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Location detection systems and methods

Abstract

A location detection system identifies the locations of medical devices such as patient support apparatuses and/or patient care devices within a medical facility. The devices communicate via a wired connection to one or more medical facility systems (e.g. nurse call system, computer network, etc.), and/or via a wireless connection to such systems. The location detection system automatically determines location information of the devices and communicates the location information so that the recipient of any outgoing alerts and/or other information sent from the devices is apprised of the location of the particular device sending the alert or other information. Caregivers are thereby able to respond to the correct location of an alert, and software systems such as EMR systems, admission discharge and transfer (ADT) systems, etc. are able to correlate transmitted device data with the location and/or patient assigned to that location.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application claims priority to U.S. patent application Ser. No. 17/178,469 filed Feb. 18, 2021, by inventors Michael Hayes et al. and entitled LOCATION DETECTION SYSTEMS AND METHODS, which in turn claims priority to U.S. patent application Ser. No. 16/720,590 filed Dec. 19, 2019, by inventors Michael Hayes et al. and entitled LOCATION DETECTION SYSTEMS AND METHODS, which in turn claims priority to U.S. patent application Ser. No. 15/988,373 filed May 24, 2018, by inventors

Michael Hayes et al. and entitled LOCATION DETECTION SYSTEMS AND METHODS, which is a divisional of U.S. patent application Ser. No. 15/075,747 filed Mar. 21, 2016, by inventors Michael Joseph Hayes et al. and entitled LOCATION DETECTION SYSTEMS AND METHODS, and which claims priority to U.S. provisional patent application Ser. No. 62/145,276 filed Apr. 9, 2015 by inventors Michael Hayes et al. and entitled LOCATION DETECTION SYSTEMS AND METHODS, the complete disclosures of all of which are hereby incorporated herein by reference.

BACKGROUND

(1) The present disclosure relates to patient support apparatuses (e.g. beds, stretchers, cots, recliners, etc.), and patient care devices, and more particularly to systems and methods for determining and communicating the location of the patient support apparatuses and/or patient care devices within medical facilities.

(2) Patient support apparatuses and patient care devices used in medical facilities often are designed to include one or more alerts states and/or to generate data that is desirably communicated to another location within the healthcare facility (e.g. a nurses' station, an electronic medical records (EMR) server, to mobile devices carried by individuals, etc.). In order for the alerts and/or data to be meaningful to the recipient, it is typically desirable to identify the room number or other location identifier that indicates where the patient support apparatus or patient care device is currently positioned.

SUMMARY

(3) The present disclosure relates to improved manners of identifying the location of medical devices such as patient support apparatuses and/or patient care devices within a medical facility. The various aspects of the disclosure are applicable to devices that communicate via a wired connection to a medical facility system (e.g. nurse call system, computer network, etc.), as well as devices that communicate via a wireless connection to one or more medical facility systems, and in some cases, devices that communicate via both wired and wireless connections. Aspects of the disclosure allow the locations of such devices to be determined automatically and communicated off the device so that the recipient of the outgoing alerts and/or other information from the device is apprised of the location of that particular device. This allows caregivers to respond to the correct location of an alert, as well as software systems (e.g. EMR systems, admission discharge and transfer (ADT) systems, etc.) to correlate the received data with the location and/or patient assigned to that location.

(4) According to one aspect, a location detection system is provided that includes a mobile patient support apparatus and a stationary module positioned at a known location with a healthcare facility. The mobile patient support apparatus has a first unique identifier, a sensor, and a first wireless transceiver. The mobile patient support apparatus is adapted to transmit via the first wireless transceiver the unique identifier and at least one signal that is based on data from the sensor. The stationary module includes a second unique identifier and a second wireless transceiver that is adapted to receive both the first unique identifier and the signal from the mobile patient support apparatus. The stationary module also includes a third wireless transceiver that is adapted to transmit the first and second unique identifiers to a wireless access point of a computer network. The stationary module further includes a wired transceiver that is adapted to transmit the signal over a cable to a nurse call system.

(5) In other embodiments, the stationary module does not transmit the first unique identifier over the cable to the nurse call system, but instead exclusively transmits the first unique identifier over the third wireless transceiver.

(6) The first and second wireless transceivers operate in accordance with the Institute of Electrical and Electronics Engineers (IEEE) standard 802.15.1 (e.g. Bluetooth), and the third wireless transceiver operates in accordance with IEEE standard 802.11 (e.g. WiFi), in some embodiments.

(7) The stationary module further includes, in some embodiments, a fourth wireless transceiver, and

the mobile patient support apparatus further includes a fifth wireless transceiver that is adapted to communicate with the fourth wireless transceiver. In some of such embodiments, the fourth and fifth wireless transceivers are infrared transceivers.

(8) In still other embodiments, the mobile patient support apparatus also includes a sixth wireless transceiver adapted to communicate with the wireless access point of the computer network. In such embodiments, the stationary module is adapted to transmit the second unique identifier to the mobile patient support apparatus using the fourth wireless transceiver, and the mobile patient support apparatus is adapted to not communicate the second unique identifier using the sixth wireless transceiver.

(9) The signal that is transmitted over a cable to a nurse call system indicates that a patient positioned on the mobile patient support apparatus may be exiting the mobile patient support apparatus, in at least one embodiment.

(10) According to other aspects, the wired transceiver is in communication with a first port of the stationary module that is adapted to physically couple to a first end of the cable, and a second end of the cable is adapted to physically couple to a second port of the nurse call system.

(11) In some embodiments, the stationary module is contained within a housing adapted to be mounted to a wall of a hospital room.

(12) In at least one embodiment, the mobile patient support apparatus is a bed, the sensor is a switch adapted to detect activation of a nurse call button on the bed, and the signal indicates that a patient on the bed desires to speak with a nurse. The bed may further include a microphone and be adapted to transmit audio signals from the microphone to the stationary module using the first wireless transceiver. In such cases, the stationary module is adapted to transmit the audio signals to the nurse call system via the wired transceiver.

(13) The bed may further include a scale adapted to detect a patient's weight, wherein the bed is adapted to transmit the patient's weight using the first wireless transceiver. In such cases, the stationary module is adapted to transmit the patient's weight to a server on the computer network using the third wireless transceiver.

(14) In some embodiments, the mobile patient support apparatus further includes a fourth wireless transceiver adapted to communicate with the wireless access point of the computer network. The mobile patient support apparatus transmits status data regarding the mobile patient support apparatus to the computer network using the fourth wireless transceiver.

(15) The location detection system is configured in some embodiments to include a second mobile patient support apparatus. The stationary module is adapted to receive a third unique identifier from the second mobile patient support apparatus and to transmit the second and third unique identifiers to the wireless access point. The stationary module receives the third unique identifier via the third wireless transceiver.

(16) According to another embodiment, a location detection system is provided that includes a stationary module and a mobile patient support apparatus. The stationary module is positioned at a fixed and known location within a facility. The stationary module includes a first unique identifier and a first wireless transceiver adapted to transmit the first unique identifier. The mobile patient support apparatus has a second unique identifier and a second wireless transceiver. The mobile patient support apparatus is adapted to receive the first unique identifier from the stationary module via the second wireless transceiver.

