



US009693691B2

(12) **United States Patent**
Johnson

(10) **Patent No.:** **US 9,693,691 B2**
(45) **Date of Patent:** **Jul. 4, 2017**

(54) **SYSTEMS AND METHODS FOR DETERMINING SPATIAL LOCATIONS OF PATIENT DATA GATHERING DEVICES**

(71) Applicant: **ZOLL MEDICAL CORPORATION**,
Chelmsford, MA (US)

(72) Inventor: **Guy Robert Johnson**, Gloucester, MA
(US)

(73) Assignee: **ZOLL Medical Corporation**,
Chelmsford, MA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/158,027**

(22) Filed: **Jan. 17, 2014**

(65) **Prior Publication Data**

US 2014/0207371 A1 Jul. 24, 2014

Related U.S. Application Data

(60) Provisional application No. 61/754,409, filed on Jan. 18, 2013.

(51) **Int. Cl.**
A61B 5/22 (2006.01)
A61B 5/00 (2006.01)
A61B 5/11 (2006.01)

(52) **U.S. Cl.**
CPC **A61B 5/0022** (2013.01); **A61B 5/1112** (2013.01)

(58) **Field of Classification Search**
USPC 701/454
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,747,556	B2 *	6/2004	Medema	.....	H04W 64/00	340/286.07
7,624,027	B1 *	11/2009	Stern	.....	G06F 19/322	705/2
8,038,593	B2 *	10/2011	Friedman	.....	A61B 5/0002	600/26
8,139,945	B1 *	3/2012	Amir	.....	H04B 10/1149	340/8.1
8,633,806	B2 *	1/2014	Amir	.....	G01S 13/825	340/10.1
9,000,930	B2 *	4/2015	Pelland	.....	G01S 5/02	340/539.13
9,092,964	B1 *	7/2015	Chan	.....	G08B 21/02	
9,219,984	B1 *	12/2015	Amir	.....	H04W 4/021	
9,298,958	B1 *	3/2016	Amir	.....	G06K 7/10009	
2003/0036683	A1 *	2/2003	Kehr	.....	G06F 19/325	600/300
2007/0229350	A1 *	10/2007	Scalisi	.....	G06F 21/35	342/350
2008/0172173	A1 *	7/2008	Chang	.....	G01C 21/30	701/408

(Continued)

FOREIGN PATENT DOCUMENTS

WO WO 2004074777 A1 * 9/2004
WO WO 2012095829 A2 * 7/2012

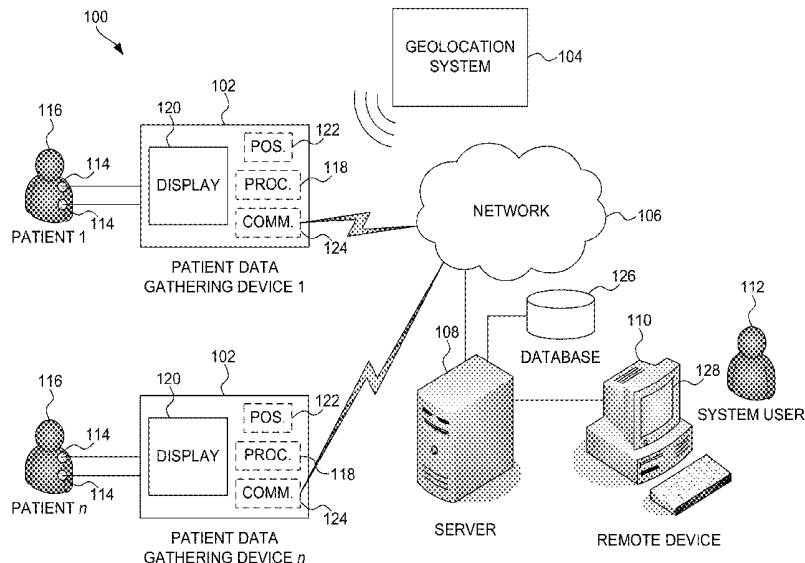
Primary Examiner — Jean-Paul Cass

(74) Attorney, Agent, or Firm — ZOLL Medical Corporation

(57) **ABSTRACT**

A method for determining a spatial location of at least one patient data gathering device includes the steps of receiving at least one signal from a geolocation system and analyzing the at least one signal to determine the spatial location of the at least one patient data gathering device.

13 Claims, 5 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

2009/0262005 A1* 10/2009 McNeill G01S 7/35
342/22
2009/0262006 A1* 10/2009 McNeill G01S 7/35
342/22
2011/0126127 A1* 5/2011 Mariotti G06F 19/321
715/753
2012/0011253 A1* 1/2012 Friedman A61B 5/0002
709/224
2013/0113647 A1* 5/2013 Sentelle G01S 13/32
342/22
2013/0300573 A1* 11/2013 Brown A61B 5/1113
340/870.01

