can be integral with the processor **118**, can comprise stand-alone memory, or can be a combination of both.

Some examples of the memory **120** can include removable and non-removable memory components, such as random-access memory (RAM), read-only memory (ROM), flash memory (e.g., a secure digital (SD) memory card, a mini-SD memory card, and/or a micro-SD memory card), magnetic memory, optical memory, universal serial bus (USB) memory devices, hard disk memory, external memory, and so forth. In implementations, the mobile integrated sensor device **102** and/or the memory **120** can include removable integrated circuit card (ICC) memory, such as memory provided by a subscriber identity module (SIM) card, a universal subscriber identity module (USIM) card, a universal integrated circuit card (UICC), and so on.

The controller **116** may include a communications interface **122**. The communications interface **122** can be operatively configured to communicate with components of the mobile integrated sensor device **102**. For example, the communications interface **122** can be configured to transmit data for storage in the mobile integrated sensor device **102**, retrieve data from storage in the mobile integrated sensor device **102**, and so forth. The communications interface **122** can also be communicatively coupled with the processor **118** to facilitate data transfer between components of the mobile integrated sensor device **102** and the processor **118** (e.g., for communicating inputs to the processor **118** received from a device communicatively coupled with the mobile integrated sensor device **102**/controller **116**). It should be noted that while the communications interface **122** is described as a component of a mobile integrated sensor device **102**/controller **116**, one or more components of the communications interface **122** can be implemented as external components communicatively coupled to the mobile integrated sensor device **102** via a wired and/or wireless connection. The mobile integrated sensor device **102** can also include and/or connect to one or more input/output (I/O) devices (e.g., via the communications interface **122**), such as a display, a mouse, a touchpad, a touchscreen, a keyboard, and so on.

The communications interface **122** and/or the processor **118** can be configured to communicate with a variety of different networks, such as a wide-area cellular telephone network, such as a 3G cellular network, a 4G cellular network, or a global system for mobile communications (GSM) network; a wireless computer communications network, such as a WiFi network (e.g., a wireless local area network (WLAN) operated using IEEE 802.11 network standards); an internet; the Internet; a wide area network (WAN); a local area network (LAN); a personal area network (PAN) (e.g., a wireless personal area network (WPAN) operated using IEEE 802.15 network standards); a public telephone network; an extranet; an intranet; and so on. However, this list is provided by way of example only and is not meant to limit the present disclosure. Further, the communications interface **122** can be configured to communicate with a single network or multiple networks across different access points. In a specific embodiment, a communications interface **122** can transmit information from the controller **116** to an external device (e.g., a cell phone, a computer connected to a WiFi network, cloud storage, etc.). In another specific embodiment, a communications interface **122** can receive information from an external device (e.g., a cell phone, a computer connected to a WiFi network, cloud storage, etc.).

Generally, any of the functions described herein can be implemented using hardware (e.g., fixed logic circuitry such as integrated circuits), software, firmware, manual process-

ing, or a combination thereof. Thus, the blocks discussed in the above disclosure generally represent hardware (e.g., fixed logic circuitry such as integrated circuits), software, firmware, or a combination thereof. In the instance of a hardware configuration, the various blocks discussed in the above disclosure may be implemented as integrated circuits along with other functionality. Such integrated circuits may include all of the functions of a given block, system, or circuit, or a portion of the functions of the block, system, or circuit. Further, elements of the blocks, systems, or circuits may be implemented across multiple integrated circuits. Such integrated circuits may comprise various integrated circuits, including, but not necessarily limited to: a monolithic integrated circuit, a flip chip integrated circuit, a multichip module integrated circuit, and/or a mixed signal integrated circuit. In the instance of a software implementation, the various blocks discussed in the above disclosure represent executable instructions (e.g., program code) that perform specified tasks when executed on a processor. These executable instructions can be stored in one or more tangible computer readable media. In some such instances, the entire system, block, or circuit may be implemented using its software or firmware equivalent. In other instances, one part of a given system, block, or circuit may be implemented in software or firmware, while other parts are implemented in hardware.

Shown in FIG. **1**B, the mobile integrated sensor device **102** can include a user interface **126** coupled to the controller **116**. In implementations, a user interface **126** can include an interface between the mobile integrated sensor device **102** and a user. For example, a user interface **126** may include a display, a touchscreen, a touchpad, a switch, a cell phone, and/or a button. It is contemplated that other types of a user interface **126** may be utilized. In specific implementations, the user interface **126** can be coupled to and/or included as a part of communications interface **122**. In one specific example, a user interface **126** can include a touchscreen display coupled to a controller **116** and configured for receiving user input and displaying an EKG waveform.

