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(54) **MOBILE MONITORING**

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Description

[0001] The following relates to wireless body networks. It finds particular application with alarm relaying from one or more wireless sensors to a cellular phone and further to a surveillance and/or alarm center. However, it is to be appreciated that the invention may also find application in providing communication between wireless sensors and other wireless transponders capable of receiving near field body coupled communication technology.

[0002] Patients are typically monitored of one or more physiological functions when they receive medical attention at a medical facility. For example, it may be desirable to monitor heart function, pulse, blood pressure, blood oxygen level and the like. Conventionally, such monitoring is accomplished utilizing sensors wired to various output devices that can notify medical personnel of one or more conditions. Alternatively, wireless sensors can be employed with wireless networks to transmit such data to one or more wireless transponders such as a display, a monitor, memory, central terminal and the like.

[0003] Such sensors typically provide continuous monitoring of a particular physiological function and an alarm output if a critical event arises. The alarm output can be transmitted utilizing conventional communication technology such as a wired hospital network, radio frequency, Bluetooth or magnetic coupling (B-field), for example. However, when the patient ranges beyond the controlled medical facility communication environment, conventional communication technologies can become unreliable. While a cell phone provides a convenient communication link between a patient and a remote site, direct communication by the monitor in an emergency is more awkward. An ECG monitor can be directly wired to a cell phone, but positioning wires is inconvenient and the wires interfere with normal usage of the cell phone. Cell phones are often compatible with Bluetooth communication protocols. However, in some situations, body attenuation prevents proper signal propagation. For example, if a patient falls down (e.g., due to a heart attack) and covers the chest mounted ECG system, the Bluetooth communication is heavily attenuated by the body and typically disrupted.

[0004] Magnetic coupling communications signals travel readily through the body but consume excessive amounts of energy restricting portability. Due to the weight of batteries, carrying a large battery power supply is inconvenient. In addition, magnetic coupling is typically unidirectional which does not accommodate bi-directional verification routines.

[0005] Typically, communication between the wireless sensor and the mobile phone is fixed due to static configured connectivity. Such static configuration prevents the safe and flexible connection to other nearby mobile phones in an emergency when the primary mobile phone is unavailable. Furthermore, such fixed association inhibits the systems from working reliably in multi-user scenarios.

[0006] In US 2003/0144581 A1 devices and methods are provided for frequently measuring the concentration of an analyte present in a biological system. A monitoring system having at least two components is employed in order to allow separation of data collection from data processing and display. Such separation allows greater flexibility and convenience for the user.

[0007] In US 2002/0013538 A1 a method for monitoring health signs of an individual is provided including the steps of detecting at least one health sign characteristic of the individual with a sensor unit that is located proximate to the individual; producing a health signal from the sensor unit that indicates at least one health sign of the individual; communicating the health signal from the individual to a receiving unit over a wireless connection; processing the health signal to determine if an emergency condition exists; and providing an indication of an emergency condition to a destination node of a network, wherein operating electrical power is applied to the receiving unit in an initialization mode. The receiving unit determines if the receiving unit has received an identification signal from the sensor unit, and receiving a health signal only from a sensor unit having the received identification signal.

[0008] In US 2003/0125017 A1 a system, method, apparatus, and computer program code for delivering a treatment includes generating a personal area network associated with a patient is described. The personal area network transmits a patient identifier associated with said patient, retrieving treatment data associated with said patient identifier, and operating a treatment device pursuant to said treatment data.

[0009] It is the object of the present invention to provide an improved apparatus and method that overcomes the aforementioned limitations and others.

[0010] This object is achieved by a wireless network for monitoring a patient and a method for communicating medical information within a wireless network according to the independent claims.

[0011] Preferred embodiments are defined in the sub claims.

[0012] According to yet another aspect, a method for transmitting medical information within a wireless network includes associating a wearable monitor with a mobile alarm relay system including initializing communication between a first body communication unit associated with the wearable monitor and a second body communication unit associated with the mobile alarm relay system utilizing a near field capacitive body coupled protocol. Secure communication is established between the wearable monitor and the mobile alarm relay system by sending an authentication request from the wearable monitor to the mobile alarm relay system and returning an authentication key from the mobile alarm relay system to the wearable monitor. Communication between the wearable monitor and the mobile alarm relay system is verified to be active by monitoring the connection between the wearable monitor and the mobile alarm relay

system, and generating an alarm if the connection becomes inactive. An alarm is triggered if the data transmitted by the wearable monitor is outside of a predetermined threshold including transmitting an alarm message from the wearable monitor to the mobile alarm relay system, and relaying the alarm message from the mobile alarm relay system to an external network.

[0013] One advantage of the present invention is that it facilitates transmission of medical information in an emergency to a patient monitoring station.

[0014] Another advantage is that out-patient monitored medical information is automatically communicated to the patient's medical care professionals.

[0015] Another advantage is that medical information can be relayed to a wireless transponder without risk of attenuation caused by the patient.

[0016] Another advantage is that medical information can be redundantly communicated to insure that such information is received by a wireless transponder.

[0017] Another advantage resides in enabling patient monitors to interconnect with and use existing cell phone networks to communicate medical information.

[0018] Another advantage is that patients who need constant medical monitoring can move freely throughout the community.

[0019] Numerous additional advantages and benefits will become apparent to those of ordinary skill in the art upon reading the following detailed description of the preferred embodiments.

[0020] The invention may take form in various components and arrangements of components, and in various steps and arrangements of steps. The drawings are only for purposes of illustrating the preferred embodiments and are not to be construed as limiting the invention.

FIGURE 1 illustrates a body coupled communication network that includes a wireless sensor that communicates to one or more external devices via a mobile alarm relay component.

FIGURE 2 illustrates a protocol employed in FIGURE 1 to facilitate communication between the wireless sensor, the mobile alarm relay component and one or more external devices.

FIGURE 3 illustrates a communication network that utilizes a body coupled communication technology and radio frequency technology to transmit information to an external network.

FIGURE 4 shows a protocol employed in FIGURE 3 to facilitate communication utilizing body coupled communication technology and radio frequency technology.

FIGURE 5 shows a redundant communication network that employs both a body coupled communication technology and radio frequency technology to transmit information between a wireless sensor and relay component.

FIGURE 6 shows a protocol employed in FIGURE 5 to facilitate redundant communication between the wireless sensor and the relay component utilizing body coupled communication technology and radio frequency technology.

[0021] A patient **10** is equipped with one or more wearable monitors, such as a wearable electrocardiographic (ECG) monitor (WCM) **12**, and a mobile alarm relay system (MAR) **14** (*e.g.*, mobile phone, PDA or other device which connects to wireless networks), which is utilized to forward alarms generated by the wearable monitor **12** to an external entity. It is to be appreciated that the wearable monitor **12** can be employed to monitor any physiological function related to the patient **10**. Both the wearable monitor 12 and the mobile alarm relay system **14** are equipped with a body communication unit (BCU) **16, 18**. The BCUs **16, 18** communicate utilizing a near-field body-coupled communication technology, based on capacitive coupling.

[0022] The wearable monitor **12** is designed to be power efficient and use low energy consumption technologies so that it can be powered by a relatively small battery **20**. The monitor communicates the monitored physiological condition to a remote monitoring station via an external connection device **22**, *e.g.* the transmit/receive portion of a cell phone **24** that communicates with the cell phone network. The external connection device **22** includes an alarm recognition component **26** that determines if an alarm condition has been sensed by the wearable monitor **12**. A memory **28** is employed by the alarm recognition component **26** to store monitor output before and after the alarm for subsequent retrieval. The memory **28** can store additional data sent by the wearable monitor **12** that relates to a particular physiological function of the patient **10.** A connection component element **30** connects the mobile relay **14** to the cell phone **24**.