* cited by examiner

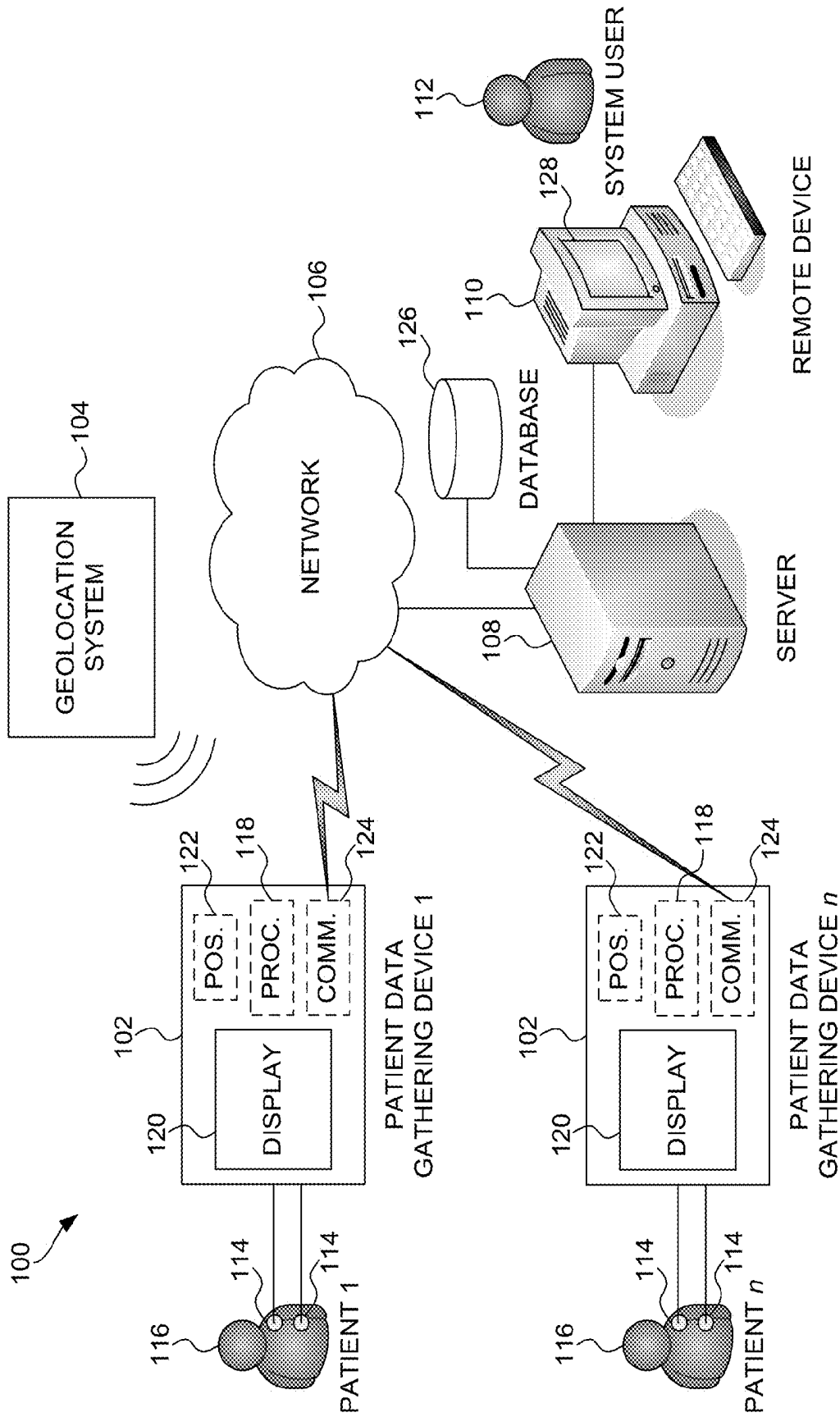


FIG. 1

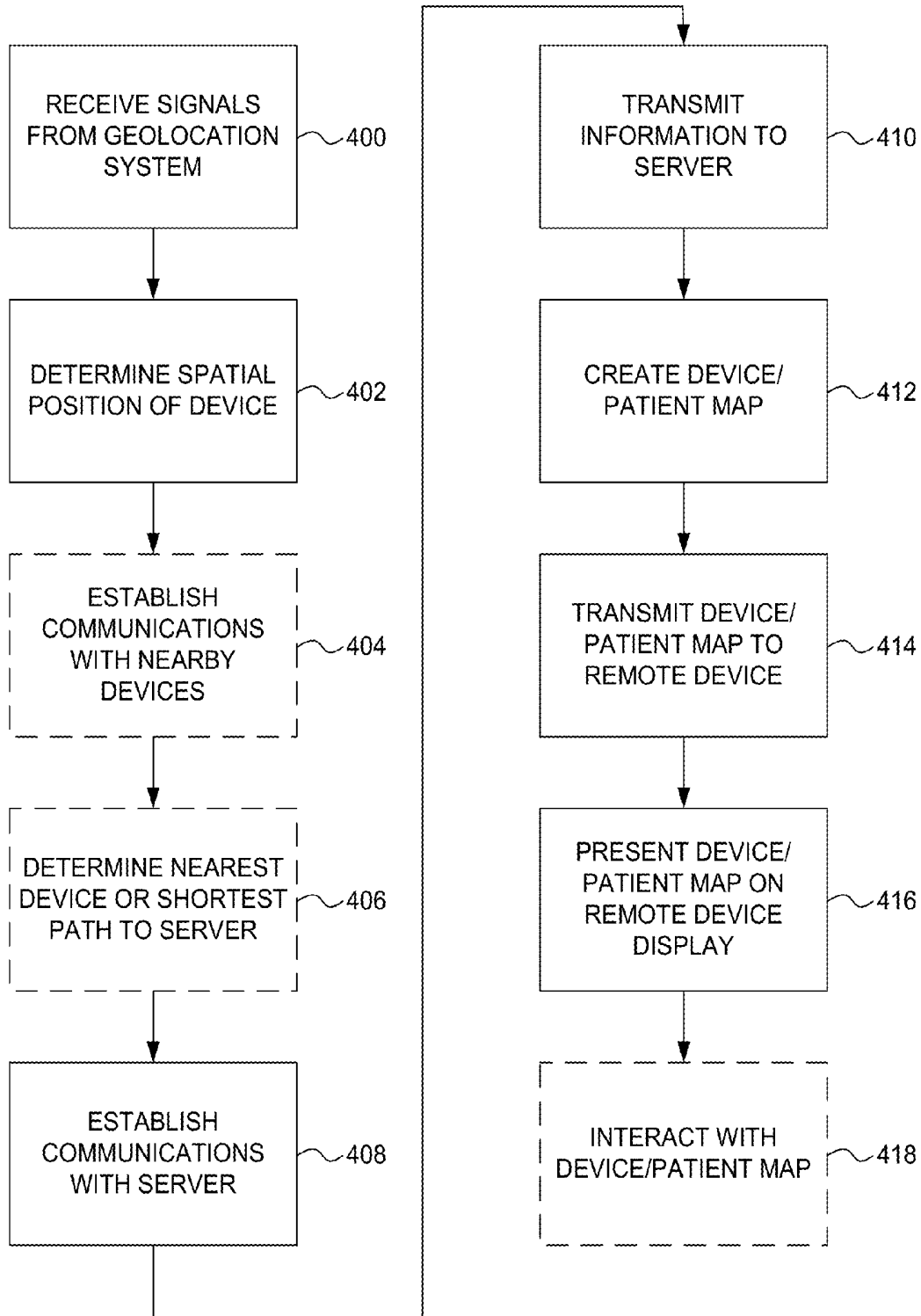


FIG. 4

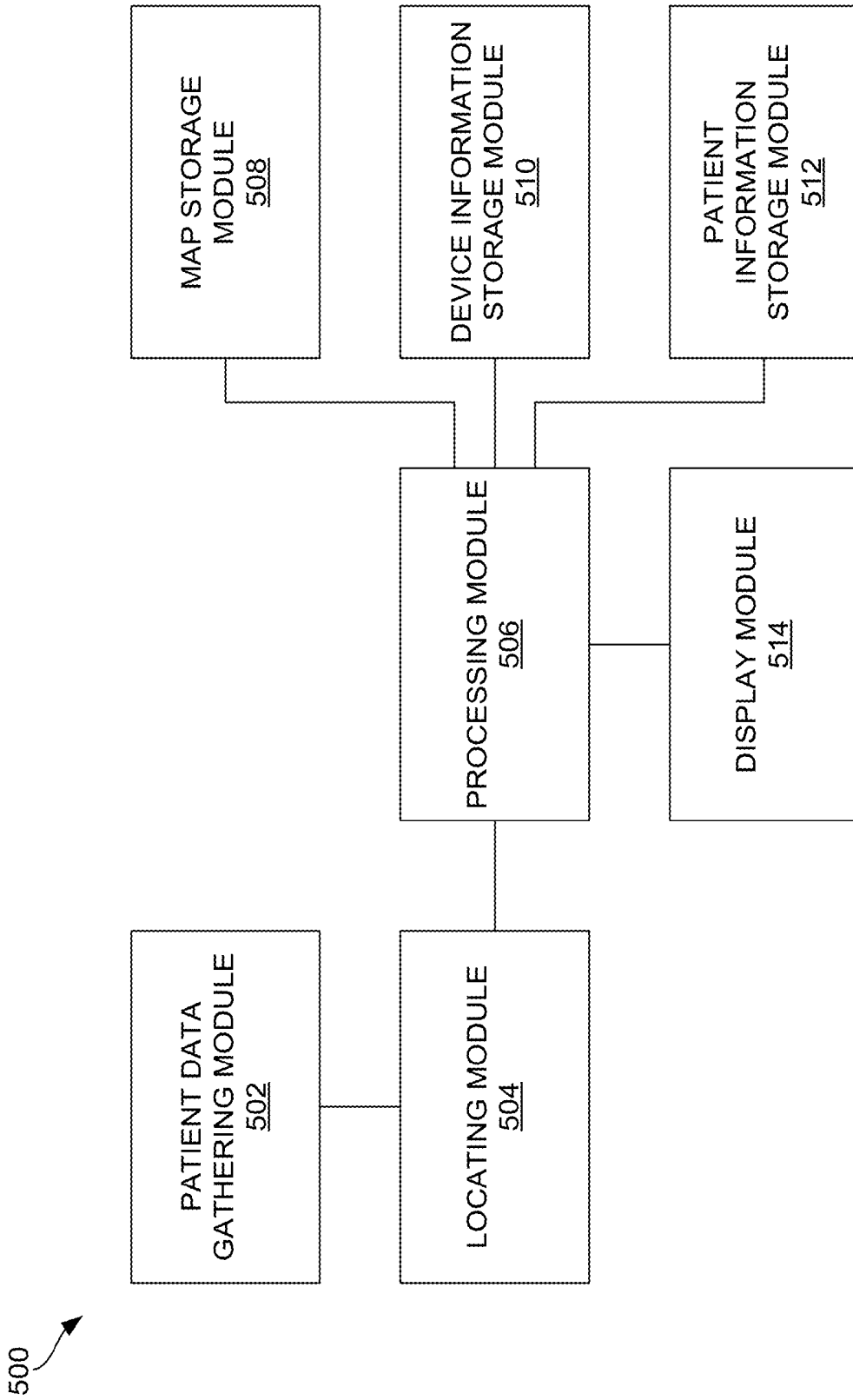


FIG. 5

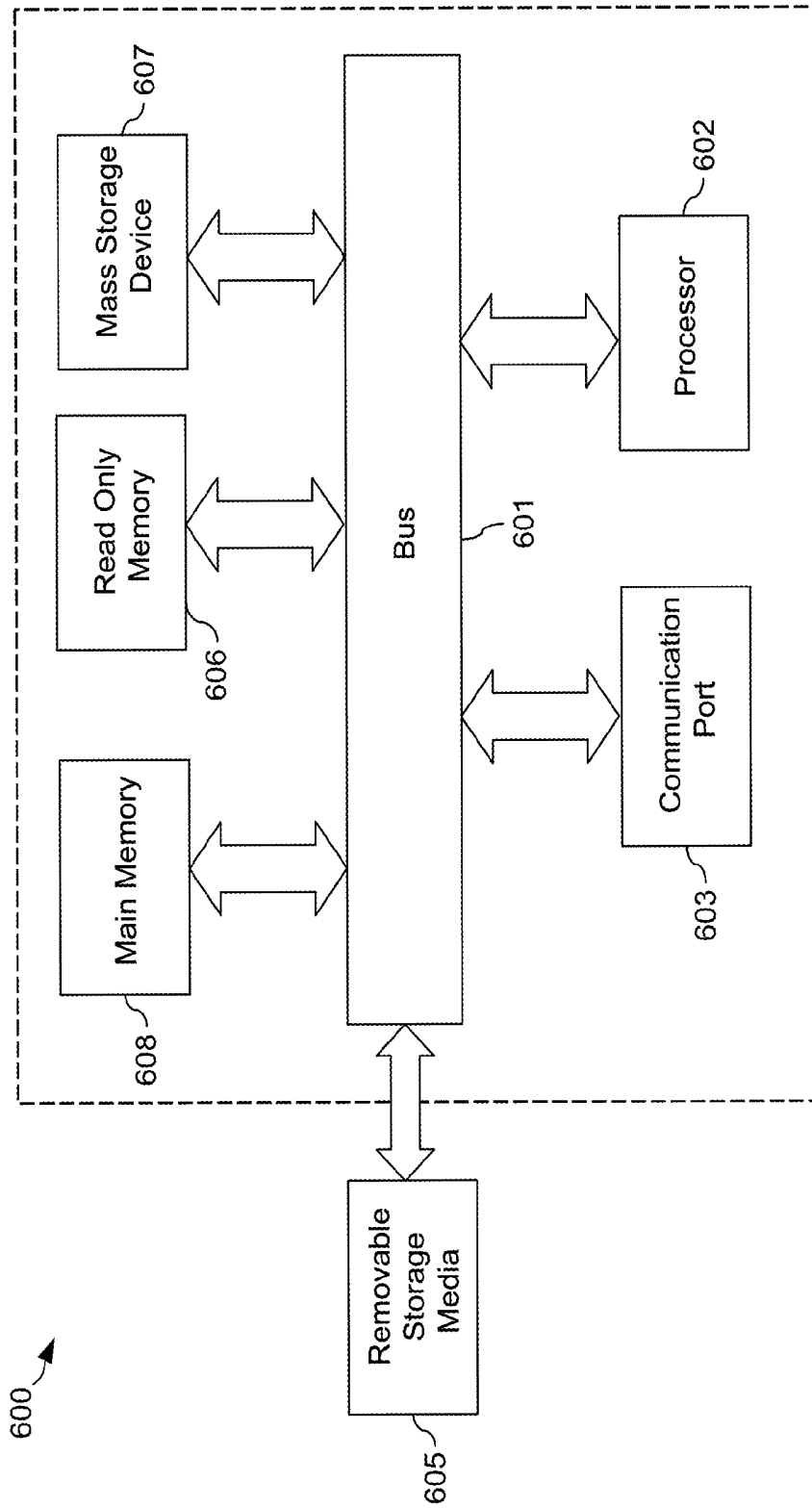


FIG. 6

SYSTEMS AND METHODS FOR DETERMINING SPATIAL LOCATIONS OF PATIENT DATA GATHERING DEVICES

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/754,409, filed on Jan. 18, 2013, which is incorporated herein by reference in its entirety for all purposes.

TECHNICAL FIELD

The present invention relates to systems and methods for determining the spatial location of one or more patient data gathering devices. More specifically, the present invention relates to systems and methods for determining the spatial locations of multiple patient data gathering devices, communicably connecting nearby patient data gathering devices, and presenting the locations of the patient data gathering devices on an electronic map.

BACKGROUND

Patient data gathering devices used in emergency medical service (EMS) applications, for example, defibrillators, are typically complex and expensive. Thus, the number of devices employed in many areas is often relatively low. Nevertheless, the locations of such devices are typically tracked manually (for example, verbally or via an electronic log). Thus, it may be cumbersome to efficiently locate and redirect patient data gathering devices in certain situations, such as mass casualty situations.

