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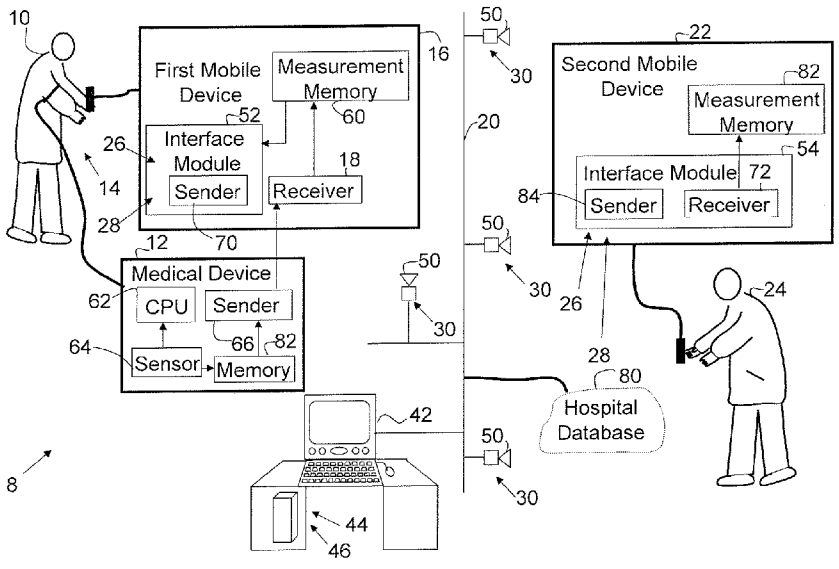
Declaration under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

[Continued on next page]

(54) Title: IP BASED MONITORING AND ALARMING



(57) Abstract: A patient monitoring system (8) monitors health related parameters of a patient (10). A medical device (12) obtains measurements of the health related parameters of the patient (10). A first mobile device (16), associated with the patient (10), wirelessly collects and transmits the health related parameters of the patient (10). A second mobile device (22), in operative communication with first mobile device, receives the transmitted health related parameters of the patient.

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IP BASED MONITORING AND ALARMING

DESCRIPTION

The present application relates to monitoring arts. It finds particular application in relation to patient monitoring at the hospital and will be described with particular reference thereto. However, it is to be appreciated that the following will also find application in conjunction with patient monitoring in retirement communities, assisted living, pharmacies, community centers, at home, and the like.

Typically, in-hospital patient monitoring is based on wired connections to measure vital parameters of the patient. More specifically, in telemetry monitoring systems, the patient is provided with a set of sensors. The sensors are typically wired to a Patient Worn Device (PWD), which is equipped with an infrastructure-based radio technology (e.g. DECT or WLAN). The PWD wirelessly transmits the patient's vital parameters to the one of the access points of the wireless infrastructure. Once at the access point, the data is forwarded over cable to the nurse station or a patient information center, where medical staff monitors the patient's vital parameters. However, the telemetry monitoring systems are expensive. In case of a critical situation, the physician receives a pager alarm from the nurse station and has to be present at either the patient side or the nurse station to evaluate the situation.

In other monitoring systems, the sensors, which are attached to the patient, form a Body Sensor Network (BSN) that communicates wirelessly to the bedside monitor in the proximity of the patient. Examples of a short-range wireless technology that can be used in such systems are Bluetooth, IEEE 802.15.4/ ZigBee, and the like. The body sensor networks are typically deployed in intensive care units where patients are near a bedside monitor. The BSN cannot be used, unless combined with other wireless technologies, to monitor moving patients. Further, similar to the telemetry monitoring systems, the BSN concept does not integrate the physician in the system.

One approach is to provide physicians with an IP-enabled mobile phone such as Cisco Wireless IP Phone 7920 that displays real-time vital parameters of the patient independently of the physicians location as long as the attending physician remains within the hospital wireless infrastructure. In such systems, the physicians can receive alarms

about a potentially hazardous change in the patient's vital parameters and examine the patient's vital parameters without the need to be physically present at the nurse station or the bedside monitor. The IP monitoring solution enables the mobility of the medical staff within the hospital and optimizes efficiency. Nevertheless the system does not provide patients with mobility nor free them from obtrusive sensor wiring.

The present application provides new and improved methods and apparatuses which overcome the above-referenced problems and others.

In accordance with one aspect, a patient monitoring system which monitors health related parameters of a patient is disclosed. A medical device obtains measurements of the health related parameters of the patient. A first mobile device, coupled with the patient, wirelessly collects and transmits the health related parameters of the patient. A second mobile device, in operative communication with first mobile device, receives the transmitted health related parameters of the patient.