[0023] The mobile relay **14** is preferably designed to be carried in contact or close proximity with a portion of the body, *e.g.* in a clothing pocket, or wrapped around the wrist, that can carry more weight, particularly a larger battery **32**. In the preferred embodiment, the mobile alarm relay system **14** is a cell phone hand set that has been modified to include the BCU and other circuitry and has been appropriately programmed.

[0024] First, the BCUs **16, 18** are associated via body coupled communication. At this stage of communication, security can be set up and a shared authentication key can be exchanged among communication components. After initialization of the BCUs **16, 18** is complete, connections between the BCUs **16, 18** is established and communication can begin. Once communication is started, verification of the communication between the BCUs **16, 18** is monitored to insure that the communication remains active. If communication is inactive, an alarm can be triggered to notify the system of such communication failure.

[0025] The wearable monitor BCU **16** receives physiological information from an electrocardiograph (ECG) sensor **34** or other sensor(s). Optionally, an alarm sensor

36 determines if the output of the monitor calls for an alarm message to be issued. The alarm message is communicated via the wearable monitor BCU **16** to the mobile alarm relay system **14** for further relaying. Alternately, all monitored data can be transferred and the alarm recognition circuit 26 of the relay 14 can recognize the alarm condition rather than the alarm signal. In the preferred cell phone embodiment, the alarm signal causes the cell phone to dial a preselected telephone number to report the emergency. Preferably, the cell phone includes a GPS system **38** which communicates the stricken patient's location as well to medical professionals or emergency dispatchers at the receiving station.

[0026] Additionally, ECG data can be transferred to the mobile alarm relay system **14** with the alarm signal so that the remote receiving station can determine a plan of action based on such particularized data. For example, if the patient's pulse exceeds an alarm threshold, the caregiver can utilize such pulse data to determine the appropriate action to take when administering care to the patient **10**. In another embodiment, the data is stored into the memory **28** in the mobile alarm relay system **14** or in the wearable monitor **12** so that data can be trended to determine the previous condition of the patient **10**. In yet another embodiment, data can be downloaded on a periodic basis from the memory **28** to a remote processor for analysis.

[0027] Fig. 2 illustrates the communication protocol between the wearable monitor **12** and the mobile alarm relay system **14** shown in Fig. 1. A body coupled communication protocol is employed to facilitate communication between the wearable monitor **12** and the mobile alarm relay system **14**. Discovery of the wearable monitor **12** is accomplished by sending a discovery signal from the wearable monitor **12** to the mobile alarm relay system **14** once the wearable monitor **12** is introduced to the network (*e.g.*, attached to the patient). A response signal is transmitted back to the wearable monitor **12** by the mobile alarm relay system **14**. Security can be set up by exchanging a shared authentication key between the wearable monitor **12** and mobile alarm relay system **14**. An authentication request is communicated from the wearable monitor **12** to the mobile alarm relay system **14** and an authentication key is returned by the mobile alarm relay system **14** to the wearable monitor **12**. An association signal is sent from the wearable monitor **12** to the mobile alarm relay system **14** and the mobile alarm relay system **14** returns a confirm signal to verify establishment of a connection between the wearable monitor **12** and mobile alarm relay system **14** on the network.

[0028] Once communication is established, a verification signal is sent at various times from the wearable monitor **12** to the mobile alarm relay system **14**. When a verification signal is received, the mobile alarm relay system **14** returns a confirm signal to indicate that communication is active between the wearable monitor **12** and the network. In case of an alarm detected by the wearable monitor **12**, an alarm signal is transmitted from the wearable monitor **12** to the mobile alarm relay system **14**. In one embodiment, data is also transmitted with the alarm signal to provide specific information relative to the alarm. The alarm signal is further transmitted from the mobile alarm relay system **14** to a remote receiving component (*e.g.*, transponder) to trigger an external alarm. When there are a plurality of mobile monitors, analogous protocol is used each to establish communication with the mobile alarm relay system **14.**

[0029] In Fig. 3, the patient **10** is again equipped with a wearable monitor **12** and an identification and relaying component (IRC) **50**. The wearable monitor **12** and the relay **50** are each equipped with a body communication unit (BCU) **16, 52**. The BCUs **16, 52** communicate utilizing a two-way near field body coupled communication technology, which is based on capacitive coupling with the patient's body. The wearable monitor BCU **16** receives alarm information from an electrocardiograph (ECG) sensor **34** detected by the wearable monitor **12**. An alarm message is transferred from an alarm sensor **36** *via* the wearable monitor BCU **16** to the IRC **50** for further relaying.

[0030] In contrast to the wearable monitor **12**, which is located in close proximity to the heart, the IRC **50** can be placed on a part of the body with no risk of attenuation (*e.g.* arms or legs). The IRC **50** includes an identification (ID) component **54** that provides unique patient identification. The IRC **50** further includes an RF system **56** that transmits information for communication via an RF system **58** to a mobile alarm relay system, preferably a cellular phone **60**, preferably using a Bluetooth or other short range, lower power transmission system. In turn, the cellular phone **60** relays data over the cell phone network to the medical professionals at a receiving station. Alternatively or additionally, the relay can communicate with a PC or PCA which communicates the alarm and other information over the Internet. Other network communications devices are also contemplated. In this manner, patient information gathered at one area of a patient's body can be communicated from a central location on the patient **10** to a global network.

[0031] An alarm recognition component **26** determines if an alarm has been sent by the wearable monitor **12**. The memory **28** is employed by the alarm recognition component **26** to store alarms for subsequent retrieval. The memory **28** can store additional data sent by the wearable monitor **12** that relates to a particular physiological function of the patient **10**. The connection element **30** connects the relay **50** to the cell phone **60**. More specifically, the RF system **56** of the relay **60** interfaces to the external connection device, *e.g.*, the transmit / receive portion of the cell phone to communicate through the cell phone network.

[0032] Fig. 4 illustrates the message flow between the wearable monitor **12**, the relay **50** and the mobile alarm relay system or cell phone **60** of Fig. 3. Communication between the wearable monitor **12** and the relay **50** is facilitated via a body coupled communication technology.

Communication between the relay **50** and the mobile alarm relay system or cell phone **38** is accomplished via radio frequency (**RF**) technology. Initially, the BCUs **16, 52** of the wearable monitor **12** and the relay **50** are discovered by the body coupled communication network. A discovery signal is sent from the wearable monitor **12** to the relay **50** which returns a response signal to the wearable monitor **12**. Next, security is established by exchanging a shared authentication key between the wearable monitor **12** and the relay **50**. The wearable monitor **12** sends an authentication request to the relay **50** and the relay **50** returns an authentication key to the wearable monitor **12**. Finally, the connection between the BCUs **16, 52** of the wearable monitor **12** and relay **50** is established via the body coupled communication network. An association signal is sent from the wearable monitor **12** to the relay **50**. The relay **50** returns a confirm signal to the wearable monitor **12** to verify that communication is established. Additionally, an RF connection between the relay **50** and the cell phone **60** is established after the relay **50** sends a connection signal to the cell phone **60**.

