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(54) Patient monitoring system having two-way communication

Anordnung zur Patientenüberwachung mit bidirektionaler Kommunikation

Système de surveillance de patients ayant une transmission bi-directionnelle

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(56) References cited:
EP-A- 0 602 459
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Description

[0001] The invention relates to patient monitoring systems and particularly to patient monitoring systems that allow the patient to ambulate through the care unit of a clinical facility.

[0002] Most patient monitoring systems that allow a patient to ambulate through a care unit in a clinical facility use telemetry-based communication schemes. In its most common form, a patient wears a telemetry transmitter attached to the patient using common ECG electrodes. The telemetry transmitter acquires an ECG signal, conducts a nominal amount of filtering on the ECG signal, and transmits the ECG signal to an antenna array, typically located in the ceiling of the care unit. The ECG signal is conducted through the antenna array to a telemetry receiver, which in turn, is connected to a central station that analyzes and displays the ECG information for viewing and evaluation by the clinicians staffing the care units.

[0003] However, it is frequently desirable to be able to quickly locate the patient in a care unit if circumstances indicate that there is a problem with the patient. In other cases, it is desirable to be able to send data back from the central station to the telemetry transmitter.

[0004] Accordingly, the invention provides a telemetry-based patient monitoring system that allows the clinician to determine the location of the telemetry transmitter, and that allows the clinician to send data from the central station to the telemetry transmitter.

[0005] Such a system is defined in independent claim 1. A system according to the preamble of claim 1 is taught by EP 0 602 459. A method of using the system of claim 1 is defined in claim 10.

[0006] More specifically, the invention includes a portable telemetry transmitter. The telemetry transmitter is connected to the patient to receive physiological signals from the patient and transmit those signals to the antenna array. The telemetry transmitter incudes an RF receiver.

[0007] The invention also provides a patient monitoring system including a central station for analyzing and displaying the physiological signals. The patient monitoring system further includes a receiver subsystem connected to the central station and an antenna array connected to the receiver subsystem. The antenna array includes a plurality of antennae each connected to an RF amplifier and supporting circuitry. Each antenna also has connected thereto a respective transmitter. In one form of the invention, each antenna includes a printed circuit board and the transmitter is mounted on the printed circuit board with the antenna circuitry, i.e., the RF amplifier and supporting circuitry. In another form of the invention, the transmitter is a discrete component that can be connected to the antenna after the system has already been installed in the care facility in order to "retro-fit" the patient monitoring system.

[0008] Each antenna is given a discrete address, the location of which is programmed into the central station. The antenna uses the antenna transmitter to transmit the address as a low power beacon. When the beacon is received by the telemetry transmitter, the telemetry transmitter combines the physiological data with the address and transmits the combined data signal to the receiver subsystem via the antenna array. From the receiver subsystem, the data is sent to the central station to be processed and displayed as required by the clinicians.

[0009] The receiver subsystem also allows communication from the central station to the transmitter associated with each antenna. Most commonly, the data will be in the form of voice communications, and will be transmitted to the telemetry transmitter and output from the transmitter on a speaker so that the communication is audible to the patient or to the clinician caring for the patient.

[0010] In still another form of the invention, each telemetry transmitter includes a microphone for receiving voice data and transmitting the voice data back to the central station.

[0011] A principal advantage of the invention is to provide a telemetry-based patient monitoring system that allows for complete two-way communication of both voice and physiological data, and that allows the clinician to accurately detect the location of the telemetry transmitter.

[0012] It is another advantage of the invention to provide a way of retro-fitting existing telemetry-based patient monitoring systems with a transmitter at each antenna in the antenna array to thereby allow for complete two-way communication of voice and physiological data, and allow the clinician to accurately determine the location of the telemetry transmitter.

[0013] Other features and advantages of the invention are set forth in the following detailed description with reference to the accompanying drawings, in which:

Fig. 1 is a block diagram of the patient monitoring system embodying the invention.

Fig. 2 is a schematic of the antenna transmitter subsystem.

Fig. 3 is a schematic illustration of the portable telemetry unit receiver subsystem.

[0014] Shown in Fig. 1 of the drawings is a block diagram of a telemetry-based patient monitoring system 10 embodying the invention. As is commonly known in the art, the patient monitoring system 10 includes a central station 14. The central station 14 typically has a CPU or central processing unit 18, which, in its most common form is a computer. The central station 14 also includes a display or display units 22 connected to the CPU 18. The display 22 typically shows patient waveforms and other patient data.

[0015] The central station 14 also includes various means for the clinician to interact with the CPU 18. As

shown in the drawing, these means include a keyboard 26 for entering information relating to the patient, a mouse 30 for controlling CPU operations, a speaker 34 for generating audible alarms, data or other audible information, and a microphone 38 for receiving audio information and transmitting that information in electronic form to the CPU 18.