(17) In some embodiments, the mobile patient support apparatus further includes a data table that correlates the first unique identifier to the known location within a healthcare facility. The mobile patient support apparatus transmits the known location to a wireless access point of a computer network using a third wireless transceiver. The data table correlates the first unique identifier to a room number of the healthcare facility. Still further, in some embodiments, the mobile patient support apparatus is adapted to receive the data table from a server coupled to the computer network. The data table is received at the mobile patient support apparatus via the third wireless

transceiver. In some embodiments, the mobile patient support apparatus requests the data table from the server in response to a triggering event.
(18) In other aspects, the mobile patient support apparatus only transmits the known location to the wireless access point of the computer network if the mobile patient support apparatus and the stationary module successfully link to each other utilizing fourth and fifth wireless transceivers. The fourth and fifth wireless transceivers have a shorter communication range than the first and second wireless transceivers.
(19) According to another embodiment, a location detection system is provided that includes a mobile patient support apparatus and a stationary module. The mobile patient support apparatus has a first unique identifier and a first wireless transceiver. The mobile patient support apparatus is adapted to transmit the first unique identifier via the first wireless transceiver. The stationary module is positioned at a fixed location within a healthcare facility and includes a second unique identifier and a second wireless transceiver adapted to receive the first unique identifier from the mobile patient support apparatus. The stationary module also includes a data table that correlates the first unique identifier to the fixed location within the healthcare facility.
(20) In some embodiments, the stationary module is adapted to transmit the fixed location and the first unique identifier to a wireless access point of a computer network using a third wireless transceiver. The stationary module is also adapted to transmit the fixed location to the mobile patient support apparatus via the second wireless transceiver, in some embodiments.
(21) According to other aspects, the stationary module receives the data table from a server coupled to the computer network. The stationary module receives the data table via the third wireless transceiver.
(22) In some embodiments, the transmission of the fixed location to the wireless access point includes transmitting a room number of a room that includes the fixed location.
(23) According to another embodiment, a patient support apparatus system is provided that includes a stationary module, an off-board device, and a patient support apparatus having a support surface for supporting a patient thereon, a first transceiver for communicating with the stationary module, a second transceiver for communicating with the off-board device, and a controller. The controller is adapted to transmit a unique identifier corresponding to the patient support apparatus to both the stationary module and the off-board device. The controller uses the first transceiver to communicate the unique identifier to the stationary module, and the controller uses the second transceiver to communicate the unique identifier to the off-board device.
(24) In some embodiments, the off-board device is a server located on a healthcare facility computer network, the first transceiver is a Bluetooth transceiver, and the second transceiver is a WiFi transceiver. Further, in some embodiments, the stationary module forwards the unique identifier to the server using a third transceiver positioned on-board the stationary module.
(25) The stationary module transmits a unique stationary module identifier to the server, in some embodiments, and the server uses the unique stationary module identifier and the unique identifier to determine the location of the patient support apparatus within the healthcare facility.
(26) According to still another embodiments of the disclosure, a patient support apparatus system is provided that includes an off-board device and a patient support apparatus having a support surface for supporting a patient thereon, a first transceiver for communicating with the off-board device, a second transceiver for communicating with the off-board device, and a controller. The controller is adapted to transmit a first data item to the off-board device using the first transceiver, and to transmit a second data item to the off-board device using the second transceiver. The first data item is different from the second data item.
(27) In some embodiments, the off-board device is a server located on a healthcare facility computer network.
(28) The first data item is a unique identifier corresponding to the patient support apparatus and the second data item is a status of a component of the patient support apparatus, in at least some

embodiments. The status of the component may be any one or more of the following: a position of a siderail, a state of a brake, a height of the support surface, and a state of an exit detection system.
(29) In some embodiments, the patient support apparatus is further adapted to transmit the first data item to the off-board device using the second transceiver.
(30) According to still another embodiment of the disclosure, a patient support apparatus system is provided that includes a stationary module and a patient support apparatus. The stationary module includes a first transceiver, a second transceiver, and a third transceiver. The patient support apparatus includes a support surface for supporting a patient thereon, a fourth transceiver for communicating with the first transceiver of the stationary module, and a controller. The controller is adapted to transmit a data item to the stationary module using the fourth transceiver, and the stationary module is adapted to forward the data item to both a first destination using the second transceiver and to a second destination using the third transceiver.
(31) In some embodiments, the first destination is a headwall connector of a nurse call system, and the second destination is a server located on a healthcare facility computer network. The second transceiver may be a wired transceiver and the third transceiver may be a wireless transceiver.
(32) The data item indicates that an alert has issued regarding the patient support apparatus, in some embodiments.
(33) The patient support apparatus may be further adapted to transmit a second data item to the stationary module using the fourth transceiver, and the stationary module may be further adapted to forward the second data item to only one of the first and second destinations. The second data item is a unique identifier corresponding to the patient support apparatus, in at least some embodiments.
(34) Before the various embodiments disclosed herein are explained in detail, it is to be understood that the claims are not to be limited to the details of operation or to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The embodiments described herein are capable of being practiced or being carried out in alternative ways not expressly disclosed herein. Also, it is to be understood that the phraseology and terminology used herein are for the purpose of description and should not be regarded as limiting. The use of "including" and "comprising" and variations thereof is meant to encompass the items listed thereafter and equivalents thereof as well as additional items and equivalents thereof. Further, enumeration may be used in the description of various embodiments. Unless otherwise expressly stated, the use of enumeration should not be construed as limiting the claims to any specific order or number of components. Nor should the use of enumeration be construed as excluding from the scope of the claims any additional steps or components that might be combined with or into the enumerated steps or components.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is a perspective view of a location detection system for a mobile patient support apparatus according to a first embodiment of the disclosure;
(2) FIG. **2** is a block diagram of the internal components of the various structures of the location detection system of FIG. **1**;
(3) FIG. **3** is a block diagram of the location detection system of FIG. **2** shown with the patient support apparatus implemented as a bed and with the system coupled to an illustrative example of a healthcare facility's information technology (IT) infrastructure;
(4) FIG. **4** is a flowchart of the location detection algorithm followed by the components of the location detection system of FIG. **2**;
(5) FIG. **5** is a block diagram of the location detection system of FIG. **2** expanded to determine the location of multiple patient support apparatuses;

(6) FIG. **6** is a block diagram of a modified location detection system shown with the patient support apparatus implemented as a bed and the system coupled to an illustrative example of a healthcare facility's IT infrastructure;
(7) FIG. **7** is a flowchart of the location detection algorithm followed by the components of the modified location detection system of FIG. **6**; and
(8) FIG. **8** is a block diagram of the internal components of the various structures of yet another modified location detection system.
DETAILED DESCRIPTION OF THE EMBODIMENTS
(9) An illustrative example of a location detection system **20** according to a first embodiment is shown in perspective view in FIG. **1**. Location detection system **20** includes a mobile patient support apparatus **22** having a mobile wireless unit **24** and a stationary module **26**. For purposes of visual description herein, patient support apparatus **22** is shown in the accompanying drawings as a hospital bed, but it will be understood that patient support apparatus **22** can be alternatively implemented as a cot, stretcher, chair, recliner, or other apparatus that is capable of supporting a person. Indeed, location detection system **20** can be applied to determine the location of other types of medical devices besides patient support apparatuses, such as, but not limited to, thermal management systems such as shown in commonly assigned U.S. patent application Ser. No. 14/282,383 filed May 20, 2014 by inventors Christopher J. Hopper et al. and entitled THERMAL CONTROL SYSTEM, the complete disclosure of which is hereby incorporated herein by reference.
(10) Patient support apparatus **22** of FIG. **1** includes a support surface **28** on which a mattress **30** is positioned to allow a person to lie or sit thereon. Patient support apparatus **22** further includes a base **32** having a plurality of wheels **34** that allow patient support apparatus **22** to be moved to different locations. Still further, patient support apparatus **22** of FIG. **1** includes a headboard **36**, a footboard **38**, and a plurality of siderails **40**.
(11) The construction of patient support apparatus **22** may take on a wide variety of different forms. In some embodiments, other than the components described below, patient support apparatus **22** is constructed in any of the manners described in commonly assigned, U.S. Pat. No. 8,689,376 issued Apr. 8, 2014 by inventors David Becker et al. and entitled PATIENT HANDLING DEVICE INCLUDING LOCAL STATUS INDICATION, ONE-TOUCH FOWLER ANGELA ADJUSTMENT, AND POWER-ON ALARM CONFIGURATION, the complete disclosure of which is hereby incorporated herein by reference. In other embodiments, those components of patient support apparatus **22** not described below are constructed in any of the manners described in commonly assigned, U.S. patent application Ser. No. 13/775,285 filed Feb. 25, 2013 by inventors Guy Lemire et al. and entitled HOSPITAL BED, the complete disclosure of which is also hereby incorporated herein by reference. Still further, in other embodiments, those components of patient support apparatus **22** not described below are constructed in any of the manners disclosed in commonly assigned, U.S. patent application Ser. No. 14/212,009 filed Mar. 14, 2014 by inventors Christopher Hough et al., and entitled MEDICAL SUPPORT APPARATUS. In still other embodiments, patient support apparatus **22** takes on other constructions.
(12) As shown in FIG. **1**, patient support apparatus **22** further includes mobile wireless unit **24**. Mobile wireless unit **24** is adapted to wirelessly communicate with stationary module **26**. Stationary module **26** is mounted to a fixed and known location within a healthcare facility, such as, but not limited to, a headwall **42** of a room **44**. As will be discussed in greater detail below, mobile wireless unit **24** and stationary module **26** are adapted to establish a communication link that allows the location of patient support apparatus **22** within the facility to be determined and/or communicated to one or more off-board devices/systems. In one embodiment, stationary module **26** includes a unique identifier that is transmitted to a wireless access point **46** of the healthcare facility's network **48** (FIG. **3**). Stationary module **26** also receives a patient support apparatus identifier that corresponds to a unique patient support apparatus **22** when the patient support