[0033] The connection between the wearable monitor **12**, the relay **50** and the cell phone **60** (mobile alarm relay system) is monitored and verified. The wearable monitor **12** sends a verification signal to the relay **50** and another verification signal is sent from the relay **50** to the cell phone **60** or other mobile alarm relay system. The cell phone **60** responds by sending a confirm signal to the relay **50**. A confirm signal is also sent from the relay **50** to the wearable monitor **12**. In this manner, the network is notified if a communication failure takes place. Once the communication between the wearable monitor **12**, the relay **50** and the cell phone **60** is established, security is implemented and transmission and reception of signals is verified.

[0034] If the wearable monitor **12** detects an alarm, an ECG alarm signal is sent from the wearable monitor **12** to the relay **50**. Afterward, an alarm signal and an alarm identification signal are sent from the relay **50** to the cell phone **60** or other mobile alarm relay system. After receiving the alarm and identification signals from the relay **26**, the cell phone 60 sends an external alarm signal to the medical emergency receiving station.

[0035] Fig. 5 illustrates a redundant communication system where the patient **10** is equipped with a wearable monitor (WCM) 70 and a mobile alarm relay system (MAR) **72**, which is utilized for alarm forwarding to an external network. An ECG monitors **74** the patient's heart. Additionally or alternatively, an alarm sensor **76** monitors the second ECG or other physiological condition and determines when an alarm triggering aberration has occurred. Both the wearable monitor **70** and the relay system 72 are equipped with body communication units (BCUs) **78, 80** as well as with RF (*e.g.*, Bluetooth) communication units **82, 84** for mutual peer-to-peer communication. In one embodiment, the relay system **72** is additionally equipped with cellular network connectivity, which is used for alarm forwarding. For example, the relay system may be embodied in a cell phone which communicates with the wearable monitor using the body-coupled communication system, when available. However, when the cell phone is separated from the patient, *e.g.* while recharging, the short range radio communication system is used.

[0036] The wearable monitor **70** and the relay system **72** automatically manage their communication by regular checking both communication links and ensuring that at least one communication link is available at any point in time. If no communication link is available, an automatic warning/notification can be communicated.

[0037] Fig. 6 illustrates the communication protocol flow between the wearable monitor **70** and the relay system **72** from Fig. 5. This communication can be broken down into three stages: association, verification and alarming. During the association phase, the BCUs **78, 80** related to the wearable monitor **70** and the relay system **72** discover each other via the body coupled communication network. A discovery signal is transmitted from the wearable monitor **70** to the relay system **72**. A shared authentication key is exchanged between the wearable monitor **70** and the relay system **72** to establish secure communication between the wearable monitor **70** and the relay system **72**. An authentication request signal is sent from the wearable monitor **70** to the relay system **72** and the relay system **72** returns an authentication key signal to the wearable monitor **70**.

[0038] In this embodiment, there are two stages of association of the wearable monitor **70** and the relay system **72**. First, BCUs **78, 80** of wearable monitor **70** and IRC (not shown) are connected. An association signal is sent via body coupled communication from the wearable monitor **70** to the relay system **72** and a confirm signal is returned from the relay system **72** to the wearable monitor **70** *via* body coupled communication. Second, an additional RF connection is established between the wearable monitor **70** and the relay system **72**. A connection signal is sent via RF from the wearable monitor **70** to the relay system **72**. The relay system **72** sends a confirm signal back to the wearable monitor **70** to indicate an RF connection is made between the wearable monitor **70** and the relay system **72**.

[0039] Verification provides a regular monitoring of connections (body coupled and RF) between the wearable monitor **70** and the relay system **72**. The system is notified if there is a failure of communication with either the body coupled communication or the RF connection. For both the body coupled communication and the RF connection, a verification signal is sent from the wearable monitor **70** to the relay system **72**. The relay system **72** returns a confirm signal to the wearable monitor **70** to verify communication.

[0040] Alarming is provided utilizing both the body coupled communication and the RF connection. In case an ECG alarm is detected by the wearable monitor **70**, an alarm message is transferred to the relay system **72**. In addition to the alarm signal, ECG data can be transferred

to the relay system **72**. Both connection technologies, body coupled and RF, are employed in parallel to ensure connectivity. An ECG alarm signal is sent from the wearable monitor **70** utilizing both body coupled communication and an RF connection. After the relay system **72** receives at least one of the communicated ECG alarm signals, an external alarm signal is relayed from the relay system **72** to an external component via a cellular network.

[0041] In another variation, the wearable monitor **70** or the relay unit **72** connects with any nearby cell phone that is equipped to receive the signal. This assures that the alarm communication reaches the remote medical monitoring station even if the patient's cell phone is unavailable, *e.g.* dead battery, left out of range, *etc.*

[0042] The invention has been described with reference to the preferred embodiments. Modifications and alterations may occur to others upon reading and understanding the preceding detailed description. It is intended that the invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

Claims

1. A wireless network for monitoring a patient (10), the wireless network comprising: at least one wearable monitor (12, 70) including:

a physiological condition sensor (34, 74) coupled to the patient (10) to sense and communicate data related to one physiological function of the patient (10), and
a first body communication unit (16, 78) that interfaces with the physiological condition sensor to communicate over the patient (10) utilizing a near field capacitive body coupled protocol; and
a relay system (14, 50, 72) including:
a second body communication unit (18, 52, 80) that receives data from and communicates with the first body communication unit (16, 78) utilizing the near field capacitive body coupled protocol, and
an external communication unit (24, 56, 72) which communicates the data to a remote medical monitoring station,

wherein the relay unit includes a cell phone (24, 60, 72), the cell phone including the second body communication unit (18, 52, 80) which receives the data transmitted with the body coupled protocol when the cell phone is touching or closely adjacent the patient and the external communication unit (24, 60, 72) which communicates the data over a cell phone network to the remote station, **characterised in that** the wearable monitor (12, 70) includes a low power radio frequency transmitter (82) and the cell phone includes a radio frequency receiver (84) which receives the physiological data directly from the wearable monitor when the second body communication unit (18) is not touching or closely adjacent the patient.

2. The system according to claim 1, the at least one wearable monitor (12, 70) further including: an alarm sensor (36, 76) that interfaces with the physiological condition sensor (34, 74) to detect whether the sensed physiological condition is outside of a predetermined threshold and causes the first communication unit (16, 78) to send out an alarm signal.

3. The system according to claim 1, the wireless body network further including:

a relaying component (60) that receives data from one of the wearable monitor (12, 70) external communicating unit (56) and transmits the data to the remote monitoring station.

4. The system according to claim 3, wherein the data is transmitted via a radio frequency signal.

5. The system according to claim 3, wherein the wireless network further includes: an identification component (54) that provides a unique patient identifier with the data.

6. The system according to claim 1, the relaying component (14, 60, 72) broadcasts received data on a cell phone network.

7. The system according to claim 1, the physiological condition sensor is one of heart rate, pulse oximetry, respiratory rate, blood pressure, temperature and electrocardiographic activity.

8. The system according to claim 1 wherein the external communication unit (56) includes a radio frequency transmitter that transmits a radio frequency signal and wherein the cell phone includes a receiver (58) which receives the radio frequency signal and which retransmits the data on the cell phone network to the remote station.

9. The system according to claim 8 wherein the wearable monitor also includes a radio frequency transmitter (82), the cell phone radio frequency receiver receiving the both radio frequency signals.