As shown in FIG. **1**B, the mobile integrated sensor device **102** may include a second electrode **130**. The second electrode **130** can be disposed such that when the integrated multifunction sensor **100** and the second electrode **130** are simultaneously touched by an object, an electrical circuit (e.g., a differential circuit) is formed that can detect an electrical signal from a finger or other object. In some instances, the second electrode **130** may be disposed proximate to the mobile integrated sensor device **102**. In other instances, the second electrode **130** may not be disposed proximate to the mobile integrated sensor device **102**. In some embodiments, the second electrode **130** can include a conductive or semi-conductive material, such as silicon and/or copper. Additionally, a second electrode **130** can be utilized for common-mode voltage control.

In an implementation, the décor of the sensor **104** is the electrode **106**. For example, the décor of the sensor **104**, which is and can function as the electrode **106**, may include a silicon lid **108**, an electrode **106** between at least two lids **108**, an electrode **106** proximate to a lid **108**, décor proximate to and/or surrounding a sensor **104**, décor proximate to and/or surrounding a camera lens **142**, a device back panel, glass with an integrated electrode **106** (e.g., a touch panel), and/or a glass electrode.

In the specific embodiment illustrated in FIGS. **1**C and **1**D, a mobile integrated sensor device **102** can include a mobile phone. In this embodiment, at least one component of the mobile phone may serve as the electrode **106**. For example, a mechanical button **138** (e.g., a home button, a volume button, a power button **132**) can function as an electrode **106**, such as a home button electrode. Other examples of an electrode **106** on a mobile integrated sensor device **102** that includes a mobile phone can include side trim **134** and/or an antenna **136** (e.g., an RF antenna **136**). Moreover, a mobile phone electrode **106** may include décor proximate to and/or surrounding a camera lens **142** (e.g., a conductive frame **144** that surrounds the camera lens **142**). An additional mobile phone example of an electrode **106** can include a sensor **104** and the screen **140** (e.g., glass) of the phone. In this example, the electrode **106** can be disposed in or on the screen **140** as a conductive and/or transparent material. It is contemplated that multiple combinations of a sensor **104** and electrode **106** can be used in a mobile integrated sensor device **102** including a mobile phone.

In the specific embodiment illustrated in FIGS. **1**E and **1**F, a mobile integrated sensor device **102** can include a wearable, such as a watch. In this embodiment, a sensor assembly **158** may be disposed within and/or as a part of the watch. In this embodiment, at least one component of the watch may be an electrode **106**. For example, the electrode **106** may include at least a portion of the band **154**, a back plate **146**, a watch face **152** (e.g., a glass lid or the watch front), a bezel **150**, and/or a watch crown **148**. For example, the watch may include a band **154** that is an electrode **106** and a watch package **156** that is a sensor **104**. In another example, the watch may include a back plate **146** that is a sensor **104** and a watch crown **148** that is an electrode **106**. It is contemplated that multiple combinations of a sensor **104** and electrode **106** can be used in a mobile integrated sensor device **102** including a watch.

In additional embodiments, a mobile integrated sensor device **102** can include wireless capability. In implementations, wireless capability may include WiFi, Bluetooth, and/or radio frequency (RF). In one specific embodiment, a mobile integrated sensor device **102** can include a watch with a sensor **104** and/or a sensor assembly **158** and an electrode **106** that includes a jewelry ring with wireless capability that is configured to wirelessly communicate with the sensor **104** and/or the sensor assembly **158**. In another specific embodiment, a mobile integrated sensor device **102** can include a mobile phone with a sensor **104** and a watch (or other wearable) having an electrode **106**, where the watch and mobile phone have wireless capability that is configured to facilitate wireless communication between the electrode **106** and the sensor **104**. In these embodiments, the electrode **106** and/or sensor **104** may be included as a portion of an electrocardiograph (EKG or ECG) system.

Example Processes

The following discussion describes example techniques for operating a mobile integrated sensor device, such as the integrated multifunction sensor **100** and/or the mobile integrated sensor device **102** shown in FIGS. **1**A through **1**F. FIG. **2** illustrates an example process **200** for operating the integrated multifunction sensor **100** and/or the mobile integrated sensor device **102** shown in FIGS. **1**A through **1**F.

In the process **200** illustrated in FIG. **2**, an integrated multifunction sensor is initiated (Block **210**). In embodiments, initiating an integrated multifunction sensor **100** can include using a controller **116** to transmit a signal to the integrated multifunction sensor **100** to begin operation (e.g., begin sensing, begin detecting an indication of a touch event, begin detecting an electrical signal, etc.). In one specific example, initiating the integrated multifunction sen-

sor **100** can include initiating controller **116** to receive an indication of a detected electrical signal from integrated multifunction sensor **100** and/or the electrode portion (e.g., electrode **106**) of the integrated multifunction sensor **100**.