apparatus **22** is positioned within close proximity (e.g. within about 5-10 feet) to stationary module **26**. Stationary module **26** also forwards this unique identifier to the wireless access point **46**. One or more servers **50** on the computer network **48** include a map or data table that correlates the location of each stationary module **26** with each room, bed bay, or other specific location within the healthcare facility. Upon receipt of the unique stationary module identifier **98** and the unique patient support apparatus identifier, the server **50** consults the map or data table and determines that that particular patient support apparatus **22** is in the location of the particular stationary module **26** that transmitted the identifiers. In at least one embodiment, as will be discussed further below with respect to FIG. **3**, the patient support apparatus **22** does not send any additional data to the stationary module **26** that is forwarded to server **50** other than the unique identifier or patient support apparatus **22**. Any further data from patient support apparatus **22** that is to be forwarded to server **50**, or another device on network **48**, is forwarded from patient support apparatus **22** directly to wireless access point **46** without passing through stationary module **26**.
(13) One example of the internal components of both mobile wireless unit **24** and stationary module **26** is shown in FIG. **2**. As can be seen, mobile wireless unit **24** includes a controller **52** that is in electrical communication with a radio module **54**, as well as a headwall hardware interface **56**, a mobile locator transceiver **58**, a main patient support apparatus controller **60**, an audio amplifier **62**, a microphone **64**, and a display **66**. Audio amplifier **62**, in turn, is in electrical communication with one or more speakers **68**. Controller **52** of mobile wireless unit **24**, as well as main controller **60** of patient support apparatus **22**, may take on a variety of different forms, such as, but not limited to, commercially available off-the-shelf microcontrollers.
(14) For example, in one embodiment, controller **52** is any one of the i.MX family of system-on-chip (SoC) processors, and main controller **60** is anyone of the Kinetis K60 family of microcontroller units (MCUs), both of which are marketed by Freescale Semiconductor of Austin, Texas Other types of commercially available microcontrollers may also be used. Still further, controllers **52** and **60** may take on still other forms, such as any combination of any one or more microprocessors, field programmable gate arrays, systems on a chip, volatile or nonvolatile memory, discrete circuitry, and/or other hardware, software, or firmware that is capable of carrying out the functions described herein, as would be known to one of ordinary skill in the art. Such components can be physically configured in any suitable manner, such as by mounting them to one or more circuit boards, or arranging them in other manners, whether combined into a single unit or distributed across multiple units. The instructions followed by controllers **52** and **60** in carrying out the functions described herein, as well as the data necessary for carrying out these functions, are stored in one or more accessible memories (not shown).
(15) Main controller **60** is responsible for carrying out the overall operations of patient support apparatus **22**, while controller **52** is responsible for carrying out the communication between patient support apparatus **22** and stationary module **26**. In some embodiments, a single controller that combines the functions of main controller **60** and controller **52** is used. In the embodiment shown in FIG. **2**, main controller **60** is in communication with one or more indicators scale/exit detection system **70**, one or more sensors **72**, and one or more motors **74**. Scale/exit detection system **70** is adapted to measure the weight of a patient support on patient support apparatus **22** and/or to detect when the patient is about to exit, or has exited, patient support apparatus **22**. In at least one embodiment, scale/exit detection system **70** is a combined scale and exit detection system that is constructed and designed in the manner disclosed in commonly assigned U.S. Pat. No. 5,276,432 issued to Travis and entitled PATIENT EXIT DETECTION MECHANISM FOR HOSPITAL BED, the complete disclosure of which is hereby incorporated herein by reference.
(16) Sensors **72** include sensors that are adapted to detect parameters of patient support apparatus **22**, such as, but not limited to, the status of a brake for wheels **34**; the height of support surface **28** relative to base **32**; the status (raised or lowered) of one or more siderails **40**; the armed or disarmed state of exit detection system **70**; and/or other parameters. Motors **74** provide movement to one or

more components of patient support apparatus **22**, such as, but not limited to, raising and lowering the height of support surface **28** relative to base **32**, and/or raising and lowering one or more sections of support surface **28**. As will be discussed in greater detail below, main controller **60** is adapted to forward information from one or more of sensors **72** to controller **52** of mobile wireless unit **24** for forwarding to either stationary module **26** or to wireless access point **46**.

(17) Controller **52** of mobile wireless unit **24**, in addition to being in communication with main controller **60**, is also in communication with audio amplifier **62** for purposes of delivering audio signals to speakers **68**. Such audio signals include the audio signals received by mobile wireless unit **24** from stationary module **26** that correspond to the voice of a caregiver who is speaking from a remote location, such as a nurses' station **78**, to an occupant of patient support apparatus **22**. Further, in some embodiments, controller **52** may send audio signals to audio amplifier **62** and speakers **68** that are received from other sources, such as from a server (e.g. server **50** or some other server) located on local area network **48** of the healthcare facility in which patient support apparatus **22** is positioned.

(18) When an occupant of patient support apparatus **22** wishes to speak to a caregiver at a remote location via the facility's nurse call system **76**, he or she speaks into microphone **64**. Controller **52** digitizes the audio signals from microphone **64** and forwards them to either radio module **54** or to headwall interface **56**, depending upon what type of wired connection exists at a nearby headwall connector **80**. A cable **82** runs from headwall connector **80** to either stationary module **26** or to patient support apparatus **22**, depending upon how a particular healthcare facility has decided to implement location detection system **20**. If cable **82** runs between patient support apparatus **22** and headwall connector **80**, controller **52** forwards the digitized audio signals to headwall hardware interface **56**, which in turns forwards them over cable **82** to headwall connector **80**. If cable **82** runs between headwall connector **80** and stationary module **26**, then controller **52** forwards the digitized audio signals to radio module **54**, which in turn wirelessly transmits them to stationary module **26**. Stationary module **26** then forwards them to headwall connector **80** via cable **82**.

(19) Radio module **54** detects when a wireless link exists between itself and stationary module **26**. A message indicating the existence or non-existence of this link is forwarded by radio module **54** to controller **52**. Similarly, headwall hardware interface **56** also detects when a wired link (e.g. cable **82**) is present between interface **56** and headwall connector **80**. Headwall hardware interface **56** forwards a message to controller **52** indicating the existence or non-existence of this link. Controller **52** utilizes these messages from radio module **54** and interface **56** to determine how to route data that is to be transmitted off of patient support apparatus **22**.

(20) Headwall connector **80** is part of, or electrically coupled to, a conventional nurse call system **76**. Headwall connector **80** is a conventional connector that often includes 37 pins adapted to be inserted into 37 mating sockets of cable **82**, or vice versa. Such 37 pin connections are one of the most common types of connectors found on existing headwalls of medical facilities for making connections to the nurse call system **76** and/or environmental controls **84** (e.g. television, temperature, curtains, etc.). Such 37 pin connectors, however, are not the only type of connectors, and it will be understood that headwall connector **80** can include a different number of pins.