Further, patient data gathering devices typically include wireless data transceivers to transmit medical information for storage in a remote medical database. However, some designs lack relatively long-range communication components (such as cellular or Wi-Fi transceivers) and in some situations, such as mass casualty situations, relatively long-range communication methods may be unavailable. In these cases, some patient data gathering devices turn to relatively short-range, device-to-device communication methods (such as near-field communications (NFC), Bluetooth, and the like) to transmit medical information. However, these devices may expend a significant amount of power by attempting to communicate with devices near the edge of their transmission range.

SUMMARY

A method for determining and presenting a spatial location of at least one patient data gathering device according to embodiments of the present invention includes receiving at least one signal from a geolocation system, analyzing the at least one signal to determine the spatial location of the at least one patient data gathering device, receiving an electronic map including the spatial location of the at least one patient data gathering device, generating a device location map by modifying the electronic map to include an icon at the spatial location of the at least one patient data gathering device, and generating a report including the device location map.

A method for determining a spatial proximity of a first patient data gathering device of a plurality of patient data gathering devices relative to second and third patient data gathering devices of the plurality of patient data gathering

devices includes receiving at least one signal from a geolocation system, analyzing the at least one signal to determine the spatial location of the first patient data gathering device, receiving respective spatial locations of the second and third patient data gathering devices, and comparing the spatial location of the first patient data gathering device to the respective spatial locations of the second and third patient data gathering devices to determine a closer of the second and third patient data gathering devices to the first patient data gathering device.

While multiple embodiments are disclosed, still other embodiments of the present invention will become apparent to those skilled in the art from the following detailed description, which shows and describes illustrative embodiments of the invention. Accordingly, the drawings and detailed description are to be regarded as illustrative in nature and not restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a system for determining and displaying the spatial location of one or more patient data gathering devices according to embodiments of the present invention.

FIG. 2 illustrates an exemplary device/patient map created according to embodiments of the present invention.

FIG. 3 illustrates an exemplary image displayed on a patient data gathering device and transmitted to a remote device according to embodiments of the present invention.

FIG. 4 illustrates an exemplary method for determining and displaying the spatial location of a patient data gathering device according to embodiments of the present invention.