10. A method for communicating medical information within a wireless network, comprising:

monitoring a physiological condition of a patient (10) via a sensor (34, 74) coupled to the patient (10);

communicating data related to the physiological conditions sensed by the sensor (34, 74) via a first body communication unit (16, 78) that communicates over the patient (10) utilizing a near field capacitive body coupled protocol;
receiving data from the at least one wearable monitor (12, 70) by a second body communication unit (18, 52, 80) that communicates with the first body communication unit (16, 78) utilizing the near field capacitive body coupled protocol, wherein the data is received when a cell phone, which includes the second body communication unit (18, 52, 80), is touching or closely adjacent the patient and an external communication unit (24, 60, 72) and wherein the wearable monitor (12, 70) includes a low power radio frequency transmitter (82) and the cell phone includes a radio frequency receiver (84) which receives the physiological data directly from the wearable monitor when the second body communication unit (18) is not touching or closely adjacent the patient; and
communicating the received data to a remote medical monitoring station over a cell phone network with the external communication unit (24, 60, 72).

11. The method according to claim 10, further including: monitoring the sensed physiological condition data and generating an alarm signal in response to the sensed physiological data being outside of a predetermined threshold.

12. The method according to claim 10, wherein communicating the received data includes: transmitting a radio frequency signal to a relay system that retransmits the data over the cell phone network.

13. The method according to claim 12, further including: communicating the data relative to the sensed physiological condition utilizing a radio frequency protocol; and, with the cell phone, receiving one of the radio frequency protocol and the radio frequency signal and retransmitting the data over the cell phone network.

14. The method according to claim 10, wherein the physiological is condition is one of heart rate, pulse oximetry, respiratory rate, blood pressure, temperature and electrocardiographic activity.

Patentansprüche

1. Drahtloses Netzwerk zur Überwachung eines Patienten (10), wobei das drahtlose Netzwerk Folgendes umfasst: mindestens ein tragbares Überwachungsgerät (12, 70) mit
einem Sensor (34, 74) des physiologischen Zustands, der mit dem Patienten (10) verbunden ist, zum Erkennen und Kommunizieren von Daten bezüglich einer physiologischen Funktion des Patienten (10) und
einem ersten Körperkommunikationsgerät (16, 78), das eine Schnittstelle zu dem Sensor des physiologischen Zustands aufweist, zum Kommunizieren über den Patienten (10) unter Verwendung eines kapazitiven, an den Körper gekoppelten Nahfeldprotokolls und
einem Weiterleitungssystem (14, 50, 72) mit
einem zweiten Körperkommunikationsgerät (18, 52, 80), das Daten von dem ersten Körperkommunikationsgerät (16, 78) erhält und mit diesem kommuniziert unter Verwendung des kapazitiven, an den Körper gekoppelten Nahfeldprotokolls, und
einem externen Kommunikationsgerät (24, 56, 72), das die Daten zu einer entfernten medizinischen Überwachungsstation überträgt,
wobei das Weiterleitungsgerät ein Mobiltelefon (24, 60, 72) umfasst, wobei das Mobiltelefon das zweite Körperkommunikationsgerät (18, 52, 80) enthält, das die mit dem an den Körper gekoppelten Protokoll gesendeten Daten empfängt, wenn das Mobiltelefon den Patienten berührt oder sich in seiner unmittelbaren Nähe befindet, und das externe Kommunikationsgerät (24, 60, 72) umfasst, das die Daten über ein Mobilfunknetz an die entfernte Station überträgt, **dadurch gekennzeichnet, dass** das tragbare Überwachungsgerät (12, 70) einen HF-Sender (82) mit geringer Energie umfasst und das Mobiltelefon einen HF-Empfänger (84) umfasst, der die physiologischen Daten direkt von dem tragbaren Überwachungsgerät empfängt, wenn das zweite Körperkommunikationsgerät (18) den Patienten nicht berührt oder sich nicht in seiner unmittelbaren Nähe befindet.

2. System nach Anspruch 1, wobei das mindestens eine tragbare Überwachungsgerät (12, 70) Folgendes umfasst:

einen Alarmsensor (36, 76), der eine Schnittstelle zu dem Sensor (34, 74) des physiologischen Zustands aufweist, zum Detektieren, ob der erkannte physiologische Zustand außerhalb des vorbestimmten Schwellenwertes liegt, und das erste Kommunikationsgerät (16, 78) veranlasst, einen Alarmsignal auszusenden.

3. System nach Anspruch 1, wobei das drahtlose Körpernetzwerk ferner Folgendes umfasst:

eine Weiterleitungseinheit (60), die Daten von entweder dem tragbaren Überwachungsgerät (12, 70) oder dem externen Kommunikationsgerät (56) empfängt und die Daten an die ent-

fernte Überwachungsstation sendet.

4. System nach Anspruch 3, wobei die Daten über ein HF-Signal gesendet werden.

5. System nach Anspruch 3, wobei das drahtlose Netzwerk ferner Folgendes umfasst:

qeine Identifizierungseinheit (54), das die Daten mit einer eindeutigen Patientenidentität versieht.

6. System nach Anspruch 1, wobei die Vermittlungseinheit (14, 60, 72) empfangene Daten in einem Mobilfunknetz verbreitet.

7. System nach Anspruch 1, wobei der Sensor des physiologischen Zustands entweder die Herzfrequenz, die Pulsoximetrie, die Atemfrequenz, den Blutdruck, die Temperatur oder die elektrokardiographische Aktivität betrifft.

8. System nach Anspruch 1, wobei das externe Kommunikationsgerät (56) einen HF-Sender enthält, der ein HF-Signal sendet, und wobei das Mobiltelefon einen Empfänger (58) enthält, der das HF-Signal empfängt und die Daten über das Mobilfunknetz zu der entfernten Station weitersendet.

9. System nach Anspruch 8, wobei das tragbare Überwachungsgerät ebenfalls einen HF-Sender (82) enthält, wobei der HF-Empfänger des Mobiltelefons beide HF-Signale empfängt.

10. Verfahren zum Übertragen von medizinischen Informationen innerhalb eines drahtlosen Netzwerks, das Folgendes umfasst:

Überwachen eines physiologischen Zustands eines Patienten (10) über einen Sensor (34, 74), der mit dem Patienten (10) verbunden ist,
Übertragen von Daten bezüglich der von dem Sensor (34, 74) erkannten physiologischen Zustände über ein erstes Körperkommunikationsgerät (16, 78), das unter Verwendung eines kapazitiven, an den Körper gekoppelten Nahfeldprotokolls über den Patienten (10) kommuniziert,
Empfangen von Daten von dem mindestens einen tragbaren Überwachungsgerät (12, 70) durch ein zweites Körperkommunikationsgerät (18, 52, 80), das mit dem ersten Körperkommunikationsgerät (16, 78) unter Verwendung des kapazitiven, an den Körper gekoppelten Nahfeldprotokolls kommuniziert, wobei die Daten empfangen werden, wenn ein Mobiltelefon, das das zweite Körperkommunikationsgerät (18, 52, 80) enthält, den Patienten berührt oder sich in seiner unmittelbaren Nähe befindet, und ein externes Kommunikationsgerät (24, 60, 72), und wobei das tragbare Überwachungsgerät (12, 70) einen HF-Sender (82) mit geringer Energie enthält und das Mobiltelefon einen HF-Empfänger (84) enthält, der die physiologischen Daten direkt von dem tragbaren Überwachungsgerät empfängt, wenn das zweite Körperkommunikationsgerät (18) den Patienten nicht berührt oder sich nicht in seiner unmittelbaren Nähe befindet, und
Übertragen der empfangenen Daten zu einer entfernten medizinischen Überwachungsstation über ein Mobilfunknetz mit dem externen Kommunikationsgerät (24, 60, 72).