(21) Mobile wireless unit **24** communicates wirelessly with stationary module **26** via radio module **54**. In the embodiment illustrated in FIG. **2**, radio module **54** includes four separate transceivers: a Bluetooth transceiver (IEEE 802.15.1) **86***a*, a WiFi transceiver (IEEE 802.11) **88***a*, a ZigBee transceiver (IEEE 802.15.4) **90***a*, and a 900 MHz transceiver **92***a*. It will be understood that the number of transceivers within radio module **54** can vary from the four shown in FIG. **2**, and that the protocols used for the transceivers can take on different forms than those illustrated in FIG. **2**. Radio module **54** communicates wirelessly with a radio module **94** contained within stationary module **26**. In the illustrated embodiment, radio module **94** includes two transceivers: a Bluetooth transceiver **86***b* that communicates with Bluetooth transceiver **86***a* of mobile wireless unit **24** and a WiFi transceiver **88***b* that communicates with wireless access point **46** (FIG. **3**). In some alternative

embodiments, stationary module **26** also includes a ZigBee transceiver **90***b* that communicates with ZigBee transceiver **90***a* of mobile wireless unit **24** and a 900 MHz transceiver **88***b* that communicates with 900 MHz transceiver **88***a* of mobile wireless unit **24**.

(22) In addition to the components previously described, mobile patient support apparatus **22** includes a unique identifier **96** (FIG. **2**) that distinguishes one patient support apparatus **22** from another, and also, in some embodiments, distinguishes a specific patient support apparatus **22** from other types of patient care devices that may be utilizing location detection system **20**. Stationary module **26** also includes a unique identifier **98** that distinguishes each particular stationary module **26** from other stationary modules **26**. At the time of installation of location detection system **20**, stationary modules **26** are mounted at fixed locations throughout a healthcare facility, such as, but not limited to, headwalls **42** in patient rooms. Once mounted, the locations of each stationary module **26** within the facility are surveyed and stored electronically in a data table or map. As will be discussed more below, this data table or map is stored, in at least some embodiments, on server **50**. In other embodiments, however, it is stored elsewhere and/or duplicated and stored in multiple locations.

(23) Mobile patient support apparatus **22** and stationary module **26** each further include a short range locator transceiver **100***a* and **100***b*, respectively. In at least one embodiment, short range locator transceivers **100***a* and **100***b* are infrared transceivers that are able to communicate with each other when they are positioned in line of sight with each other, and within a relatively short range of each other, such as, but not limited to, five to ten feet. Short range locator transceivers **100***a* and **100***b*, identifiers **96** and **98**, and the data table or map are used to determine the location of patient support apparatus **22** within a facility in several different manners, one of which is explained in more detail below with reference to FIGS. **3** and **4**.

(24) FIG. **3** illustrates an illustrative example of a first embodiment of a location detection system **20** that is configured for determining the location of a patient support apparatus **22** that is implemented as a bed. FIG. **4** illustrates a flowchart of steps taken by various components of the location detection system **20** of FIG. **3** that are used to determine which room **44** (and/or bay) patient support apparatus **22** of FIG. **3** is located in. More specifically, FIG. **4** illustrates a first location detection algorithm **104** executed by location detection system **20** according to a first embodiment. Location detection algorithm **104** includes three components: a patient support apparatus algorithm **106**, a stationary module algorithm **108**, and a server algorithm **110**. Patient support apparatus algorithm **106** is executed by controller **52** of patient support apparatus **22**. Stationary module algorithm **108** is executed by a controller **112** (FIG. **2**) on board stationary module **26**. Server algorithm **110** is executed by a server located outside of room **44**, such as, but not limited to, server **50**.

(25) Location detection algorithm **104** begins at an initial step **114** when patient support apparatus **22** detects a triggering event. The specific triggering event may vary. In some embodiments, the triggering event is the application of the brakes on board patient support apparatus **22**. In other embodiments, the triggering event is the plugging in of an AC power cable on board the patient support apparatus **22** to an AC wall outlet. In still other embodiments, the both of these events are triggering events and/or still other triggering events are used.

(26) Regardless of the specific triggering event, once it is detected by patient support apparatus **22**, controller **52** moves onto step **116** where it sends out an interrogation signal. The interrogation signal is sent out via short range locator transceiver **100***a* and is configured to be detected by a stationary module **26**. Because it is sent out via short range transceiver **100***a*, it is only detected by a stationary module **26** if the patient support apparatus **22** is within close proximity to stationary module **26** (e.g. within the same room, or adjacent a particular bay within a room if the room is semi-private and adapted to accommodate multiple patients). The interrogation signal includes patient support apparatus ID **96**.

(27) Short range locator transceiver **100***b* of stationary module **26** receives the interrogation signal

from patient support apparatus **22** and passes it to controller **112**. Controller **112** executes stationary module algorithm **108** in response to receipt of this interrogation signal. Controller **112** begins this algorithm at step **118**, where it responds to the interrogation signal. This response is sent from stationary module **26** via short range locator transceiver **100***b*. In at least one embodiment, this response includes the patient support apparatus identifier **96** that was received at stationary module **26** from patient support apparatus **22** in the interrogation message. This identifier **96** is used to address the response to the specific patient support apparatus **22** that broadcast the interrogation signal at step **116**. This ensures that, in the unlikely event that multiple patient support apparatuses **22**, or other medical devices, are within communication range of stationary module **26**, the response message is processed by only the originator of the interrogation message.

(28) After responding to the interrogation message at step **118**, controller **112** of stationary module **26** proceeds to step **120** where it transmits both the patient support apparatus identifier **96** and its stationary module ID **98** to server **50**. This transmission is done wirelessly, in at least one embodiment. More specifically, in at least one embodiment, controller **112** uses WiFi transceiver **88***b* to transmit the identifiers **96** and **98** from stationary module **26** to a wireless access point **46** (FIG. **3**) of healthcare facility network **48**. Once the identifiers **96** and **98** reach access point **46**, they are forwarded via the internal routing procedures of network **48** to server **50**, which is part of the network **48**.

(29) Server **50** begins server algorithm **110** at step **122** when it receives the identifiers **96** and **98** from stationary module **26** via network **48** and wireless access point **46**. Server **50** uses the identifiers **96** and **98** to determine the location of the patient support apparatus **22** within the healthcare facility at step **124**. This is done with reference to the data table or map described previously that was generated during installation of stationary modules **26**. As noted, this data table identifies the room and/or bays of each stationary module **26** with the healthcare facility. When server **50** receives a particular pair of identifiers **96** and **98**, its looks in the table to determine where in the healthcare facility the stationary module **26** having that particular identifier **98** is located. Once the location of that particular stationary module **26** is identified, server **50** associates that location with the patient support apparatus **22** having the identifier **96** that was transmitted with the identifier **98**. In other words, upon receipt of a message from a particular stationary module **26** wherein the message includes that particular stationary module identifier **98** and a corresponding patient support apparatus identifier **96**, server **50** concludes that the particular patient support apparatus **22** having ID **96** is located at the same location as that particular stationary module **26**. This conclusion is justified because, as noted earlier, patient support apparatus **22** is only able to communicate with stationary module **26** when it is within close range, and indeed, is unable to communicate with other stationary modules **26** that may be within the same room, but are positioned at other bays or other designated areas. Thus, the fact that patient support apparatus **22** was able to forward its ID **96** to module **26**, which in turn forwarded it to server **50**, is an indication that patient support apparatus is located close to module **26**.

(30) Returning to the patient support apparatus algorithm **106**, controller **52** of patient support apparatus **22** proceeds to step **126** after transmitting its interrogation signal at step **116**. At step **126**, patient support apparatus **22** awaits receipt of a message from stationary module **26** acknowledging receipt of its interrogation signal. Once patient support apparatus **22** receives this acknowledgement at step **126**, controller **52** of patient support apparatus **22** considers patient support apparatus **22** and stationary module **26** to be linked together.