FIG. 5 illustrates a system overview for determining and displaying the spatial location of one or more patient data gathering devices according to embodiments of the present invention.

FIG. 6 illustrates an exemplary computer system according to embodiments of the present invention.

While the invention is amenable to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and are described in detail below. The intention, however, is not to limit the invention to the particular embodiments described. On the contrary, the invention is intended to cover all modifications, equivalents, and alternatives falling within the scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION

FIG. 1 illustrates a system **100** for determining and presenting the spatial location of one or more patient data gathering devices **102**. In some embodiments, such location determinations are facilitated by a remote geolocation system **104** (for example, the Global Positioning System (GPS), a cellular geolocation system, a Wi-Fi geolocation system, or the like). The patient data gathering devices **102** communicate with and transmit location information (for example, using cellular data transmissions, Wi-Fi, near-field communications (NFC), Bluetooth, and the like) to a server **108** via a network **106** (for example, the Internet or a mesh network). The server **108** incorporates the location information into a map. The server **108** transmits the map to a remote terminal or device **110** for presentation to a system user **112**.

The patient data gathering devices **102** may be, for example, defibrillators (such as ZOLL® X-Series® or E-Series® devices), automatic external defibrillators (AEDs, such as ZOLL® AED Pro® devices), wearable cardioverter

defibrillators (such as ZOLL® LifeVest® devices), combinations thereof, and the like. Some of the patient data gathering devices **102** may be assigned to patients (that is, currently connected to patients and gathering data), and some of the patient data gathering devices **102** may be unassigned (that is, currently disconnected from patients and not gathering data). For simplicity, the following paragraphs only provide the details for one assigned patient data gathering device **102**. It is to be understood, however, that in some embodiments similar details apply to each of the different types of devices **102**.

The patient data gathering device **102** receives signals from one or more sensors or electrodes **114** coupled to the patient **116**. In some embodiments, a processor **118** uses such signals to monitor, detect, and/or derive or calculate various patient conditions. For example, the processor **118** may monitor, detect, and/or derive or calculate heart rate, blood pressure, temperature, respiration rate, blood oxygen level, end-tidal carbon dioxide level, pulmonary function, blood glucose level, end/or weight. In some embodiments, the patient data gathering device **102** includes a display **120** for presenting data associated with one or more of the above medical parameters. For example, the display **120** may present an electrocardiograph (ECG).

In some embodiments and as shown in FIG. 1, the patient data gathering device **102** includes a positioning device **122**, such as a GPS receiver, to receive signals from the geolocation system **104**. For example, the positioning device **122** may receive signals from multiple GPS satellites of the geolocation system **104**. The positioning device **122** transmits the received signals to the processor **118**. The processor **118** determines the spatial location (for example, longitude and latitude coordinates, elevation/altitude, and the like) of the patient data gathering device **102** by analyzing the signals. The resulting spatial location information is transmitted to the server **108** via the network **106** by using a communication device **124**, such as a cellular data transceiver or a Wi-Fi transceiver.

In some embodiments, the patient data gathering device **102** includes alternative or additional components and/or determines its position in other manners. For example, the position of the patient data gathering device **102** may be determined by cellular signal multilateration, Wi-Fi signal multilateration, accelerometer or gyroscope data, combinations thereof, and the like.

The patient data gathering devices **102** may include different components and/or operate in different manners. In some embodiments, for example, the patient data gathering device **102** includes separate processors (not shown) for analyzing signals received from the sensors **114** and the geolocation system **104**. In some embodiments, the patient data gathering device **102** transmits the signals received from the geolocation system **104** to the server **108** and/or the remote device **110**. The server **108** and/or the remote device **110** then determine the spatial location of the device **102** and optionally transmit the location information to the device **102**.

In addition to transmitting location information, in some embodiments, the patient data gathering device **102** transmits stored device information (for example, the device's type, model number, serial number, device capabilities, assigned setting, such as an ambulance or hospital, and the like) and/or associated patient information (that is, information about the patient **116** to which the device **102** is assigned) to the server **108** via the network **106**. Such patient information may include, for example, the patient's name, age, weight, height, medical history, past and/or real-time

medical data obtained by the patient data gathering device **102**, and the like. In some embodiments, the system **100** may use the ZOLL® RescueNet® Link system to transmit medical data obtained by the patient data gathering devices **102** to the server **108**.

As described briefly above, the network **106** may be, for example, the Internet. As another example, the network **106** may be a "mesh" network in which the patient data gathering devices **102** define network nodes. In such a network, each of the devices **102** directly communicates with at least one other device **102** (for example, via NFC, Bluetooth, and the like). Further, at least one of the devices **102** directly communicates with the server **108** (for example, via NFC, Bluetooth, cellular data transmissions, Wi-Fi, and the like). Thus, the remainder of the devices **102** indirectly communicate with the server **108**. Additional general aspects of mesh networks are described in Poor, Robert; WIRELESS MESH NETWORKS; Sensors (Feb. 1, 2003), which is incorporated herein by reference.

In one aspect of the present systems and methods, a mesh network may be employed if some of the devices **102** do not have, for example, cellular or Wi-Fi capabilities or if cellular or Wi-Fi service is not available to some of the devices **102**. In some embodiments, each device **102** may analyze the location information transmitted by other devices **102** to determine, for example, the nearest adjacent device **102**. Thus, each device **102** may then directly communicate with only the nearest adjacent device **102** to conserve power. In some embodiments, each device **102** may analyze the location information transmitted by other devices **102** to determine, for example, the shortest path for communicating with the server **108**.

The server **108** receives information from the various patient data gathering devices **102**. In some embodiments, a database **126** in communication with the server **108** stores device information (for example, device types, model numbers, serial numbers, device capabilities, assigned setting, and the like). The server **108** associates the appropriate device information with a device's location upon receiving location information and device identification (for example, the device's serial number or the like). Similarly, in some embodiments the database **126** stores patient information (for example, the patient's age, weight, height, medical history, and the like). The server **108** associates the appropriate patient information with a device's location upon receiving location information and patient identification (for example, the patient's name or the like).