11. Verfahren nach Anspruch 10, das ferner Folgendes umfasst:

Überwachen der erkannten Daten des physiologischen Zustands und Erzeugen eines Alarmsignals als Reaktion darauf, dass die erkannten physiologischen Daten außerhalb eines vorbestimmten Schwellenwertes liegen.

12. Verfahren nach Anspruch 10, wobei das Übertragen der empfangenen Daten Folgendes umfasst:

Senden eines HF-Signals an ein Weiterleitungssystem, das die Daten über das Mobilfunknetz weitersendet.

13. Verfahren nach Anspruch 12, das ferner Folgendes umfasst:

Übertragen der Daten bezüglich dem erkannten physiologischen Zustand unter Verwendung eines HF-Protokolls und mit dem Mobiltelefon Empfangen entweder des HF-Protokolls oder des HF-Signals und Weitersenden der Daten über das Mobilfunknetz.

14. Verfahren nach Anspruch 10, wobei der physiologische Zustand entweder die Herzfrequenz, die Pulsoximetrie, die Atemfrequenz, den Blutdruck, die Temperatur oder die elektrokardiographische Aktivität betrifft.

Revendications

1. Réseau sans fil pour surveiller un patient (10), le réseau sans fil comprenant : au moins un moniteur portable (12, 70) comprenant :

un capteur d'état physiologique (34, 74) couplé au patient (10) pour détecter et communiquer des données relatives à une fonction physiolo-

gique du patient (10), et
une première unité de communication corporelle (16, 78) qui est en interface avec le capteur d'état physiologique pour communiquer sur le patient (10) en utilisant un protocole à couplage de corps capacitif de champ proche ; et
un système de relais (14, 50, 72) comprenant :
une deuxième unité de communication corporelle (18, 52, 80) qui reçoit des données de la première unité de communication corporelle (16, 78) et communique avec celle-ci en utilisant un protocole à couplage de corps capacitif de champ proche, et
une unité de communication externe (24, 56, 72) qui communique les données à un poste de surveillance médicale distant,
dans lequel l'unité de relais comprend un téléphone cellulaire (24, 60, 72), le téléphone cellulaire comprenant la deuxième unité de communication corporelle (18, 52, 80) qui reçoit les données transmises avec le protocole à couplage de corps lorsque le téléphone cellulaire touche le patient ou est très proche de celui-ci et l'unité de communication externe (24, 60, 72) qui communique les données sur un réseau de téléphone cellulaire au poste distant,

caractérisé en ce que le moniteur portable (12, 70) comprend un émetteur de fréquences radio de faible puissance (82) et le téléphone cellulaire comprend un récepteur de fréquences radio (84) qui reçoit les données physiologiques directement du moniteur portable lorsque la deuxième unité de communication corporelle (18) ne touche pas le patient ou n'est pas très proche de celui-ci.

2. Système selon la revendication 1, l'au moins un moniteur portable (12, 70) comprenant en outre :

un capteur d'alarme (36, 76) qui est en interface avec le capteur d'état physiologique (34, 74) pour détecter si l'état physiologique détecté est à l'extérieur d'un seuil prédéterminé et qui amène la première unité de communication (16, 78) à envoyer un signal d'alarme.

3. Système selon la revendication 1, le réseau corporel sans fil comprenant en outre :

un composant de relais (60) qui reçoit des données de l'un du moniteur portable (12, 70) et de l'unité de communication externe (56) et qui transmet les données au poste de surveillance distant.

4. Système selon la revendication 3, dans lequel les données sont transmises par le biais d'un signal de fréquences radio.

5. Système selon la revendication 3, dans lequel le réseau sans fil comprend en outre :

un composant d'identification (54) qui fournit un identifiant de patient unique avec les données.

6. Système selon la revendication 1, dans lequel le composant de relais (14, 60, 72) diffuse les données reçues sur un réseau de téléphone cellulaire.

7. Système selon la revendication 1, dans lequel le capteur d'état physiologique est l'un de capteurs de fréquence cardiaque, d'oxymétrie de pouls, de fréquence respiratoire, de pression artérielle, de température et d'activité électrographique.

8. Système selon la revendication 1, dans lequel l'unité de communication externe (56) comprend un émetteur de fréquences radio qui transmet un signal de fréquences radio et dans lequel le téléphone cellulaire comprend un récepteur (58) qui reçoit le signal de fréquences radio et qui retransmet les données sur le réseau de téléphone cellulaire au poste distant.

9. Système selon la revendication 8, dans lequel le moniteur portable comprend également un émetteur de fréquences radio (82), le récepteur de fréquences radio de téléphone cellulaire recevant les deux signaux de fréquences radio.

10. Procédé de communication d'informations médicales dans un réseau sans fil, comprenant :

la surveillance d'un état physiologique d'un patient (10) par le biais d'un capteur (34, 74) couplé au patient (10) ;
la communication de données relatives aux fonctions physiologiques détectées par le capteur (34, 74) par le biais d'une première unité de communication corporelle (16, 78) qui communique sur le patient (10) en utilisant un protocole à couplage de corps capacitif de champ proche ;
la réception de données de l'au moins un moniteur portable (12, 70) par une deuxième unité de communication corporelle (18, 52, 80) qui communique avec la première unité de communication corporelle (16, 78) en utilisant le protocole à couplage de corps capacitif de champ proche, dans lequel les données sont reçues lorsqu'un téléphone cellulaire, qui comprend la deuxième unité de communication corporelle (18, 52, 80), touche le patient ou est très proche de celui-ci et une unité de communication externe (24, 60, 72) et dans lequel le moniteur portable (12, 70) comprend un émetteur de fréquences radio de faible puissance (82) et le téléphone cellulaire comprend un récepteur de fréquen-

ces radio (84) qui reçoit les données physiologiques directement du moniteur portable lorsque la deuxième unité de communication corporelle (18) ne touche pas le patient ou n'est pas très proche de celui-ci ; et
la communication des données reçues à un poste de surveillance médicale distant sur un réseau de téléphone cellulaire avec l'unité de communication externe (24, 60, 72).

11. Procédé selon la revendication 10, comprenant en outre :

la surveillance des données d'état physiologique détecté et la génération d'un signal d'alarme en réponse au fait que les données d'état physiologique détecté sont à l'extérieur d'un seuil prédéterminé.