[0016] The central station 14 is connected to a receiver subsystem 42. The receiver subsystem 42 includes a single input/output (I/O) port 46 connected to the central station 14, and a series of I/O ports 50 connected to a plurality of antennae 54 spaced about the care unit to form an antenna array connected to the receiver subsystem 42. While the number of antennae 54 may vary in any particular situation, the antennae 54 are all identical and accordingly only the single antenna 54 shown in Fig. 1 will be described.

[0017] The antenna 54 includes a control circuit 58 coupled with a radio frequency (RF) amplifier. A common RF antenna 62 is connected to the control circuit and RF amplifier 58 so that incoming radio frequency signals are picked up by the RF antenna 62, and are transmitted to the control circuit and RF amplifier 58 where they are filtered, amplified and sent to the receiver subsystem 42.

[0018] The antenna 54 also includes an antenna transmitter circuit 66 connected to the control circuit and RF amplifier 58. The antenna transmitter circuit 66 generates a low power RF carrier signal 70 (represented as a phantom line in Fig. 1). Fig. 2 illustrates a schematic diagram of the antenna transmitter circuit 66. As shown in Fig. 2, the antenna transmitter circuit includes an EPROM-based 8-bit CMOS microcontroller 68 (Microchip Technology, Inc. Part No. PIC16C62X) connected to an RF antenna 72 through an inverting buffer 78 and a transmitter 82. While any appropriate transmitter can be used, the transmitter 82 prototyped for the preferred embodiment is a 303.825 megahertz hybrid transmitter (Model No. HX1006 produced by RF Monolithics, Inc.) As shown in Fig. 2, the antenna transmitter circuit 66 also includes an oscillator 86, and various support circuitry, as well as power connections 90 and common connections 94 as those of skill in the art understand are required for operating the antenna transmitter circuit 66.

[0019] Referring again to Fig. 1, the telemetry-based patient monitoring system 10 also includes a portable telemetry monitor 98. In use, the portable telemetry monitor 98 is connected to the patient (not shown) via ECG leads (also not shown) or through a patient connection suitable for measuring other patient parameters. Once connected to the patient, the patient is free to ambulate throughout the care unit as desired or able. As is commonly known in the art, the portable telemetry monitor 98 includes a transmitter sub-circuit 102 connected to a transmitting antenna 106. The transmitter sub-circuit 102 generates a RF carrier signal 110 (represented as a phantom line in Fig. 1) for transmitting patient and other data to the antenna array.

[0020] The portable telemetry monitor 98 also includes a receiver sub-circuit 114 connected to a receiving antenna 118, a speaker 122, and a microphone 126. Fig. 3 illustrates in greater detail a schematic illustration of the receiver sub-circuit 114. As shown in Fig. 3, the receiver sub-circuit 114 includes an RF receiver 130 connected to antenna 118. While any appropriate RF receiver can be used, the RF receiver 130 prototyped in the preferred embodiment is a 303.825 megahertz amplifier-sequenced hybrid receiver (Model No. RX1120, manufactured by RF Monolithics, Inc.). The receiver sub-circuit 114 also includes support circuitry, power inputs 134 and common connections 138 as those of skill in the art understand are required for operating the receiver sub-circuit 114. The receiver sub-circuit 114 also includes an microprocessor input 142 connected to the microprocessor (not shown) of the portable telemetry unit. The microprocessor is responsible for receiving all physiological data and other incoming signals and routing them to the transmitter sub-circuit 102. Inverting buffer 144 is connected between microprocessor input 142 and RF receiver 130.

[0021] In operation, the antenna transmitter circuit 66 generally functions in a default or beacon mode. In this mode, the antenna transmitter circuit 66 generates an 8-bit address and transmits (via the low power RF carrier 70) the 8-bit address. In the lower power beacon mode, the carrier 70 is capable of being received by the portable telemetry monitor 98 at a range of approximately ten to twenty feet from the RF antenna 62. While the range of the low power beacon mode may vary, it is important that the range be sufficiently limited so as not to overlap with the low power beacon mode transmission of another antenna transmitter. The location of the RF antenna 62 is programmed into the central station 14 at the time of installation using the 8-bit address. In the preferred embodiment, the 8-bit address is retransmitted every 500 milliseconds and represents approximately five percent of the total available broadcast time of the antenna transmitter. The remaining 95 percent of the antenna transmitter broadcast time is kept available to be used for data communication.

