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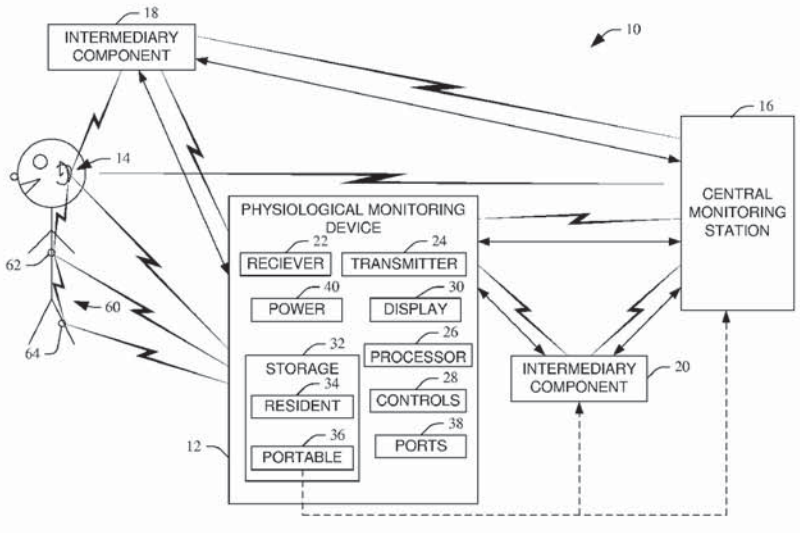
(54) **Title:** DEVICE PROVIDING SPOT-CHECK OF VITAL SIGNS USING AN IN-THE-EAR PROBE



(57) **Abstract:** A portable physiological monitoring device (12) includes a receiver (22) that wirelessly receives physiological measurements from each of a plurality of in-the-ear probes (14) upon entering a communication range of one of the in-the-ear probes (14). The portable physiological monitoring device (12) farther includes a display (30) for presenting the physiological measurements.

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DEVICE FOR PROVIDING SPOT-CHECK OF VITAL SIGNS USING AN IN-THE-EAR PROBE

DESCRIPTION

The following relates to monitoring physiological parameters. It finds particular application as a portable device that receives physiological measurements such as blood pressure, respiration, perfusion index, blood oxygen, pulse rate, body temperature, etc. from an in-the-ear probe, displays the physiological measurement, and conveys the physiological measurement to a monitoring station.

Physiological parameters have been measured from within the ear via an in-the-ear probe. One such probe includes a multi-parameter physiological measurement system that non-invasively measures blood pressure as well as respiration, perfusion, blood oxygen, pulse rate, body temperature, etc. from within the ear canal. This probe includes a series of in-the-ear sensors that interconnect to electronics and a battery pack that are mounted behind the ear or in connection with another location on the patient (e.g., around the neck, wrist, etc.). A processor in the electronics analyzes the raw data and converts it into measurements of physiological parameters that are wirelessly sent to a central monitoring station, which is remote form the location of the subject being monitored.

Typically, such physiological parameters are continuously or periodically measured and conveyed to the central monitoring station. However, in some instances it is not convenient for a clinician to have to view the parameters at the central monitoring station, which is located away from the patient. In addition, instances exist wherein continuous and/or periodic conveyance of such information is not desirable. For example, spot-check or on-demand monitoring may be more desirable with patients having their vital signs checked only every one, two, four … hours. In another example, the network used for such conveyance may have limited bandwidth that is shared with other wireless monitoring devices. Such devices may have to compete for available bandwidth, which may result in delays and/or lost data. In yet another example, the sensitivity of the information may dictate how often it is transmitted, if at all.

In one aspect, a portable physiological monitoring device is illustrated. The portable physiological monitoring device includes a receiver and a display. The receiver wirelessly receives physiological measurements from each of a plurality of in-the-ear probes upon entering a communication range of one of the in-the-ear probes. The received physiological measurements are subsequently presented on the display.

One advantage resides in locally displaying physiological signals measured with an in-the-ear probe.

Another advantage is user validation of physiological signals measured with an in-the-ear probe.

Another advantage is that spot-check monitoring of the physiological signals measured with an in-the-ear probe is facilitated.

Another advantage is using the device as a continuous monitor for the physiological signals measured with an in-the-ear probe with or without the use of a central monitoring station.

Still further advantages will become apparent to those of ordinary skill in the art upon reading and understanding the detailed description of the preferred embodiments.

The drawings are only for purposes of illustrating embodiments and are not to be construed as limiting the claims.