In accordance with another aspect, a method for monitoring a patient is disclosed. Wireless first and second mobile devices are assigned to a patient and a medical clinician. The first mobile device is associated to a medical measurement device which is linked to a corresponding patient. A health related parameter of the patient is measured with the medical measurement device. The results of the measurements are collected with the first mobile device. The results of the measurements of the patient are transmitted to the second mobile device.

In accordance with another aspect, a patient monitoring system for monitoring health related parameters of a patient is disclosed. A medical device obtains measurements of the health related parameters of the patient. A first mobile device is associated with the patient, for wirelessly collecting and transmitting the health related parameters of the patient for review. A second mobile device is in operative communication and associated with the first mobile device and a clinician, for receiving the transmitted health related parameters of the patient.

One advantage is that physicians wirelessly receive and monitor the patient's measurement data.

Still further advantages of the present invention will be appreciated to those of ordinary skill in the art upon reading and understand the following detailed description.

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 is a diagrammatic illustration of a patient monitoring system.

With reference to FIGURE 1, in a patient monitoring system **8**, vital signs measurements or health related parameters, such as temperature, blood pressure, weight, heart rate and rhythm, respiration, oxygen, and the like, are monitored from one or more patients **10** using a medical or measurement device or devices **12**. In one embodiment, the medical devices **14** associated with the same patient form a body sensor network or BSN **14**. Each patient **10** wears a first or patient mobile device **16** such as an IP phone which includes a short range communication interface such as a receiver **18** to wirelessly receive measurements taken by each measurement device **12**. The patient mobile device **16** further wirelessly communicates the measurements via a local area network **20** to a second or physician mobile device **22** such as an IP phone worn by a physician or other medical professional **24**.

Generally, the IP phone **16** uses a general-purpose communication protocol to communicate voice or digital information via a best effort type communication network such as a private phone network, local area network (LAN) or the Internet. An example of a suitable IP phone is a unified wireless IP phone 7920 manufactured by Cisco which uses IEEE 802.11b protocol. In one embodiment, the patient's and clinician's mobile devices **16**, **22** are preconfigured to communicate with one another as, for example, when the patient is initially checked in at the hospital and the attending physician is assigned to the patient. In one embodiment, the first and second IP phones are configured into a virtual local area network (VLAN). For example, the network administrator configures the first and second mobile devices into the VLAN through software. For example, when the first mobile device moves to another location, the first mobile device stays within the same VLAN without the need for any hardware reconfiguration.

Of course, the mobile devices **16**, **22** can be cellular phones, palm computers, notebook computers, laptop computers, held-hand devices, PDAs, pagers,

desktop computers, or any other devices which can be configured for wireless communications with the local area network of the hospital or the Internet. The first and second mobile devices **16, 22** each includes an associated communication interface including appropriate software and hardware **26, 28** to communicate with the local area network or any other appropriate communication net.

Generally, the local area network **20** couples multiple access points or stations **30** (only four access points are shown for simplicity of illustration), which are distributed throughout a defined area or space to provide wireless service to the mobile devices **16, 22** which operate within the space and are configured to communicate with the access points **30**. Each access point **30** has a finite operational range, which is typically 30-50 meters and operates within its own dedicated radio channel with a known radiofrequency.

The access points **30** are wired or otherwise connected into the wired network infrastructure or the local area network (LAN) **20**. A central computer **42**, which is connected to the local area network **20** and includes associated software means **44** and hardware means or processor **46**, oversees the operations of the monitoring system **8** and, for example, provides an interface to various systems and/or applications which are available within the local area network **20**.

Each access point **30** includes an antenna or receiving/transmitting means **50** to communicate bi-directionally with the mobile devices **16, 22**. E.g., the access points **30** at least receive, buffer, and transmit data between the mobile devices **16, 22** and the wired network **20**. Each mobile device **16, 22** includes associated transceivers or interface modules **52, 54** which provide an interface between the mobile devices **16, 22** and the receiving/transmitting means **50**.

With continuing reference to FIGURE 1, the patient mobile device **16** includes at least a measurement memory **60** for storing results of the measurements. Of course, it is also contemplated that more information can be stored in the patient mobile device **16**, for example, name, anamnesis, diagnosis, therapy and the like.

Each patient mobile device **16** is attached or carried in a close proximity to the patient's body. Likewise, the physician's mobile device **22** is attached or carried in close proximity of physician's body.