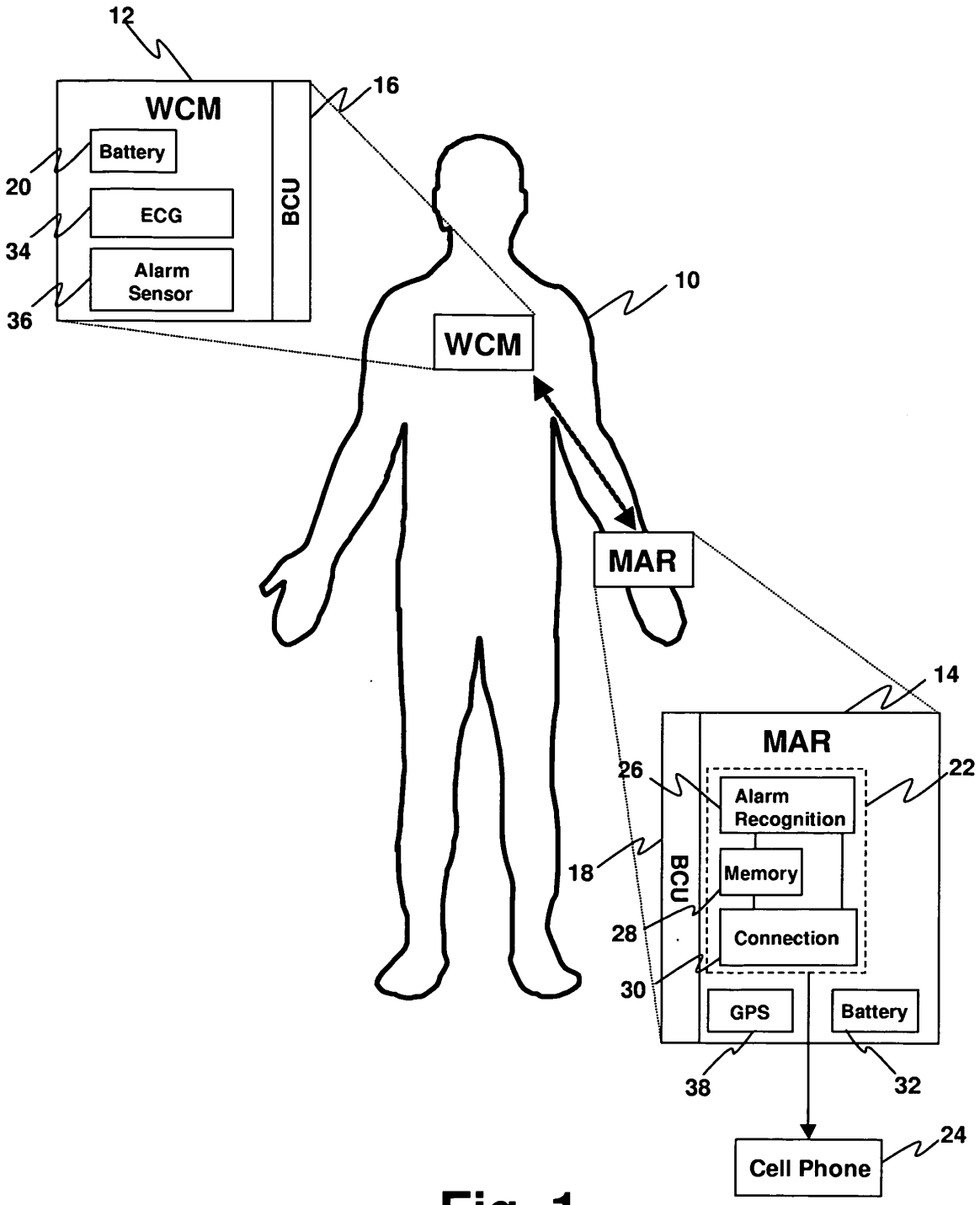
12. Procédé selon la revendication 10, dans lequel la communication des données reçues comprend :

la transmission d'un signal de fréquences radio à un système de relais qui retransmet les données sur le réseau de téléphone cellulaire.

13. Procédé selon la revendication 12, comprenant en outre :

la communication des données relatives à l'état physiologique détecté en utilisant un protocole de fréquences radio ; et, avec le téléphone cellulaire, la réception de l'un du protocole de fréquences radio et du signal de fréquences radio et la retransmission des données sur le réseau de téléphone cellulaire.

14. Procédé selon la revendication 10, dans lequel l'état physiologique est l'un de la fréquence cardiaque, l'oxymétrie de pouls, la fréquence respiratoire, la pression artérielle, la température et l'activité électrographique.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WCM
Battery
ECG
Alarm Sensor
BCU
16
20
34
36
10
WCM
MAR
14
MAR
26
Alarm Recognition
22
18
BCU
Memory
28
Connection
30
GPS
Battery
38
32
24
Cell Phone

Fig. 1

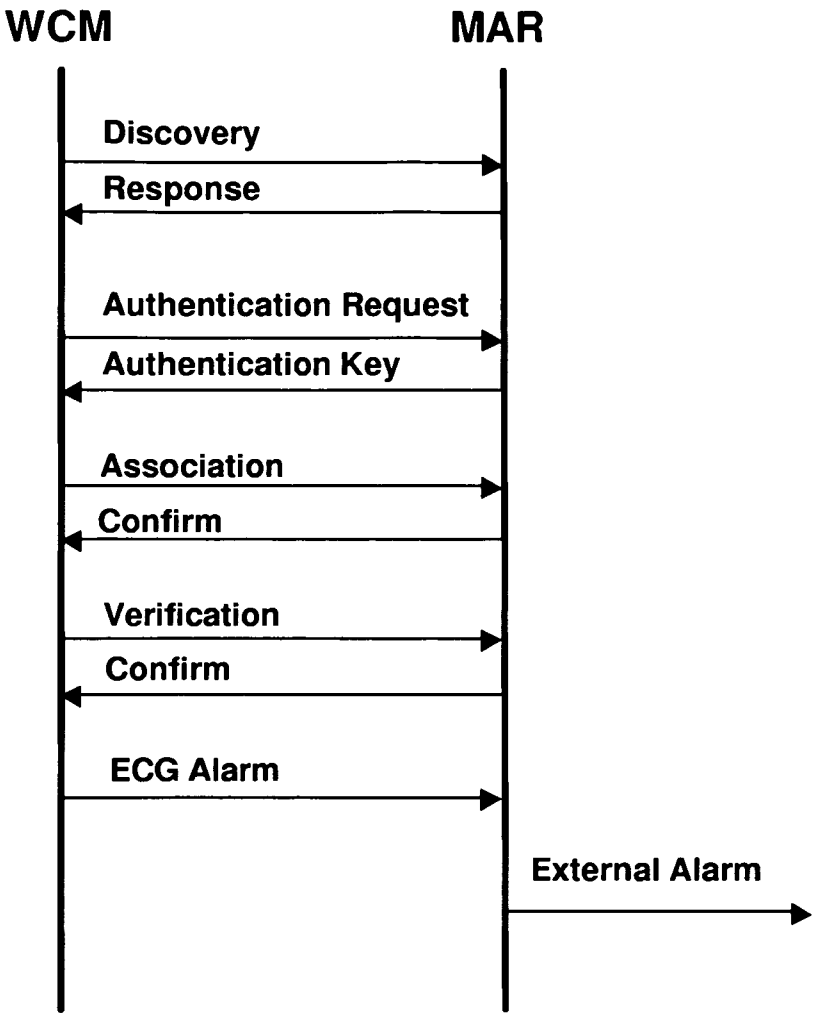
WCM
MAR
Discovery
Response
Authentication Request
Authentication Key
Association
Confirm
Verification
Confirm
ECG Alarm
External Alarm