Touch information is then received from the integrated multifunction sensor (Block **220**). In embodiments, receiving touch information from the integrated multifunction sensor **100** can include using controller **116** to receive at least one electrical signal from the integrated multifunction sensor **100** and/or electrode **106**. Some examples of touch information can include an indication of a positive touch event and/or an electrical signal from a finger (e.g., a change in body electrical potential change). It is contemplated that other types of information can be received by controller **116** from integrated multifunction sensor **100** (e.g., information from the sensor portion of the integrated multifunction sensor **100**, such as an indication of a fingerprint from a fingerprint sensor, an indication of a proximate object from a proximity sensor, etc.). In some embodiments, touch and/or other information may be received from an analog device **114**, such as an amplifier, which can be configured to detect changes in electrical potential in a finger or person's body (e.g., ECG/EKG).

Then, a controller is used to determine health information using received touch information (Block **230**). In embodiments, using a controller **116** to determine health information can include using a controller **116** to determine an ECG/EKG waveform using touch information, such as electrical signals received from a user's finger and/or body. Examples of health information can include an ECG/EKG waveform, an indication of heart activity, etc. Additionally, controller **116** can determine health information such as heartbeat information, heart characteristics, and/or heart damage.

Next, health information is presented by controller to a user interface (Block **240**). In implementations, presenting health information to a user interface **126** can include using a controller **116** to present health information, such as an ECG/EKG to a user interface **126**, such as a touchscreen display. In implementations, the user interface **126** can further present the health information to a user.

CONCLUSION

Although the subject matter has been described in language specific to structural features and/or process operations, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

What is claimed is:

1. An integrated multifunction sensor, comprising:

an optical sensor;

a lid wherein a first section of the lid comprises a material operable to transmit visible and near infra-red (IR) wavelengths and a second section of the lid comprises a semi-conductive material operable to transmit IR wavelengths and further operable to conduct electrical signals when contacted by a person's body;

a first electrode operable to detect electrical signals when the lid is contacted by a person's body;

an analog device connected to the lid, the analog device comprising an amplifier configured to detect changes in electrical potential when the lid is contacted by the person's body;

a second electrode operable to complete a differential circuit when the lid and the second electrode are simultaneously contacted by the person's body; and

a controller operable to receive information from the optical sensor, the first electrode, the analog device and the second electrode and output health information about a user.

2. The integrated multifunction sensor as recited in claim **1**, further comprising at least one of: a temperature sensor, a gas sensor, an infrared sensor, a pulse sensor, a flash sensor, an EKG sensor, or a proximity sensor.

3. The integrated multifunction sensor as recited in claim **1**, wherein the lid includes at least one of silicon or germanium.

4. The integrated multifunction sensor as recited in claim **1**, wherein the analog device receives an indication of changes in electrical potential in a person's body.

5. The integrated multifunction sensor as recited in claim **1**, wherein the controller is configured to determine an electrocardiogram using body electrical potential changes detected by the multifunction sensor.

6. The integrated multifunction sensor as recited in claim **1**, wherein the integrated multifunction sensor is configured for use in at least one of a wearable, a mobile phone, or a watch.

* * * * *

专利名称(译)	移动集成电极多功能传感器和方法		
公开(公告)号	US10231629	公开(公告)日	2019-03-19
申请号	US14/799961	申请日	2015-07-15
[标]申请(专利权)人(译)	马克西姆综合产品公司		
申请(专利权)人(译)	美信集成产品，INC.		
当前申请(专利权)人(译)	美信集成产品，INC.		
[标]发明人	PEI CHENG WEI OLSEN RICHARD I		
发明人	PEI, CHENG-WEI OLSEN, RICHARD I.		
IPC分类号	A61B5/024 A61B5/0205 A61B5/00 A61B5/0408		
CPC分类号	A61B5/02055 A61B5/6898 A61B5/681 A61B5/7435 A61B5/02438 A61B5/0408 A61B5/02433 A61B5/0245 A61B5/0404 A61B5/0428 A61B2562/0209 A61B2562/0257 A61B2562/0271		
优先权	62/041172 2014-08-25 US		
外部链接	Espacenet		

摘要(译)

描述了一种集成的多功能传感器，移动集成传感器装置和过程，其包括传感器，其中传感器主要用于除电极之外的第一目的。在一种实施方式中，集成多功能传感器包括配置为传感器和第一电极的多功能传感器，该多功能传感器包括耦合到传感器的第一侧的盖子，其中盖子包括半导体材料，以及模拟装置连接到盖子;其中多功能传感器被配置为耦合到从第一电极和第二电极接收健康信息的控制器。在一些实施例中，集成多功能传感器可包括集成光学传感器。在一些实施方案中，第二电极可位于移动集成传感器装置中的其他位置且完成差分电路。