The medical device **12** typically includes a central processing unit (CPU) **62**, and typically a sensor **64**. In one embodiment, the medical device **12** includes a user interface for manual input of data. The medical device **12** takes the measurements via the sensor **64** or user interface and, in one embodiment, attaches a time stamp to the measurement. The measurement result is wirelessly sent via a sender **66** of the measurement device **12** to the receiver **18** of the first mobile device **16**, for example, using a body coupled communication protocol. A sender **70** wirelessly sends the patient's data via the local area network **20** to a receiver **72** of the second mobile device **22** of the medical professional assigned to this particular patient. The medical professional, for example, receives the stored or real time measurements of the patient on request. Alternatively, the medical professional continuously receives patient's measurement results on the second mobile device **22**. In one embodiment, the measurement data is stored in the measurement memory **60**. In another embodiment, the measurement data of the patient **10** is stored in a hospital database **80**. The measurement result at least includes the measurement values. In one embodiment, the measurement result includes other parameters such as date, time, type of the measurement device used, and other. Optionally, the measurement device **12** includes a memory **82** in which the measurements are stored for future communication. In one embodiment, the physician **24** retrieves the results from at least one of the measurement memory **60**, medical device memory **82** and hospital database **80** by sending a request via a second mobile device sender **84**. This allows the physician **24** to review the historical data of the patient **10**. In one embodiment, the mobile devices **16, 22** include GPS subsystems which facilitate rapid location functions.

In one embodiment, a positioning system enables medical staff to quickly find the patient they are looking for or/and the system to notify the nearest physician or nurse in case of a critical situation. This enhancement leads to a further increase in the efficiency of hospital staff.

When the measurements are determined by the CPU **62**, or centrally at the hospital database to be critical, an audible or visible alarm is sent to the mobile device **22** of the attending physician or other medical personnel. If the condition is urgent and the attending physician is located too far from the patient, an alarm can also be sent to the closest physician or other medical professionals. Using the voice protocol, the physician

can quickly establish voice communications with the patient as well as with other medical professionals responding to the alarm.

In one embodiment, the patients are monitored at another location, e.g., when the patients have WLAN coverage at home or in commercial, educational, commercial buildings, or other locations with a publicly accessible WLAN internet connection. The home and hospital WLANs interconnect over the internet. An important cost reduction is involved through the use of IP-based vital data transmission. Furthermore, cheap IP phone calls are also possible for personal contact between patient and physician. The vital sign monitoring in combination with the cheap phone call possibility enables a dramatic reduction of hospital and practice visits, since such visits can be restricted to those necessary cases (e.g. critical situations or cases where additional medical tests are required). In another embodiment, the mobile devices are dual IP phone/cell phone units. This provides a redundant backup communication system when direct IP phone communication is not available.

Physicians can either continuously receive the patient's vital signs or consult the patient's vital signs after having received an alarm notification. By adding a storage capability to the system, physicians can also receive and examine the patient's past vital signs, with which the physicians can judge the development of the patient or better evaluate critical situations that aroused in the past.

In this manner patients are mobile and completely free of cables (as opposed to existing telemetry solutions). The patient only wears one or more small measurement devices under his/her garments and carries an IP phone. Of course, it is contemplated that the mobile devices **16**, **22** can be incorporated into the garments, attached to the garments, coupled to the garments of the patient or clinician, and the like. This accelerates the recovery and raises the comfort level of the patients. Physicians are also mobile, which maximizes their work output. Patients' vital signs can be checked from hallways, elevators, cafeterias, or most anywhere the physician happens to be. Patient safety is increased for there is no need for a physician to be in close proximity to evaluate the vital parameters. An IP telephone call to the patient enables physicians to retrieve verbal information that helps to assess the patient's condition. This increases the quality of patient care. The (re)utilization of the hospital WLAN infrastructure allows for very cost-efficient implementations of the above. Seamless transitions between different hospital areas where

patient monitoring is needed is enabled (the BSN at the patient's body need not be replaced).

In one embodiment, a plurality of patients is assigned to the medical professional. Typically, when each patient is admitted to the health care facility, a corresponding unique identification number is configured for this patient. The configured unique patient's identification number is associated to a corresponding patient record in the hospital database. The patient's identifier is associated with the patient's mobile device. Alternatively, the patient's identifier is associated with the transmitted measurement results. Each physician or medical professional is assigned a unique physician's identifier as well. The unique identifiers allow relating the measurement results of the specific patient to the assigned clinician. In one embodiment, a graphical user interface facilitates association of each patient's identifier to the attending physician's identifier and corresponding attending physician's mobile device. Of course, it is contemplated that the patients' mobile devices can be associated with the physician's mobile device by any other appropriate means, such as software program or algorithm.