Turning now to FIG. 2, the database **126** also stores electronic maps of various areas (for example, states, cities, ZIP codes, and the like). Upon receiving location information from one or more of the devices **102**, the server **108** selects a map **200** including each of the locations. The server **108** uses the map **200** and the location information to create an aggregated device/patient map **202**. Such a map **202** includes one or more unassigned device icons (for example, D1) and/or assigned device/patient icons (for example, P1) disposed on the map **202** according to the associated location information.

In some embodiments, the device/patient map **202** includes a list of the unassigned and/or assigned patient data gathering devices **102**. Such a list may include, for example, arbitrary device and/or device/patient identifiers (such as D1, P1, and the like), device information (such as the type of device, model number, serial number, device capabilities, and the like), patient information (such as the patient's name, age, weight, height, medical history, and the like), spatial locations (such as longitude and latitude coordinates,

elevation/altitude, and the like), distances from a particular facility (such as a nearby hospital), combinations thereof, and the like.

The device and patient icons may take various forms. In some embodiments, for example, the device icons may include a basic shape (such as a rectangle) and arbitrarily assigned distinguishing indicia (such as the term "D1" as shown in FIG. 2). As another example, each patient icon may include a general depiction of a patient (such as shapes representing the head and torso of a person as shown in FIG. 2) and arbitrarily assigned distinguishing indicia (such as the terms "P1", "P2", and "P3" as shown in FIG. 2). As another example, each patient icon may include the associated patient's name or initials.

In some embodiments, the patient icons may take different forms to provide an indication of a patient's medical condition. In some embodiments, the patient icons may include different colors to represent a patient's condition. For example, a green patient icon may represent a patient in stable condition, and a red patient icon may represent a patient in critical condition.

The server 108 transmits the device/patient map 202 to the remote device 110 for presentation on the remote device's display 128. The remote device 110 may be, for example, a desktop computer, a notebook computer, a tablet computer, a mobile telephone, or the like. In some embodiments, the server 108 transmits the same or different device/patient maps 202 to multiple remote devices 110.

In some embodiments, the system user 112 may manipulate the remote device 110 (for example, using a mouse, a keyboard, a touch-sensitive display, and the like) to select a specific area (for example, a city, ZIP code, and the like) for device and patient monitoring. In some embodiments, the remote device 110 may be assigned to continuously monitor a particular area (for example, a city, ZIP code, and the like). In this case, the system 100 may automatically and continuously update the locations of the unassigned and/or assigned patient data gathering devices 102 in the area.

In some embodiments, the system user 112 may manipulate the remote device 110 to interact with the device/patient map 202. For example, the system user 112 may pan or zoom the device/patient map 202 to depict different areas. As another example, the system user 112 may selectively show or hide landmarks (for example, roads, buildings, bodies of water, and the like) on the map 202. In latter case, the map 202 simply includes device and/or patient icons disposed at appropriate locations relative to each other.

In some embodiments, the system user 112 may manipulate the remote device 110 to interact with the device and patient icons. For example, selecting one of the patient icons on the map 202 may cause the remote device's display 128 to present additional patient information. Such information may include, for example, the patient's name, age, weight, height, medical history, past and/or real-time medical data obtained by the patient data gathering device 102, and the like. As another example, selecting one of the patient icons may cause the remote device's display 128 to replicate the image presented on the display 120 of the associated patient data gathering device 102. For example, the display 128 may present an ECG 300 and other medical data as shown in FIG. 3. As yet another example, the display 128 may present real-time medical data obtained by the patient data gathering device 102, and/or the system user may enter a previous time (for example, an earlier date) from which medical data is to be presented.

In some embodiments, the remote device 110 may present information received from the patient data gathering devices

102 in any of the manners described in US Pat. App. Pub. 2011/0172550, which is incorporated herein by reference.

In some embodiments, the system user 112 may manipulate the remote device 110 to add further information to the device/patient map 202. For example, the system user 112 may enter information pertaining to a reported emergency (such as the patient's name, location, medical condition, and the like) to the remote device 110. If the information includes the patient's location, the system 100 may add a patient icon to the appropriate location on the device/patient map 202. Similarly, the system user 112 may enter information pertaining to the location of available resources (for example, ambulances lacking patient data gathering devices 102) or the system 100 may automatically incorporate vehicle location information received from, for example, the ZOLL® RescueNet® Navigator system. Thus, the system 100 may determine the nearest available resources and/or unassigned devices 102 to a reported emergency.

Turning to FIG. 4, an exemplary method for determining and displaying the spatial location of a patient data gathering device 102 according to one embodiment of the invention is as follows. The method begins at step 400 by receiving signals from the geolocation system 104. At step 402, the device 102 analyzes the received signals to determine its spatial position. Optionally, the device 102 then establishes communications with nearby devices 102 at step 404. In some cases, the device 102 receives and analyzes position information from the other devices 102 to determine the nearest device 102 at step 406. Alternatively, the device 102 receives and analyzes position information from the other devices 102 to determine the shortest path for communicating with the server 108 at step 406. At step 408, the device 102 establishes communications (directly or indirectly) with the server 108 via the network 106. The device 102 transmits location information, device information, and patient information to the server 108 at step 410. At step 412, the server 108 creates a map including a device/patient icon disposed according to the location information. The server 108 then transmits the device/patient map 202 to the remote device 110 at step 414. At step 416, the remote device 110 presents the device/patient map 202 on its display 128. Optionally, the system user 112 manipulates the remote device 110 to interact with the device/patient map at step 418.