Fig. 2

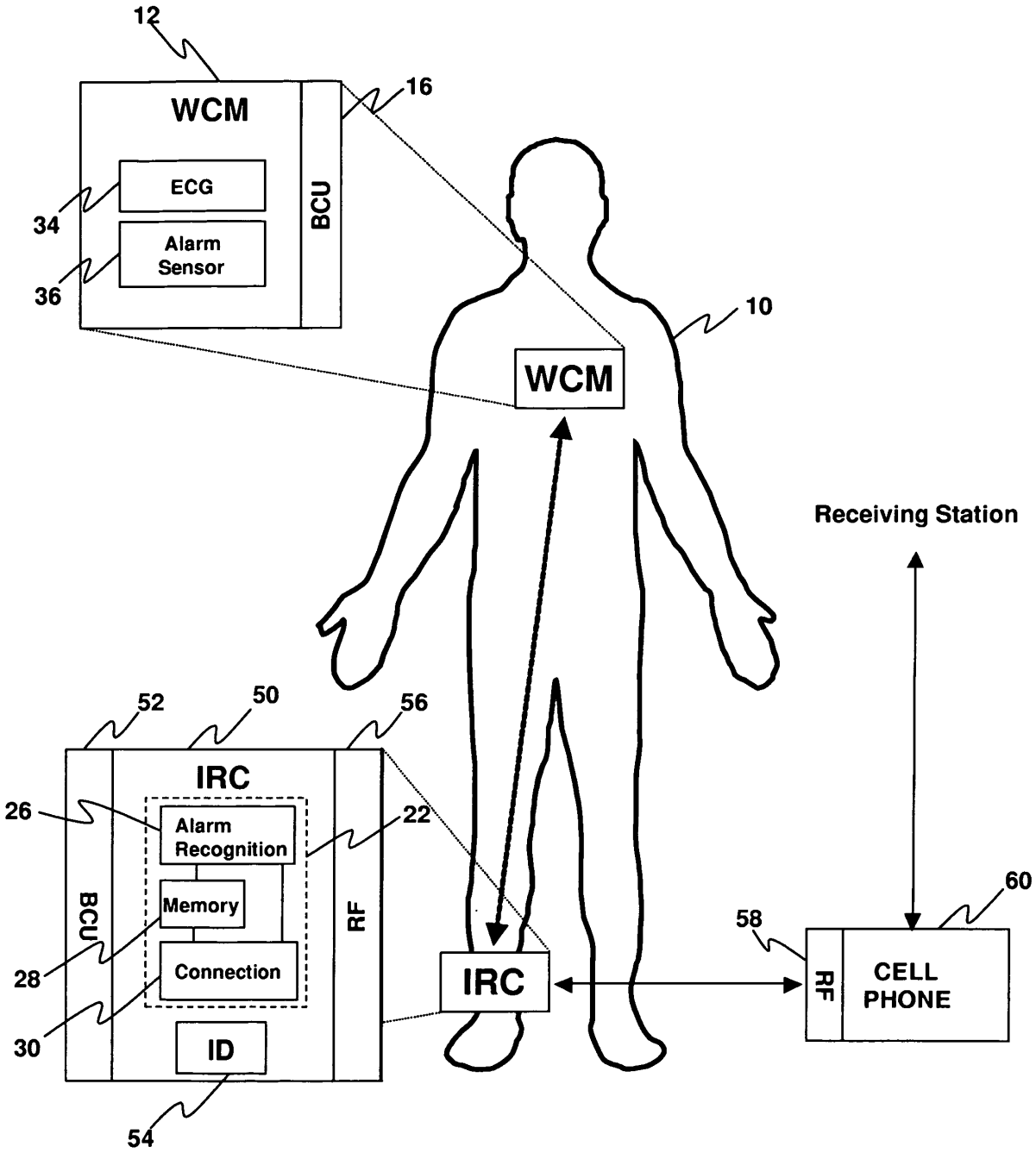
12
WCM
16
ECG
34
Alarm Sensor
36
BCU
10
WCM
Receiving Station
52
50
56
IRC
26
Alarm Recognition
22
Memory
28
Connection
30
ID
BCU
RF
54
IRC
58
60
RF
CELL PHONE

Fig. 3

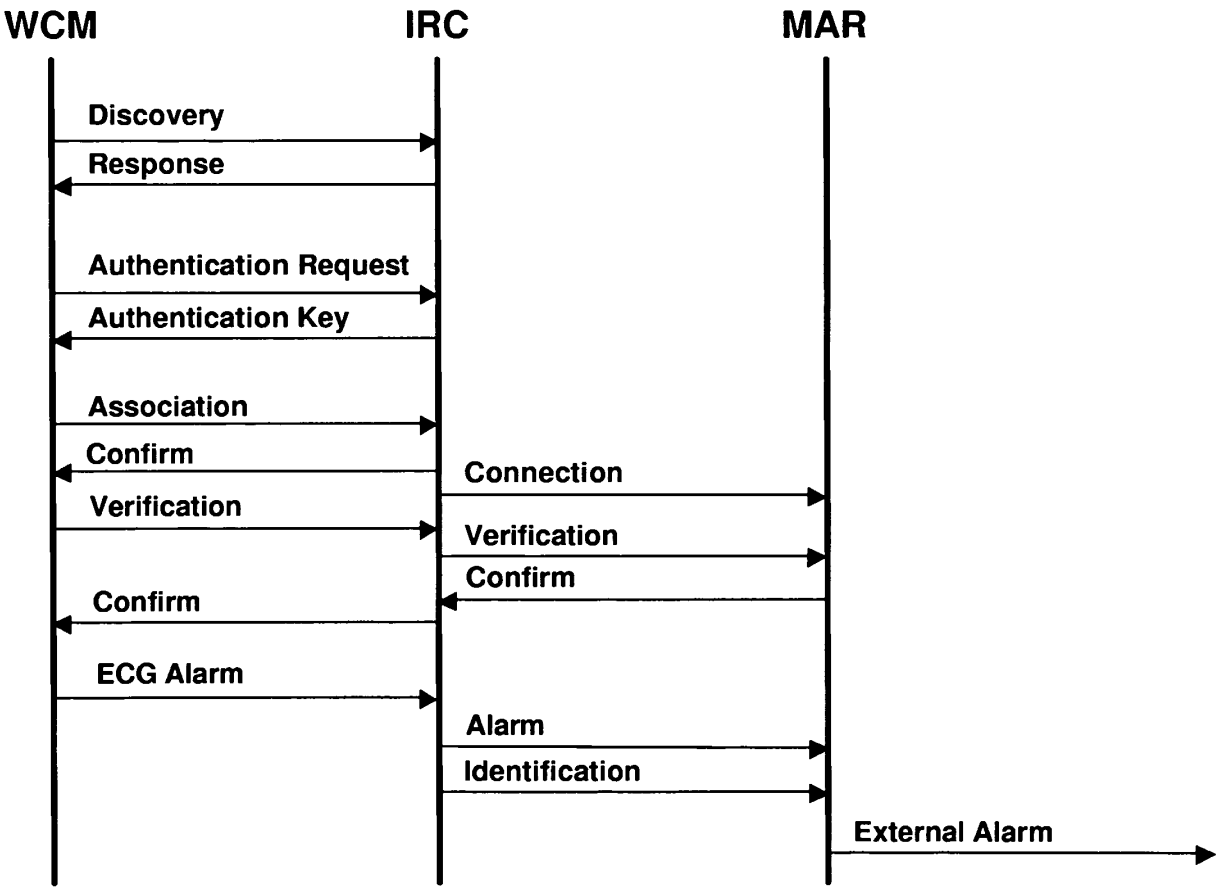
WCM
IRC
MAR
Discovery
Response
Authentication Request
Authentication Key
Association
Confirm
Verification
Confirm
ECG Alarm
Connection
Verification
Confirm
Alarm
Identification
External Alarm