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 constructed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

CLAIMS

Having thus described the preferred embodiments, the invention is now claimed to be:

1. A patient monitoring system **(8)** for monitoring health related parameters of a patient **(10)**, the system comprising:

a medical device **(12)** for obtaining measurements of the health related parameters of the patient **(10)**;

a first mobile device **(16)**, associated with the patient **(10)**, for wirelessly collecting and transmitting the health related parameters of the patient **(10)**; and

a second mobile device **(22)**, in operative communication with first mobile device **(16)**, for receiving the transmitted health related parameters of the patient **(10)**.

2. The system as set forth in claim 1, wherein at least one of the first and second mobile device **(16, 22)** includes an IP phone.

3. The system as set forth in claim 1, wherein at least one of the first and second mobile device **(16, 22)** includes:

an interface module **(52, 54)** which is configured for communications with the network **(20)**.

4. The system as set forth in claim 1, wherein:

the medical device **(12)** includes a sensor **(64)** for sensing at least one parameter of the patient, and a short range or body coupled communication sender **(66)**;

the first mobile device **(16)** includes a receiver **(18)** for receiving the short range or body coupled communication from the medical device, an IP interface module **(52)** programmed with software **(26)** for wireless communication with a local area network **(20)**, and a memory **(60)**; and

the second mobile device **(22)** includes one of an IP phone, a palm notebook, or laptop computer with a wireless interface, or a PDA or other mobile device

which communicates wirelessly with the local area network **(20)** directly or through an internet interconnection.

5. The system as set forth in claim 1, wherein the medical device **(12)** includes:

a sensor **(64)** for measuring a physiological parameter of the patient **(10)**.

6. The system as set forth in claim 1, wherein at least one of the first and second mobile devices **(16, 22)** includes:

a measurement memory **(60, 82)** for storing at least the measurement results.

7. The system as set forth in claim 1, further including:

a database **(80)** from which the second mobile device **(22)** withdraws the patient's measurements.

8. The system as set forth 1, further including:

a body sensor network **(14)** which includes a plurality of wireless medical devices **(12)**, operatively connected to the patient **(10)** which wireless medical devices **(12)** collect and transfer information related to the patient's health.

9. A monitoring method, comprising:

assigning wireless first and second mobile devices correspondingly to a subject and a reviewer;

associating the first mobile device to a medical measurement device which is linked to a corresponding subject ;

measuring a health related parameter of the subject with the medical measurement device;

collecting the results of the measurements with the first mobile device; and

transmitting the results of the measurements of the subject to the second mobile device.

10. The method as set forth in claim 9, wherein the first and second mobile devices each have a unique IP address and wherein:

the assigning step includes storing the IP address of the first mobile device in the second mobile device and the IP address of the second mobile device in the first mobile device;

with the first mobile device the transmitting step includes wirelessly transmitting the measured health parameter and the second IP address to a local area network and wirelessly transmitting the measured health parameter and the second IP address to the second mobile device.

11. The method as set forth in claim 9, further including:

establishing a communication link between the first and second mobile devices via at least one of Internet, local area network, private phone network, or other network.

12. The method as set forth in claim 9, wherein at least one of the first mobile device and the first measurement device include a memory which stores the health parameter measurements, and further including:

monitoring the measured health parameters to determine if health parameters are in a critical range;

in response to determining that the measured health parameter is in a critical range, sending an alarm to the second mobile device;

in response to receiving the alarm, accessing the first mobile device from the second mobile device, displaying the health parameter measurements in real time on the second mobile device, and displaying selected stored health parameters on the second mobile device.

13. The method as set forth in claim 9, further including:

comparing the measured health parameters to a prespecified range which parameters include at least one of an Electrocardiogram (ECG), Electroencephalogram (EEG), an Electromyogram (EMG), an invasive blood pressure (BP), a non-invasive blood

pressure (NiBP), pulse, cardiac output, respirations, blood oxygen (SpO_2), and core body temperature;

determining if the measured health parameters are out of range;

in response to determining that the measured health parameters are in the range, automatically displaying the health parameter measurements in real time on the second mobile device; and

in response to determining that the measured health parameters are out of range, continuing automatically displaying the health parameter measurements in real time on the second mobile device, displaying selected critical health parameters on the second mobile device, and generating one of a video and audio alarm for medical personnel, which alarm includes at least one of text, graphics, sound, vibration, and color accents.