FIG. 5 illustrates a system 500 overview for determining and displaying the spatial location of one or more patient data gathering devices according to embodiments of the present invention. The system 500 includes a patient data gathering module 502 in communication with a locating module 504. The locating module 504 receives signals from a geolocation system and is in communication with a processing module 506. The processing module 506 is also in communication with a map storage module 508, a device information storage module 510, and a patient information storage module 512. The processing module 506 uses information received from the locating module 504, the map storage module 508, the device information storage module 510, and the patient information storage module 512 to create an interactive device/patient map. The processing module 506 is in communication with a display module 514 for presenting the device/patient map to a system user.

While the system 500 is described as having an ability to communicate with a server 108 over a network, system 500 may alternatively be included on a local device or a group of local devices (for example patient data gathering device 102), or distributed across two or more local devices, which may operate in a similar manner without the involvement of a central server 108. As such, a map may be generated

showing devices within a certain radius, for example 30 feet, 50 feet, 100 feet, 1000 feet, a mile, and the like, even without the involvement of a server **108** and/or a database **126** containing maps. Maps of local geographic or political features may be stored locally on the device on which the map is generated, and/or locally on device **102**. Alternatively, even without any map overlay features, a map may be generated similar to that of FIG. 2, but showing only icons along with information about a relative location of the mapped devices **102**, for example with respect to the device on which the map is generated or some other reference device. Such relative location information may permit rapid location of patient data gathering devices **102** in the field. The relative location information may include, for example, a legend indicating relative distance between icons, or distance information provided as a segment between icons with a textual distance identifier. According to some embodiments, the locating module **504** and the processing module **506** permit an icon to be selected from a map or a list of devices in order to activate a locating process, in which the user is provided with a directional and/or distance indicator to assist a mobile user in finding the particular device **102** represented by the icon.

In addition to two-dimensional maps, such as the map of FIG. 2, the system **100** may also permit three-dimensional location, for example by providing the device's **102** geographic coordinates as well as altitude and/or elevation. This may assist a user in locating one or more devices **102** on different levels of a multi-level building, and/or at different elevations of a hillside or ravine, and may be accomplished for example using GPS data. Such a function may also be particularly useful in a mass casualty situation.

In addition to locating devices **102** when devices **102** are in use (and thereby locating the patients with which the devices **102** are associated), the system **100** may also be configured to locate devices **102** in a similar manner for inventory, planning, and/or event review. For example, the system user **112**, which may be a supervisor of an ambulance crew, may use the information from positioning devices **122** to determine how many devices **102** are deployed in the field and their current locations, in order to make possible real-time location decisions. An ambulance crew may use such location information to determine whether the location of any devices **102** for which it is responsible matches with a location of their vehicle (e.g., to determine if any devices **102** have been left behind in an emergency response). Also, the device's **102** location information may be recorded along with other patient information, to permit a person later reviewing the medical incident data to know where the actual device **102** was located throughout the emergency response, as distinct from the location of the vehicle which was used to respond.

Systems and methods according to the present invention may be used in various situations. For example, the systems and methods may be used in mass casualty situations to locate both assigned and unassigned patient data gathering devices **102** in a particular area (for example, a city, a ZIP code, and the like). This facilitates assigning patient data gathering devices **102** to nearby patients. Further, this facilitates locating assigned patient data gathering devices **102** and, thus, the associated patients. As described above, in some embodiments, the patient icons indicate the medical condition of a patient (for example, by using various colors). Thus, the systems and methods may facilitate determining a chronological order for deployment of further resources (for example, air lift services, ambulance services, and the like). For example, further resources may be first deployed to

relatively critical patients and then to relatively stable patients. Similarly, in some embodiments, the present systems and methods can be used to recognize assignment of a relatively simple data gathering device **102** (for example, a basic life support device employed by fire services) to a patient. Subsequently and if warranted by the patient's condition, a relatively sophisticated data gathering device **102** (for example, an advanced life support device employed by ambulance services) can be directed to the patient.

In the above situations, the system users **112** could be EMS dispatchers. The dispatchers could direct personnel and resources to appropriate locations according to information provided by the present systems and methods. Alternatively or additionally, the system users **112** could be ambulatory personnel (such as ambulance personnel, fire department personnel, and the like) and the remote device **110** could be a portable device (such as a notebook computer, a tablet computer, and the like). Thus, the ambulatory personnel could determine, for example, the location and identity of nearby patients by using the remote device **110**.

In various situations the device's **102** location may be used to approximately determine the location of resources (such as air lift services, ambulance services, and the like) and/or personnel (such as ambulance personnel, fire department personnel, and the like) employing the device **102**.

As another example and particularly if the patient data gathering devices **102** are wearable cardioverter defibrillators, the present systems and methods may be used in hospital settings to monitor the location and movement of one or more ambulatory patients.

As yet another example, the present systems and methods may be used in various settings to identify nearby storage and/or maintenance locations for the devices **102** (for example, a storage area in a hospital). The systems and methods may also provide directions for moving the devices **102** to nearby or previously assigned storage and/or maintenance locations.

FIG. 6 is an exemplary computer system **600** with which embodiments of the present invention may be utilized. According to the present example, the computer system includes a bus **601**, at least one processor **602**, at least one communication port **603**, a main memory **608**, a removable storage media **605**, a read only memory **606**, and a mass storage **607**.

Processor(s) **602** can be any known processor, such as an Intel® Itanium® or Itanium 2® processor(s), or AMD® Opteron® or Athlon MP® processor(s), or Motorola® lines of processors. Communication port(s) **603** can be any of an RS-232 port for use with a modem based dialup connection, a 10/100 Ethernet port, a Gigabit port using copper or fiber, or a wireless communication port, for example. Communication port(s) **603** may be chosen depending on a network such as a Local Area Network (LAN), Wide Area Network (WAN), or any network to which the computer system **600** connects. Main memory **608** can be Random Access Memory (RAM), or any other dynamic storage device(s) commonly known to one of ordinary skill in the art. Read only memory **606** can be any static storage device(s) such as Programmable Read Only Memory (PROM) chips for storing static information such as instructions for processor **602**, for example.