(31) After this linkage is established, controller **52** moves to step **128** where it transmits patient support apparatus data to server **50** via WiFi transceiver **88***a* (FIGS. **3** and **4**) and wireless access point **46**. Such data includes status data regarding any one or more of the following components of patient support apparatus **22**: siderails **40** (e.g. up or down), a brake for wheels **34** (e.g. braked or unbraked), support surface **28** (e.g. its height), scale/exit detection system **70** (e.g. whether the system is armed, disarmed, alerting, or not alerting), sensors **72**, motors **74**, and still other

components. Such data may also include data regarding the patient, such as the patient's weight, the patient's vital signs, one or more therapies or protocols performed on the patient while on or near the patient support apparatus **22**, and other patient data. Regardless of its specific content, the transmission of such data by patient support apparatus **22** at step **128** includes the transmission of patient support identifier **96**.

(32) In addition to transmitting patient support status at step **128** to server **50**, controller **52** of patient support apparatus **22** also transmits nurse call audio and alerts to nurse call system **76**, as appropriate. The transmission of such audio and/or alerts takes place in one of two different manners. When a cable **82** is connected between headwall hardware interface **56** of patient support apparatus **22** and headwall connector **80**, controller **52** transmits the patient support apparatus status data at step **130** first to headwall hardware interface **56**, which forwards the information via cable **82** to headwall connector **80**, and from there it is passed to nurse call system **76**. Alternatively, if a cable **82** is connected between stationary module **26** and headwall connector **80**, controller **52** transmits the patient support apparatus status data at step **130** first to radio module **54**, which forwards the data wirelessly to radio module **94** of stationary module **26**. (This latter situation is illustrated in FIG. **3**, although it will be understood that the location of cable **82** in FIG. **3** can be modified to extend directly from patient support apparatus **22** to connector **80**). From radio module **94**, controller **112** of stationary module **26** forwards the data to a headwall hardware interface **132** of stationary module **26**. Headwall hardware interface **132** forwards the data via cable **82** to connector **80**, which then passes the data to nurse call system **76**. In at least one embodiment, the transmission of such data from radio module **54** to radio module **94** takes place via a Bluetooth protocol (e.g. IEEE 802.15.1).

(33) At step **134** of server algorithm **110**, server **50** receives the data from patient support apparatus **22**. After receiving this data, server **50** proceeds to step **136** where it associates the data it received at step **134** with either the location of stationary module **26** or a particular patient associated with patient support apparatus **22**. Such location association is carried out using the pairing of identifiers **96** and **98** that were received by server **50** at step **122**. That is, when server **50** receives identifiers **96** and **98** at step **122**, it knows that the patient support apparatus **22** with the identifier **96** is located at the location of stationary module **26**, and that any future data received from the patient support apparatus **22** with identifier **96** at step **134** is data coming from the location of the stationary module **26** having the identifier **98**.

(34) If server **50** associates the data received at step **136** with a particular patient, rather than a location, it does so by consulting another database that maintains a log of the current locations of particular patients within the healthcare facility. This database may be stored in another server on network **48**, such as an Admission, Discharge, and Tracking (ADT) server, or some other server, which forwards the relevant information to server **50**. In other embodiments, this database may be stored elsewhere. Regardless of its location, server **50** uses this database correlating patients to locations to associate the data received at step **136** with a particular patient.

(35) Once the data received at step **136** is associated with either a location or a patient (or both), server **50** proceeds to step **138** where it stores the received data and/or forwards it to one or more other network devices (e.g. servers). For example, in at least one embodiment, server **50** is configured to automatically forward patient information to an electronic medical records (EMR) server. In such an embodiment, server **50** associates the incoming data from a particular patient support apparatus **22** at step **134** with a patient identifier at step **136**. Once associated, server **50** forwards this data to the EMR server for entry into that particular patient's electronic medical record.

(36) In the embodiments shown and described with respect to FIGS. **3** and **4**, the stationary module identifier **98** is never forwarded from patient support apparatus **22** to server **50** via the WiFi transceiver **88***a* on-board patient support apparatus **22**. Instead, as noted, stationary module identifier **98** is forwarded to server **50** from stationary module **26** itself.

(37) From the description provided herein of the location detection system **20** of FIGS. **3** and **4**, it can be seen that patient support apparatus **22** forwards its identifier **96** to two different entities using two different types of transceivers. That is, it forwards its identifier **96** to short range locator transceiver **100***b* using its own short range locator transceiver **100***a*, and it also forwards its identifier **96** to server **50** via WiFi transceiver **88***a* and wireless access point **46**. Although forwarded to two different entities using two different communication protocols, the identifier **96** arrives at the same destination: server **50**. Server **50**, as noted above, uses the identifier **96** to determine the location of the patient support apparatus **22** using the message received from stationary module **26**. Server **50** also uses the identifier to determine what location and/or patient to associate the data with that it receives from patient support apparatus **22** at step **134**.
(38) It will be understood that, in a typical healthcare facility, server **50** will be in communication with a plurality of stationary modules **26** and associated patient support apparatuses **22**. One such example is shown in FIG. **5**. Room **44** of FIG. **5** includes a first patient support apparatus **22***a* and a second patient support apparatus **22***b*. Patient support apparatus **22***a* and patient support apparatus **22***b* each individually carry out algorithm **106** (FIG. **4**). Similarly, stationary modules **26***a* and **26***b* each individually carry out algorithm **108**. Server **50**, in turn, carries out algorithm **110** with respect to each of these different support apparatuses **22***a*, **22***b*, and modules **26***a*, **26***b*. That is, server **50** determines the locations of each of support apparatuses **22***a* and **22***b* and associates the data received from each of them at step **134** either with their location or with the patient who is associated with support apparatuses **22***a* and **22***b*. Location detection system **20** can, of course, be applied to facilities having more than two patient support apparatuses **22**. Indeed, location detection system **20** can be utilized with other devices besides patient support apparatuses **22**, as mentioned previously.
(39) Another embodiment of a location detection system **20***a* is depicted in diagram form in FIG. **6**. The location detection algorithm **104***a* followed by the components of location detection system **20***a* are shown in the flowchart of FIG. **7**. Those components of location detection system **20***a* that are the same as the components of location detection system **20** are labeled herein with the same reference numbers as system **20**. Similarly, those steps of algorithm **104***a* that are the same as the steps of algorithm **104** are labeled with the same reference numbers. Those components or steps of system **20***a* and algorithm **104***a* that have been modified in some fashion as compared to system **20** and/or algorithms **104** have been labeled with the same reference number followed by the letter “a.” Finally, those components or steps of system **20***a* and algorithm **104***a* that are completely new have been provided a new reference number.
(40) Location detection system **20***a* differs structurally from location detection system **20** in that patient support apparatus **22***c* does not include a WiFi transceiver **88***a*. Instead, patient support apparatus **22***c* communicates data to server **50** using stationary module **26** as an intermediary. This is described in greater detail below with respect to location detection algorithm **104***a*.
(41) Location detection algorithm **104***a* differs from location detection algorithm **104** in that it includes modified steps **128***a*, **120***a*, and **122***a*, as well as new step **140**. With reference to FIG. **7**, algorithm **104***a* begins with a patient support apparatus algorithm **106***a* at step **114**, which is the same as step **114** of algorithm **104**, and need not be described further. Patient support apparatus algorithm **106***a* then proceeds to steps **116** and **126**, which are the same as previously described. Patient support algorithm **106***a* differs from algorithm **106** when it reaches modified step **128***a*. At step **128***a*, patient support apparatus transmits the patient support apparatus data wirelessly to stationary module **26** using, in at least one embodiment, Bluetooth transceiver **86***a*. This differs from step **128** where patient support apparatus **22** transmits its patient support apparatus data to wireless access point **46** (and from there to server **50**) using WiFi transceiver **88***a*. Thus, algorithm **106***a* differs from algorithm **106** in that patient support apparatus **22***c* transmits its data to stationary module **26** using a Bluetooth transceiver **86***a*, rather than to wireless access point **46** using a WiFi transceiver **88***a* (which patient support apparatus **22***c* does not have, as noted above).