FIGURE 1 illustrates an exemplary physiological monitoring device that communicates with an in-the-ear physiological measurement probe and other physiological monitoring equipment.

FIGURE 2 illustrates another exemplary physiological monitoring device that communicates with an in-the-ear physiological measurement probe and other physiological monitoring equipment.

FIGURE 3 illustrates an exemplary in-the-ear physiological measurement probe.

FIGURE 4 illustrates an in-the-ear physiological measurement probe connected to a behind-the-ear supporting device.

FIGURE 1 illustrates a physiological monitoring system ("system") 10. The system 10 includes a physiological monitoring device 12, which is a mobile device that communicates with physiological measuring equipment (e.g., an in-the-ear probes, etc.) and devices (e.g., a central monitoring station, etc.) used in connection therewith. The physiological monitoring device 12 can be hand held or held by an ambulatory carrier. As described in detail below, the physiological monitoring device 12 can be used to intercept, display, validate and forward (via wire or wirelessly) physiological measurements continuously over a wireless network, or spot-check received physiological measurements obtained by an in-the-ear probe and communicate or download such measurements to a central monitoring station, send and receive information (e.g., physiological measurements, patient history, medical history, messages, notifications, alarms, etc.) to an authorized individual, the central monitoring station, another physiological monitoring device 12, etc., as well as various other activities.

As briefly discussed above, the physiological monitoring device 12 is used in connection with other physiological monitoring equipment. For example, an in-the-ear probe 14 (e.g., described in detail in connection with FIGURES 3-4 below) may be used at a hospital, a home, a nursing home, etc. to measure, record, and/or convey physiological parameters (e.g., non-invasive blood pressure, pulse, blood oxygen, temperature, perfusion, respiration, etc.) obtained by the probe 14 from within an ear of an individual. In such environments, the physiological parameters may be wirelessly transmitted (e.g., continuously, periodically at a predetermined rate, on-demand, upon occurrence of an event, etc.) from the probe 14 to a central monitoring station 16, an intermediate device 18 (e.g., a bedside monitor, a signal router, this physiological monitoring device 12 acting as a continuous bedside monitor, an input for a wired network that carries the measured parameters to the central station 16, etc.), etc. The physiological monitoring device 12 communicates (uni or bi-directionally) with the probe 14, the central monitoring system 16, optionally the intermediate device 18, and/or other devices such as a second intermediate component 20. Such communication can be through wired (e.g., Ethernet, USB, serial, parallel, FireWire, optical

wave guides, telephone wire, coaxial cable, etc.) and/or wireless (e.g., radio frequency, infrared, optical, mechanical wave, magnetism, etc.) technologies.

Communication between the physiological monitoring device 12 and the probe 14 includes, but is not limited to, reception and/or retrieval via a receiver 22 of physiological measurements obtained by the probe 14, requests transmitted by a transmitter 24 to the probe 14 instructing the probe 14 to perform and/or send a physiological measurement(s) to the receiver 22, security indicia, device information such as a probe or device serial number, user identification, software/firmware upgrades for the probe 14, diagnostic applications to troubleshoot the probe 14, etc. In one instance, the foregoing communication is directly between the physiological monitoring device 12 and the probe 14, while in another instance, such communication between the physiological monitoring device 12 and the probe 14 is facilitated by the intermediary component 18 and/or other components.

The receiver 22 and/or the transmitter 24 can communicate over various communication mediums. For instance, the probe 14 may reside within a body area network 60. In this instance, the physiological monitoring device 12 can communicate within such network to interact with the probe 14, one or more physiological sensors 62 positioned on the patient, one or more emitters 64 positioned on the patient, local measurement devices measuring physiological parameters, the intermediary component 18, another physiological monitoring device 12, etc. The central monitoring station 16 may communicate over a network local to the facility, regional within the facility, and/or global to the community. The network may be part of or communicate with one or more larger networks such as a large area network (LAN), a wide area network (WAN), including the Internet, as well as other public and/or private networks. The central monitoring station 16 may communicate this selected information to the physiological monitoring device 12.

A processor 26 controls the receiver 22 and the transmitter 24. For instance, upon entering a communication range of the probe 14, the processor 26 can automatically invoke the receiver 22 to detect and capture information emitted by the probe 14, automatically invoke the transmitter 24 to send a request to the probe 14 for information stored therein, automatically invoke the transmitter 24 to perform measurements, establish a secure communication link with the probe 14, etc. Such requests may indicate which of a plurality of

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