14. The method as set forth in claim 9, further including:

receiving the transmitted health related parameters of the subject by at least one of a clinician assigned to the subject, a third party and a clinician other than the assigned clinician who is physically closer to the subject than the assigned clinician.

15. The method as set forth in claim 9, further including:

measuring a physiological parameter of the subject **(10)** with a sensor.

16. The method as set forth in claim 9, further including:

storing the measurement results at least in one of:

a medical device memory,

a first mobile device memory,

a second mobile device memory,

a hospital database, and

a server.

17. A patient monitoring system **(8)** for monitoring health related parameters of a patient **(10)**, the system comprising:

a medical device **(12)** for obtaining measurements of the health related parameters of the patient **(10)**;

a first mobile device **(16)**, associated with the patient **(10)**, for wirelessly collecting and transmitting the health related parameters of the patient **(10)** for review;

a second mobile device **(22)**, associated with the first mobile device **(16)** and a clinician **(24)**, for receiving the transmitted health related parameters of the patient; and

a network **(20)**, in operative communication with the first and second mobile devices **(16, 22)**, for receiving the health related parameters of the patient from the first mobile device and transmitting the health related parameters of the patient **(10)** to the second mobile device **(22)**.

18. The system as set forth in claim 17, wherein at least one of the first and second mobile device includes at least one of an IP phone, cellular phone, a laptop computer, and a pager.

19. A method for monitoring a plurality of patients, comprising:

assigning an identification code to each patient which identification code uniquely identifies the patient;

assigning first mobile devices to selected patients;

associating each patient's identification code with the respective assigned first mobile device;

assigning an identification code to a clinician which identification code uniquely identifies the clinician;

associating the identification code of each patient with the selected clinician;

assigning a second mobile device to a selected physician;

associating the physician's identification code with the assigned second mobile device;

measuring a physiological function of each of the plurality of patients; and

transmitting results of the measurements to the second mobile device.

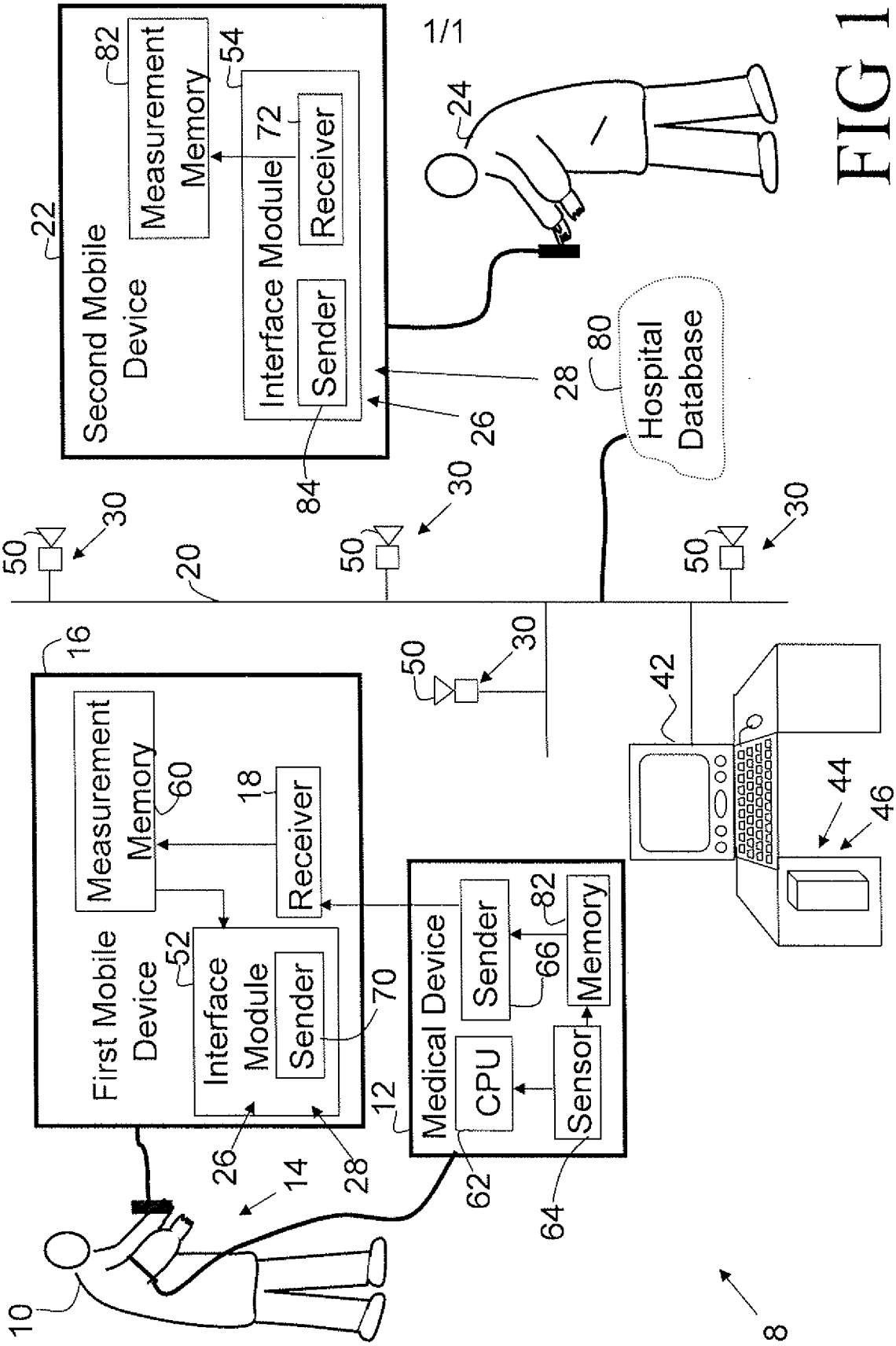
1/1
Second Mobile Device
22
Measurement Memory
82
Interface Module
72
54
Receiver
Sender
84
26
28
24
Hospital Database
80
30
50
20
16
First Mobile Device
Measurement Memory
60
18
Receiver
Interface Module
52
Sender
70
26
28
14
10
12
Medical Device
Sender
82
66
Memory
CPU
Sensor
62
64
42
44
46
8