(42) Stationary module algorithm **108***a* differs from algorithm **108** in that it includes the new step **140** of receiving the transmitted patient support apparatus data from patient support apparatus **22***c*. This transmitted data includes the patient support apparatus identifier **96**. Upon receiving this data at step **140**, controller **112** of stationary module **26** proceeds to modified step **120***a*, where it transmits—in addition to patient support apparatus identifier **96** and stationary module identifier **98**—the patient support apparatus data received at step **140**. These items—identifiers **96**, **98**, and the patient support apparatus data—are transmitted at step **120** to wireless access point **46** via WiFi transceiver **88***b* on board stationary module **26**. The patient support apparatus data includes any of the data previously mentioned and described above with respect to algorithm **104**.

(43) Server algorithm **110***a* includes the same steps as server algorithm **110** with the exception of a modified step **122***a* and the omission of step **134**. Step **122***a* differs from step **122** in that server **50** also receives at step **122***a* the patient support apparatus data from stationary module **26**. As shown in FIG. **4**, this patient support apparatus data is received by server **50** at step **134** from patient support apparatus **22** itself in algorithm **104**. The patient support apparatus data therefore follows a different path to server **50** in algorithm **104***a* than it follows in algorithm **104**.

(44) It will be understood that the transmission of patient support data at steps **128**, **128***a* in both algorithms **104** and **104***a* may take place repetitively. That is, the transmitted data can occur repeatedly while the patient support apparatus **22**, **22***a-c* is positioned at particular location. It is not necessary for another triggering event to occur at step **114** before such additional data is transmitted. Thus, for example, when any status data regarding patient support apparatus **22**, **22***a-c*, or the patient associated therewith changes, additional data may be transmitted off of patient support apparatus **22**, **22***a-c*.

(45) It will further be understood that the transmission of nurse call audio and alerts to nurse call system **76** at step **130** of algorithm **104***a* can occur in either of two ways—as described previously with respect to algorithm **104**—depending upon whether cable **82** is coupled between stationary module **26** and headwall connector **80** or between patient support apparatus **22**, **22***a-c* and headwall connector **80**.

(46) FIG. **8** illustrates the internal details of another modified location detection system **20***b*. Those components of location detection system **20***b* that are the same as the components of location detection systems **20** and/or **20***a* are labeled herein with the same reference numbers as systems **20** and/or **20***a*. Those components of system **20***b* that have been modified in some fashion as compared to systems **20** and/or **20***a* have been labeled with the same reference number followed by the letter “a” or “b.”

(47) Location detection system **20***b* differs from location detection systems **20** and **20***a* in that it includes a modified stationary module **26***c*. Stationary module **26***c* differs from stationary module **26** in that it does not include a headwall hardware interface **132**. Stationary module **26***c* therefore is not capable of receiving a nurse call cable **82**. As a result, stationary module **26***c* does forward any data received from patient support apparatus **22** onto headwall connector **80**. Any data or messages from patient support apparatus **22** that are destined to headwall connector **80** (and any of the downstream components, such as nurse call system **76**, nurses' station **78**, and/or the entertainment controls **84**) are transmitted from patient support apparatus **22** via cable **82**. All of the other components of stationary module **26***c* are the same as the components of stationary module **26**.

(48) Location detection system **20***b* may follow either location algorithm **104** or location algorithm **104***a*. The only modification to these algorithms is that step **130** is carried out via the cable **82** running from patient support apparatus **22** to connector **80**, rather than wirelessly, as is an option for location detection systems **20** and **20***a*. This is because, as noted, stationary module **26***c* does not include structure for receiving a cable **82** and therefore all communication between patient support apparatus **22** and nurse call system **76** (or the entertainment controls **84**) bypasses stationary module **26***c* via cable **82**.

(49) It will be understood by those skilled in the art that various other modifications may be made

to location detection systems **20**, **20***a*, and **20***b*. For example, in one such modification, the data table or map that correlates the identifiers of each stationary module **26** (or **26***c*) within the healthcare facility is stored onboard each patient support apparatus **22**. In such modified embodiments, the step of associating a patient support apparatus **22** to a particular location—which is carried out in step **136** by server **50** in algorithms **104** and **104***a*—is carried out by patient support apparatus **22** (or **22***a-c*). With such a modification, it is not necessary for patient support apparatus **22**, **22***a-c*—to transmit its identifier **96** to wireless access point **46** or to server **50**. Instead, any data or messages that are to be communicated from patient support apparatus **22**, **22***a-c* to wireless access point **46** and/or to server **50** are instead transmitted with the location of patient support apparatus **22**, **22***a*. In other words, instead of transmitting its identifier with each message, patient support apparatus **22**, **22***a-c* transmits its location with each message. The transmitted location may be a room number, or it may be the combination of a room and a bed bay identifier within the room. In still other situations, stationary modules **26**, **26***c* may be positioned at locations other than in rooms, and the transmitted location may take on other forms, such as "hallway X," or "elevator Y," or still other forms.
(50) When server **50** receives the messages and data from the patient support apparatus **22**, **22***a-c*, it uses the location information transmitted therewith to correlate the transmitted messages and/or data with the correct patient. That is, as noted previously, server **50** either contains, or has access to, a database that identifies patients according to their room number and/or bed bay number. By determining the patient from the transmitted location, server **50** is able to determine, for example, what electronic medical record to file certain the receiving information with and/or what caregiver is assigned to that patient, and/or still other information.
(51) In any of the various embodiments described herein, radio modules **54** and **94** include transceivers that are able to transmit binary data packets at a rate of at least 10 kilobits per second with a delay of less than 100 milliseconds. Further, the modules include transceivers that are used to communicate audio signals and that have a bandwidth of at least 8 kilohertz and transmits the audio signals with less than 400 milliseconds of delay. Other bandwidths and delay thresholds can, of course, be used for either or both sets of transceivers.
(52) In still other embodiments, stationary module **26** may be modified so as to communicate wirelessly with headwall connector **80**, instead of using cable **82**. Such wireless communication between stationary module **26** and headwall connector **80** is described in more detail in commonly assigned U.S. patent application Ser. No. 62/035,656 filed Aug. 11, 2014 by inventors Krishna Bhimavarapu et al. and entitled PATIENT SUPPORT APPARATUSES WITH WIRELESS HEADWALL COMMUNICATION, the complete disclosure of which is hereby incorporated herein by reference.
(53) In still other embodiments, mobile wireless unit **24** is a unit that is physically separate from patient support apparatus **22**, **22***a-c* but is adapted to be selectively plugged into and unplugged from patient support apparatus **22**, **22***a-c* (such as, but not limited to, a dongle). For example, in one embodiment, mobile wireless unit **24** is plugged into the connector in headwall hardware interface **56** that is otherwise used to couple cable **82** between patient support apparatus **22**, **22***a-c* and connector **80**. Thus, if a wireless connection to connector **80** is desired, mobile wireless unit **24** is plugged into headwall hardware interface **56** instead of a cable. This enables wireless communication between patient support apparatus **22**, **22***a-c* and stationary module **26** without having to make any modifications to patient support apparatus. When so constructed, mobile wireless unit **24** can therefore be used to convert existing patient support apparatuses **22** that do not include wireless communication abilities into patient support apparatuses that are capable of wireless communication. Further, when so constructed, mobile wireless unit **24** communicates with main controller **60**, audio amplifier **62**, and mobile locator transceiver **58** via headwall hardware interface **56**, rather than directly (as it does in the embodiment shown in FIG. **2**).
(54) It will be understood that radio modules **54** and **94** can be modified to include a different

number of transceivers than what is shown in FIG. **2**, as well as one or more transceivers that use different wireless communication protocols from those shown in FIG. **2**. It will also be understood that the use of the term "transceiver" herein is intended to cover not only devices that include a transmitter and receiver contained within a single unit, but also devices having a transmitter separate from a receiver, and/or any other devices that are capable of both transmitted and receiving signals or messages.