[0022] The receiver sub-circuit 114 in the portable telemetry monitor 98 picks up the 8-bit sequence and combines the 8-bit sequence with the physiological patient data acquired by the portable telemetry monitor 98. The transmitter sub-circuit 102 in the portable telemetry monitor 98 then broadcasts the combined 8-bit address and physiological data signal back to the antenna array via the RF carrier signal 110. The signals at the various antennae 54 are then transmitted to the receiver subsystem 42 and from there, to the central station 14 for processing and subsequent display.

[0023] In the event that data communication is desired, i.e., that the clinician wishes to send information from the central station 14 to the portable telemetry monitor 98, the antenna transmitter circuit 66 switches into a communication mode. In this operational mode, a digital signal is encoded by the central- station 14 and routed to

all of the antennae 54 in the antenna array, where it is transmitted via the antenna transmitter 66 to the receiver sub-circuit 114 in the portable telemetry monitor 98. The information contained in this data can be either digital voice communication or system command data. The data is sent with a header address that is unique to each individual portable telemetry monitor 98. In this way, only the portable telemetry monitor 98 that is intended to receive the information will process and respond to the information.

Claims

1. A patient monitoring system comprising:

a portable transmitter (98) operable to be connected to a patient to receive physiological data from the patient, the portable transmitter (98) comprising a transmitter circuit (902);
at least one antenna (54); and
a system receiver (42) connected to the antenna (54);
the portable transmitter (98) further comprising a receiver circuit (114);
characterised by:
the antenna (54) being adapted to generate an address and to transmit the address with low power to the portable transmitter (98);
the receiver circuit (114) of the portable transmitter (98) being adapted to receive the address transmitted by the antenna (54) and to combine the address with the physiological data; and
the transmitter circuit (102) being adapted to transmit the combined address and physiological data to the antenna (54).

2. A patient monitoring system as set forth in Claim 1 further comprising a portable patient monitor (98) comprising said transmitter circuit (102).

3. A patient monitoring system as set forth in Claim 1 further comprising:

a central station (14) for analyzing and displaying patient data, the central station (14) being connected to said system receiver (42); and
wherein said at least one antenna comprises an antenna array connected to the system receiver (42) and including a plurality of antennae, each having connected thereto a respective transmitter.

4. A patient monitoring system as set forth in Claim 1 further comprising a central station (14) connected to the system receiver (42), and wherein the system receiver (42) is adapted to transmit data from the antenna to the central station and transmit data from the central station to the antenna transmitter.

5. A patient monitoring system as set forth in any of claims 1 to 4 wherein the portable transmitter (98) includes a microphone (126) connected to the transmitter to allow the transmission of voice data from the patient to the central station 914), and a speaker (122) connected to the receiver to allow the transmission of voice data from the central station to the patient.

6. A patient monitoring system as set forth in claim 2 or claim 4 wherein the, or each, transmitter is adapted to generate a location code unique to the respective antenna, and wherein data transmitted from the transmitter is combined with the location code before being transmitted to the central station.

7. A patient monitoring system as set forth in any one of claims 1 to 6 wherein the respective transmitters are telemetry transmitters.

8. A patient monitoring system as set forth in one of claims 1 to 7 wherein the, or each, antenna includes a circuit board and wherein the respective transmitter is mounted on the circuit board.

9. A patient monitoring system as set forth in any one of claims 1 to 8 wherein the, or each, antenna is a discrete component from the respective transmitter.

10. A method of operating a patient monitoring system, wherein the system comprises:

a portable transmitter (98) for connection to a patient for receiving physiological data from the patient, the portable transmitter (98) comprising a transmitter circuit (102) and a receiver circuit (114);
at least one antenna (54); and
a system receiver (42) connected to the antenna (54);
the method comprising:

the antenna (54) generating an address and transmitting the address with low power to the portable transmitter (98);
the receiver circuit (114) of the portable transmitter (98) receiving the address transmitted by the antenna (54) and combining the address with the physiological data; and
the transmitter circuit (102) transmitting the combined address and physiological data to the antenna (54).

11. A method as set forth in claim 10 wherein the at least one antenna (54) is one of a plurality of antennas; each antenna (54) having a respective location, a nd

wherein the method further comprises the act of programming the respective locations of the antenna into a central station (14).

12. A method as set forth in claim 11 and further comprising the act of transmitting data from the central station (14) to the antenna array.

13. A method as set forth in claim 11 wherein the act of transmitting data from the central station to the antenna array includes the act of transmitting a header address unique to each antenna.