Mass storage **607** can be used to store information and instructions. For example, hard disks such as the Adaptec® family of SCSI drives, an optical disc, an array of disks such as RAID (for example, the Adaptec family of RAID drives), or any other mass storage devices may be used, for example. Bus **601** communicably couples processor(s) **602** with the

other memory, storage and communication blocks. Bus 601 can be a PCI/PCI-X or SCSI based system bus depending on the storage devices used, for example. Removable storage media 605 can be any kind of external hard-drives, floppy drives, flash drives, IOMEGA® Zip Drives, Compact Disc-Read Only Memory (CD-ROM), Compact Disc-Re-Writable (CD-RW), or Digital Video Disk-Read Only Memory (DVD-ROM), for example.

Various modifications and additions can be made to the exemplary embodiments discussed without departing from the scope of the present invention. For example, while the embodiments described above refer to particular features, the scope of this invention also includes embodiments having different combinations of features and embodiments that do not include all of the described features. Accordingly, the scope of the present invention is intended to embrace all such alternatives, modifications, and variations as fall within the scope of the claims, together with all equivalents thereof.

I claim:

1. A computerized system for determining a spatial proximity of a first patient data gathering device of a plurality of patient data gathering devices relative to second and third patient data gathering devices of the plurality of patient data gathering devices, the computerized system comprising a processor configured to:

receive, from a positioning signal receiver communicatively coupled to the processor, data indicative of a spatial location of each of the first patient data gathering device, the second patient data gathering device and the third patient data gathering device, wherein the spatial location comprises one or more of an altitude and an elevation of at least one of the first, second, and third patient data gathering devices;

compare the spatial location of the first patient data gathering device to the respective spatial locations of the second and third patient data gathering devices to determine a closer of the second and third patient data gathering devices to the first patient data gathering device;

receive an electronic three-dimensional geographical map including the respective spatial locations of the first, second, and third patient data gathering devices;

generate a device location map by modifying the electronic three-dimensional geographical map to include a plurality of icons such that a respective icon of the plurality of icons is associated with each of the respective spatial locations of the first, second, and third patient data gathering devices to indicate the one or more of the altitude and elevation of at least one of the first, second, and third patient data gathering devices;

receive, from one or more medical condition sensors communicatively coupled to the processor and associated with one or more of the first, second, and third patient data gathering devices, one or more signals indicative of patient medical data;

determine the patient medical data from the one or more signals indicative of the patient medical data;

generate a report including the device location map;

receive second data indicative of a selection of at least one of the respective icons associated with the first, second, and third patient data gathering devices; and

generate data for display in response to the selection of the icon, the data comprising the patient medical data; wherein the computerized system is in communication with the plurality of patient data gathering devices via a mesh network comprised by the plurality of patient data gathering devices.

2. The computerized system of claim 1, wherein upon determining the closer of the second and third patient data gathering devices to the first patient data gathering device, the processor is further configured to cause the first patient data gathering device to subsequently directly communicate with only the closer of the second and third patient data gathering devices.

3. The computerized system of claim 1 wherein the device location map includes a list including the first, second, and third patient data gathering devices.

4. The computerized system of claim 1 wherein generating the report includes presenting the device location map on an electronic display.

5. The computerized system of claim 1, wherein the processor is further configured to receive the data indicative of the spatial location from a geolocation system including at least one of a Global Positioning System, a cellular geolocation system, and a Wi-Fi geolocation system.

6. The computerized system claim 1, wherein the processor is further configured to replicate an image displayed on at least one of the first, second or third patient data gathering devices for display with the device location map.

7. The computerized system of claim 1 wherein the patient medical data comprises one or more of heart rate, blood pressure, temperature, respiration rate, blood oxygen level, end-tidal carbon dioxide level, pulmonary function, blood glucose level, an electrocardiograph, and weight.

8. The computerized system of claim 1 wherein the positioning signal receiver comprises one or more of a global positioning system receiver, a cellular geolocation system receiver, and a Wi-Fi geolocation system receiver.

9. The computerized system of claim 1 wherein the patient medical data is real-time patient medical data.

10. The computerized system of claim 4, wherein the processor is further configured to select the icon on the device location map to present the patient medical data on the electronic display.

11. The computerized system of claim 1, wherein at least some of the plurality of patient data gathering devices are configured to:

determine a shortest path for indirectly communicating with a server via the plurality of patient data gathering devices; and

subsequently indirectly communicate with the server only via the shortest path.

12. The computerized system of claim 1, wherein the device location map includes depictions of landmarks proximate the spatial location of the at least the first patient data gathering device.

13. The computerized system of claim 1, wherein the processor is further configured to receive the data indicative of the spatial location from a geolocation system including at least one of a Global Positioning System, a cellular geolocation system, and a Wi-Fi geolocation system.

专利名称(译)	用于确定患者数据收集设备的空间位置的系统和方法		
公开(公告)号	US9693691	公开(公告)日	2017-07-04
申请号	US14/158027	申请日	2014-01-17
[标]申请(专利权)人(译)	卓尔医学产品公司		
申请(专利权)人(译)	ZOLL医疗公司		
[标]发明人	JOHNSON GUY ROBERT		
发明人	JOHNSON, GUY ROBERT		
IPC分类号	A61B5/22 A61B5/00 A61B5/11		
CPC分类号	A61B5/0022 A61B5/1112 G06F19/00 G16H40/67		
代理机构(译)	ZOLL医疗公司		
优先权	61/754409 2013-01-18 US		
其他公开文献	US20140207371A1		
外部链接	Espacenet USPTO		

摘要(译)

一种用于确定至少一个患者数据收集设备的空间位置的方法包括以下步骤：从地理定位系统接收至少一个信号并分析所述至少一个信号以确定所述至少一个患者数据收集设备的空间位置。