(55) In at least one embodiment, in addition to sending signals received from mobile wireless unit **24** of patient support apparatus **22** to headwall connector **80**, stationary module **26** is also adapted to forward signals received from headwall connector **80** via cable **82** to mobile wireless unit **24** of patient support apparatus **22**. Stationary module **26** is therefore adapted, in at least one embodiment, to provide bidirectional communication between patient support apparatus **22** and headwall connector **80**. Such bidirectional communication includes, but is not limited to, communicating audio signals between a person supported on patient support apparatus **22** and a caregiver positioned remotely from patient support apparatus **22** (which is accomplished by stationary module **26** forwarding the audio signals of the person on patient support apparatus **22** to nurse call system **76**, and vice versa).

(56) As was noted above with respect to algorithms **104** and **104***a*, patient support apparatuses **22**, **22***a-c* are adapted to transmit patient support apparatus data in steps **128** and **128***a*, respectively. In algorithm **104**, this status data is transmitted to server **50** via WiFi transceiver **88***a* on-board the patient support apparatus, which forwards the data to a wireless access point **46**, which in turn forwards it to **50**. In algorithm **104***a*, this status data is first transmitted to stationary module **26** via Bluetooth transceiver **86***a*, and stationary module **26** then transmits this data to server **50** via its own WiFi transceiver **88***b*. In at least some embodiments, patient support apparatuses **22**, **22***a-c* are adapted to also transmit some or all of this status data to nurse call system **76**. In such embodiments, this data is transmitted to nurse call system **76** in one of two ways, depending upon whether cable **82** is coupled to patient support apparatus **22**, **22***a-c* or to stationary module **26**. When cable **82** is coupled to the patient support apparatus, controller **52** sends this data, or a portion of it, to headwall hardware interface **56**, which then forwards the data via cable **82** to connector **80**, from which it then travels to nurse call system **76**. When cable **82** is coupled to stationary module **26**, controller **52** sends this data, or a portion of it, to radio module **54**, which then forwards it via Bluetooth transceiver **86***a* to stationary module **26**. Stationary module **26** then forwards it to its own headwall hardware interface **132** (FIG. **2**), which passes the data via cable **82** to connector **80** and nurse call system **76**.

(57) In such embodiments, it can therefore be seen that at least some of the data transmitted at step **128** of algorithm **104** is sent off of the patient support apparatus **22**, **22***a-b* via two different methods. One such method is the transmission of the data by way of headwall hardware interface **56**, cable **82**, and connector **80** to nurse call system **76** (or alternatively by way of Bluetooth transceiver **86***a*, stationary module **26**, headwall hardware interface **132**, and connector **80** to nurse call system **76**). Another such method is the transmission of the data by way of WiFi transceiver **88***a* and wireless access point **46** to server **50**.

(58) It can also be seen that at least some data transmitted at step **128***a* of algorithm **104***a* is sent off of the patient support apparatus **22***c* via two different methods, in at least some embodiments. One such method is the transmission of the data by way of headwall hardware interface **56**, cable **82**, and connector **80** to nurse call system **76**. Another such method is the transmission of the data by way of Bluetooth transceiver **86***a*, stationary module **26**, WiFi transceiver **88***b*, and wireless access point **46** to server **50**.

(59) Still further, it can also be seen that, at least in some embodiments, patient support apparatuses **22**, **22***a-c* are adapted to transmit the same data to two different locations. In such embodiments, some of the data is transmitted to nurse call system **76** and some of the same data is transmitted to server **50**. Still further, in some embodiments, the transmission of the data to these two different

locations is accomplished via the patient support apparatus transmitting the data via different on board transceivers (e.g. Bluetooth transceiver **86***a*, WiFi transceiver **88***a*, and/or headwall hardware interface **56**), while in other embodiments, the patient support apparatus **22** transmits the data only once to stationary module **26** and stationary module **26** splits the data for forwarding to both nurse call system **76** and to server **50**.

(60) In the embodiment of location detection system **20** shown in FIGS. **2-5**, stationary module **26** communicates the data and signals it receives from mobile wireless unit **24** to connector **80** by directing the incoming data and signals it receives to the appropriate pin or pins of headwall connector **80**. For example, when headwall connector **80** includes 37 sockets for coupling to a 37 pin plug, or vice versa, it is common for pin numbers **30** and **31** of connector **80** to be used for indicating a “priority alert,” which is often synonymous with an alert that is issued when a patient exits from patient support apparatus **22**. Further, depending upon the particular configuration that has been implemented at a particular healthcare facility, the connection between pin numbers **30** and **31** may be normally open or it may be normally closed. Regardless of whether it is normally open or normally closed, whenever stationary module **26** receives a message from mobile wireless unit **24** that a person has exited from patient support apparatus **22**, stationary module **26** changes the status of pins **30** and **31** such that they switch from whatever state they are normally in to their opposite state. Stationary module **26** therefore reacts to the exit message it receives from mobile wireless unit **24** by either opening or closing pins **30** and **31**. The nurse call system **76** that is communicatively coupled to headwall connector **80** interprets this opening or closing of pins **30** and **31** in the same manner as if a cable were coupled between patient support apparatus **22** and headwall connector **80**, such as by sending the appropriate signals to one or more nurse's stations, flashing a light outside the room of patient support apparatus **22**, forwarding a call to a mobile communication device carried by the caregiver assigned to the occupant of patient support apparatus **22**, and/or taking other steps, depending upon the specific configuration of the nurse call system.

(61) In addition to sending data indicating that an occupant of patient support apparatus **22** has exited, or is about to exit, from support surface **28**, mobile wireless unit **24** is configured, in at least one embodiment, to wirelessly send to stationary module **26** at least the following additional messages: messages to turn on or off one or more room lights; messages to turn on or off one or more reading lights; messages to increase or decrease the volume of a nearby television set; messages to change a channel of the nearby television set; and messages containing audio packets generated from one or more microphones on the patient support apparatus **22** into which an occupant of patient support apparatus **22** speaks when desiring to communicate with a remote caregiver.

(62) In other embodiments, mobile wireless unit **24** is configured to wirelessly send to stationary module **26** any one or more of the following messages, either in addition to or in lieu of any one or more of the messages previously mentioned: messages indicating the current status of one or more siderails **40** of patient support apparatus **22** (e.g. whether the side rails are up or down, or have changed position); messages indicating the current status of a brake on patient support apparatus **22**; messages indicating the current status of the height of support surface **28** relative to base **32** (e.g. such as whether support surface **28** is at its lowest height or not); messages indicating the current angle of a head section of support surface **28** that is adapted to support a patient's torso and head; messages indicating the current status of exit detection system **70** (e.g. whether the exit detection system is armed or not); messages indicating the current charging status of one or more batteries on patient support apparatus **22**; messages indicating the current status of an alternating current (A/C) power cable on patient support apparatus **22** (e.g. whether it is plugged in or not); diagnostic information about patient support apparatus **22**; and/or any other messages containing information about patient support apparatus **22** which may be useful to communicate to a remote location.