FIG 1

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/077981

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F A61B H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	EP 1 587 017 A (BIOTRONIK GMBH & CO KG [DE] BIOTRONIK CRM PATENT AG [CH]) 19 October 2005 (2005-10-19) paragraphs [0001] - [0003], [0009], [0013], [0015], [0020] - [0023], [0026] - [0028], [0032] figures 1-1, 1-2	1,3,5-7, 9,11, 14-19 2,4,8, 10,12,13
Y	WO 2006/056896 A (KONINKL PHILIPS ELECTRONICS NV [NL]; ROSNOV BRIAN SCOTT [US]) 1 June 2006 (2006-06-01) page 3, lines 20-28 page 4, lines 19-25 figure 1	2,4,10, 12,13

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 February 2008	27/02/2008

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Rapp, Alexander

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/077981

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2005/122879 A (PHILIPS INTELLECTUAL PROPERTY [DE]; KONINKL PHILIPS ELECTRONICS NV [NL) 29 December 2005 (2005-12-29) page 5, line 32 - page 6, line 24 figure 1 -----	8

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2007/077981

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1587017 A	19-10-2005	NONE	
WO 2006056896 A	01-06-2006	CN 101065948 A	31-10-2007
		EP 1817894 A1	15-08-2007
WO 2005122879 A	29-12-2005	CN 1968645 A	23-05-2007

专利名称(译)	基于IP的监控和报警		
公开(公告)号	EP2066229A1	公开(公告)日	2009-06-10
申请号	EP2007842120	申请日	2007-09-10
[标]申请(专利权)人(译)	皇家飞利浦电子股份有限公司		
申请(专利权)人(译)	皇家飞利浦电子N.V.		
当前申请(专利权)人(译)	皇家飞利浦电子N.V.		
[标]发明人	ELIXMANN MARTIN ESPINA JAVIER FALCK THOMAS		
发明人	ELIXMANN, MARTIN ESPINA, JAVIER FALCK, THOMAS		
IPC分类号	A61B5/00 G06F19/00		
CPC分类号	A61B5/002 A61B5/1112 A61B5/747 G06F19/3418 G16H40/67		
优先权	60/825957 2006-09-18 US		
外部链接	Espacenet		

摘要(译)

患者监测系统（8）监测患者（10）的健康相关参数。医疗设备（12）获得患者（10）的健康相关参数的测量值。与患者（10）相关联的第一移动设备（16）无线地收集并发送患者（10）的健康相关参数。与第一移动设备可操作通信的第二移动设备（22）接收所发送的患者的健康相关参数。