Fig. 4

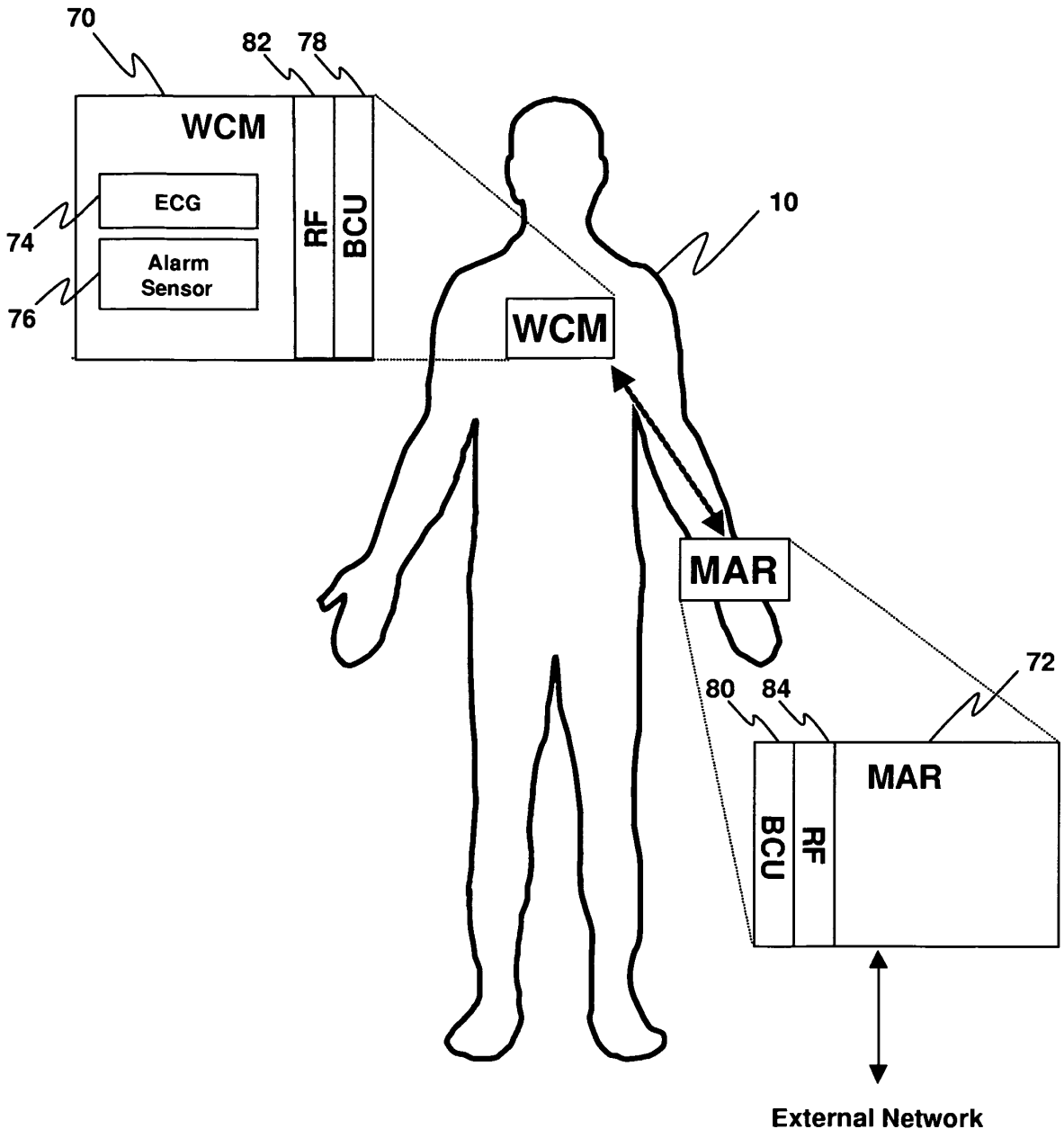
70
82
78
WCM
ECG
Alarm Sensor
RF
BCU
74
76
10
WCM
MAR
72
80
84
MAR
BCU
RF
External Network

Fig. 5

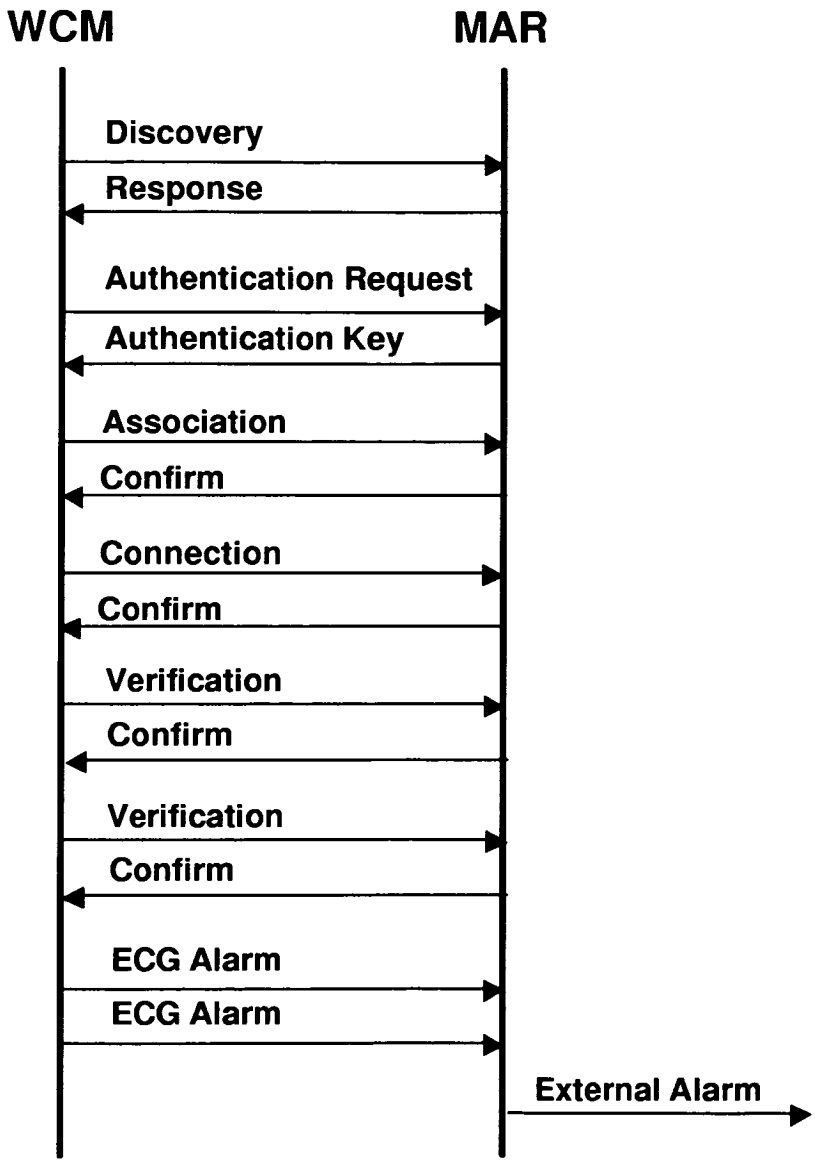
WCM
MAR
Discovery
Response
Authentication Request
Authentication Key
Association
Confirm
Connection
Confirm
Verification
Confirm
Verification
Confirm
ECG Alarm
ECG Alarm
External Alarm

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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摘要(译)

用于监视患者（10）的无线网络包括至少一个可佩戴监视器（12,70），其包括耦合到患者（10）的生理状况传感器（34,74），以感测和传送与该患者的一个生理功能相关的数据。病人（10）。第一身体通信单元（16,88）与至少一个可佩戴监视器（12,70）对接，以利用近场电容体耦合协议在患者（10）上进行通信。中继系统（14,50,72）包括第二主体通信单元（18,52,80），其接收来自至少一个可穿戴监视器（12,70）的数据并与第一主体通信单元（16,88）通信利用近场电容体耦合协议。外部通信单元（22）经由蜂窝电话网络或因特网将数据传送到远程医疗监控站。