(63) In at least one embodiment, stationary module **26** is further configured to transmit information to headwall connector that does not originate from patient support apparatus **22**, but instead is generated internally within stationary module **26**. For example, in one embodiment, stationary module **26** is adapted to forward to headwall connector **80** an alert whenever the communication link between stationary module **26** and mobile wireless unit **24** is unintentionally lost. In other embodiments, stationary module generates any one or more of the following messages to be sent to mobile wireless unit **24**: the charge status of a battery **142** (FIGS. **2**, **8**) contained within stationary module **26**; acknowledgements of messages transmitted from mobile wireless unit **24** to stationary module **26**; and messages used to establish, maintain, and disestablish the communication link between mobile wireless unit **24** and stationary module **26**. Still other types of signals that originate from within stationary module **26** may also be sent to headwall connector **80**.
(64) When stationary module **26** is coupled via cable **82** to connector **80**, it is also adapted, in at least some embodiments, to forward the following messages to wireless unit **24** based on information it receives from headwall connector **80**: messages indicating the establishment and disestablishment of a nurse-call communication link (e.g. messages used for turning on and off a “nurse answer” light on patient support apparatus **22**); and messages containing audio packets of a caregiver's voice (generated from a microphone into which the caregiver speaks and forwarded to the appropriate pins of connector **80**).
(65) It will be understood that, in those embodiments of location detection system **20** where patient support apparatus **22** communicates status data to stationary module **26**, such as during step **128***a* of algorithm **106***a* (FIG. **7**), patient support apparatus **22** can be configured to utilize the stationary module unique identifier **98** to ensure that patient support apparatus **22** does not communicate with an incorrect stationary module **26**. For example, with specific reference to FIG. **5** where two stationary modules **26***a* and **26***b* are present in a single room **44**, the acknowledgement from stationary module **26***a* that first patient support apparatus **22***a* receives at step **126** will include the unique identifier **98** of stationary module **26***a*. Patient support apparatus **22***a* uses this unique identifier **98** as an address in subsequent communications with stationary module **26***a*, such as during step **128***a*. The use of this unique identifier **98** ensures that, for example, if stationary module **26***b* inadvertently detects the transmission from patient support apparatus **22***a* to stationary module **26***a*, stationary module **26***b* will know that this message is not intended for it because it is addressed to stationary module **26***a*. The unique stationary identifiers can therefore be used to ensure that wireless messages between patient support apparatuses **22** and stationary modules **26** that use any of the longer range transceivers (e.g. not transceiver **100**) are only acted upon by their intended recipients.
(66) In some embodiments, when stationary module **26** are initially installed within a room of a healthcare facility, the unique identifiers **98** of the modules **26** are input into these modules **26**. The inputting of this data into each of modules **26** may take on a variety of different forms, such as by setting appropriate dip switches on each of module **26** that corresponds to their unique identifier **98**; uploading the unique identifiers **98** via a USB port, or other type of electronic port, integrated into each stationary module **26**; having each stationary module **26** connect to a server on a local area network using, for example, WiFi transceiver **88***b*, and downloading from the server the corresponding unique identifiers **98**; or by other means. Regardless of the manner of inputting this information, each stationary module **26** is configured during set-up to have stored in its memory a unique identifier **98** that distinguishes itself from the unique identifiers **98** of the other stationary modules **26**.
(67) Various additional alterations and changes beyond those already mentioned herein can be made to the above-described embodiments. This disclosure is presented for illustrative purposes and should not be interpreted as an exhaustive description of all embodiments or to limit the scope of the claims to the specific elements illustrated or described in connection with these embodiments. For example, and without limitation, any individual element(s) of the described

embodiments may be replaced by alternative elements that provide substantially similar functionality or otherwise provide adequate operation. This includes, for example, presently known alternative elements, such as those that might be currently known to one skilled in the art, and alternative elements that may be developed in the future, such as those that one skilled in the art might, upon development, recognize as an alternative. Any reference to claim elements in the singular, for example, using the articles “a,” “an,” “the” or “said,” is not to be construed as limiting the element to the singular.

Claims

1. A patient support apparatus comprising: a support surface adapted to support a mattress; a power cord for receiving electrical power from an electrical outlet; a sensor adapted to detect a parameter of the patient support apparatus; a wireless transceiver adapted to communicate with a stationary module positioned at a known location within a healthcare facility; a network transceiver adapted to communicate with a server on a computer network via a wireless access point of the computer network; and a controller adapted, in response to the power cord being plugged into the electrical outlet, to execute a wireless message exchange with the stationary module in which a first identifier of the patient support apparatus is transmitted to the stationary module and a second identifier of the stationary module is transmitted to the patient support apparatus; and after executing the wireless message exchange, to perform the following: transmit first audio signals via the wireless transceiver to the stationary module for forwarding to a nurse call system; receive second audio signals via the wireless transceiver from the stationary module for forwarding to a speaker onboard the patient support apparatus; and transmit status data indicative of the detected parameter to the server via the network transceiver.
2. The patient support apparatus of claim 1 further comprising an exit detection system adapted to detect when a patient exits the patient support apparatus, and wherein the parameter is an alert issued by the exit detection system when the patient exits from the patient support apparatus.
3. The patient support apparatus of claim 1 further comprising an exit detection system adapted to detect when a patient exits the patient support apparatus, and wherein the parameter indicates whether the exit detection system is armed or not.
4. The patient support apparatus of claim 1 wherein the wireless transceiver is a Bluetooth transceiver.
5. The patient support apparatus of claim 1 further including a plurality of siderails adapted to be moved to a plurality of different positions.
6. The patient support apparatus of claim 5 wherein the parameter indicates a current position of at least one of the siderails.
7. The patient support apparatus of claim 5 wherein the parameter indicates a current height of the support surface.
8. The patient support apparatus of claim 5 further comprising a plurality of wheels and a brake adapted to selectively brake at least one of the wheels, and wherein the parameter indicates a current state of the brake.
9. The patient support apparatus of claim 1 wherein the second identifier is a location identifier, and the controller is adapted to transmit the location identifier to the server via the network transceiver.
10. The patient support apparatus of claim 9 wherein the location identifier is unique to the stationary module, and the server includes a data table that correlates the location identifier to a location of the stationary module within the healthcare facility.
11. A patient support apparatus system comprising: a patient support apparatus and a stationary module positioned at a known location within a healthcare facility, wherein the patient support apparatus comprises: (a) a support surface adapted to support a mattress; (b) a sensor adapted to detect a parameter of the patient support apparatus; (c) a headwall interface adapted to

communicatively couple to a nurse call cable; (d) a power cord for receiving electrical power from an electrical outlet; (e) a controller adapted, in response to the power cord being plugged into the electrical outlet, to execute a wireless message exchange with the stationary module in which a first identifier of the patient support apparatus is transmitted to the stationary module and a second identifier of the stationary module is transmitted to the patient support apparatus; and after executing the wireless message exchange, to transmit status data indicative of the detected parameter to the headwall interface; and wherein the stationary module comprises: (i) a multi-pin connector adapted to be electrically coupled to a wall outlet of the nurse call system; and (ii) wireless transceiver adapted to receive first audio signals from the patient support apparatus for forwarding to the multi-pin connector, and to transmit second audio signals to the patient support apparatus for forwarding to a speaker onboard the patient support apparatus.

12. The patient support apparatus system of claim 11 wherein the patient support apparatus further comprises an exit detection system adapted to detect when a patient exits the patient support apparatus, and wherein the parameter is an alert issued by the exit detection system when the patient exits from the patient support apparatus.

13. The patient support apparatus system of claim 11 wherein the patient support apparatus further comprises an exit detection system adapted to detect when a patient exits the patient support apparatus, and wherein the parameter indicates whether the exit detection system is armed or not.

14. The patient support apparatus system of claim 11 wherein the wireless transceiver is a Bluetooth transceiver.

15. The patient support apparatus system of claim 11 wherein the patient support apparatus further includes a plurality of siderails adapted to be moved to a plurality of different positions.

16. The patient support apparatus system of claim 15 wherein the parameter indicates a current position of at least one of the siderails.

17. The patient support apparatus system of claim 11 wherein the parameter indicates a current height of the support surface.

18. The patient support apparatus system of claim 11 wherein the patient support apparatus further comprises a plurality of wheels and a brake adapted to selectively brake at least one of the wheels, and wherein the parameter indicates a current state of the brake.

19. The patient support apparatus system of claim 11 wherein the second identifier is a location identifier, and the controller is adapted to transmit the location identifier to a server on a computer network via a wireless access point of the computer network.

20. The patient support apparatus system of claim 19 wherein the location identifier is unique to the stationary module, and the server includes a data table that correlates the location identifier to a location of the stationary module within the healthcare facility.