14. A method as set forth in claim 12 wherein the data is a voice data.

Patentansprüche

1. Patientenüberwachungssystem mit:

einem tragbaren Sender (98), der so betrieben werden kann, dass er mit einem Patienten verbunden ist, um physiologische Daten von dem Patienten aufzunehmen, wobei der tragbare Sender (98) eine Senderschaltung (102) aufweist;
wenigstens einer Antenne (54); und
einem mit der Antenne (54) verbundenen Systemempfänger (42);
wobei der tragbare Sender (98) ferner eine Empfängerschaltung (114) aufweist;
dadurch gekennzeichnet, dass:

die Antenne (54) dafür eingerichtet ist, eine Adresse zu erzeugen und die Adresse mit geringer Leistung an den tragbaren Sender (98) zu übertragen;
die Empfängerschaltung (114) des tragbaren Senders (98) dafür eingerichtet ist, die durch die Antenne (54) übertragene Adresse zu empfangen und die Adresse mit den physiologischen Daten zu kombinieren; und
die Senderschaltung (102) dafür eingerichtet ist, die kombinierten Adressen und physiologischen Daten an die Antenne (54) zu übertragen.

2. Patientenüberwachungssystem nach Anspruch 1, ferner mit einem die Senderschaltung (102) aufweisenden tragbaren Patientenmonitor (98).

3. Patientenüberwachungssystem nach Anspruch 1, ferner mit:

einer zentralen Station (14) zum Analysieren und Anzeigen von Patientendaten, wobei die zentrale Station (14) mit dem Systemempfänger (42) verbunden ist; und
wobei die wenigstens eine Antenne ein mit dem Systemempfänger (42) verbundenes Antennenarray umfasst, das mehrere Antennen enthält, die jeweils an einen entsprechenden Sender angeschlossen sind.

4. Patientenüberwachungssystem nach Anspruch 1, ferner mit einer mit dem Systemempfänger (42) verbundenen zentralen Station (14), wobei der Systemempfänger (42) dafür eingerichtet ist, Daten von der Antenne an die zentrale Station zu übertragen und Daten von der zentralen Station an den Antennensender zu übertragen.

5. Patientenüberwachungssystem nach einem der Ansprüche 1 bis 4, wobei der tragbare Sender (98) ein mit dem Sender verbundenes Mikrophon (126), um die Übertragung von Sprachdaten von dem Patienten an die zentrale Station (14) zu ermöglichen, und einen mit dem Empfänger verbundenen Lautsprecher (122) enthält, um die Übertragung von Sprachdaten von der zentralen Station an den Patienten zu ermöglichen.

6. Patientenüberwachungssystem nach Anspruch 2 oder Anspruch 4, wobei der oder jeder einzelne Sender dafür eingerichtet ist, einen für die entsprechende Antenne eindeutigen Positionscode zu erzeugen, und wobei von dem Sender übertragene Daten mit dem Positionscode kombiniert werden, bevor sie an die zentrale Station übertragen werden.

7. Patientenüberwachungssystem nach einem der Ansprüche 1 bis 6, wobei die entsprechenden Sender Telemetriesender sind.

8. Patientenüberwachungssystem nach einem der Ansprüche 1 bis 7, wobei die oder jede einzelne Antenne eine Leiterplatte enthält und wobei der entsprechende Sender auf der Leiterplatte montiert ist.

9. Patientenüberwachungssystem nach einem der Ansprüche 1 bis 8, wobei die oder jede einzelne Antenne eine diskrete Komponente des entsprechenden Senders ist.

10. Verfahren zum Betreiben eines Patientenüberwachungssystems, wobei das System aufweist:

einen tragbaren Sender (98) zur Verbindung mit einem Patienten, um physiologische Daten von dem Patienten aufzunehmen, wobei der tragbare Sender (98) eine Senderschaltung (102) und eine Empfängerschaltung (114) aufweist;
wenigstens eine Antenne (54); und
einen mit der Antenne (54) verbundenen Sy-

stemempfänger (42);
wobei das Verfahren die Schritte aufweist, dass:

die Antenne (54) eine Adresse erzeugt und die Adresse mit geringer Leistung an den tragbaren Sender (98) überträgt;
die Empfängerschaltung (114) des tragbaren Senders (98) die durch die Antenne (54) übertragene Adresse empfängt und die Adresse mit dem physiologischen Daten kombiniert; und
die Senderschaltung (102) die kombinierten Adressen und physiologischen Daten an die Antenne (54) überträgt.

11. Verfahren nach Anspruch 10, wobei die wenigstens eine Antenne (54) eine von mehreren Antennen ist; jede Antenne (54) eine entsprechende Position hat, und wobei das Verfahren ferner den Vorgang einer Einprogrammierung der entsprechenden Positionen der Antenne in eine zentrale Station (14) enthält.

12. Verfahren nach Anspruch 11, und ferner mit dem Vorgang der Übertragung von Daten von der zentralen Station (14) an das Antennenarray.

13. Verfahren nach Anspruch 11, wobei der Vorgang der Übertragung von Daten von der zentralen Station an das Antennenarray den Vorgang der Übertragung einer für jede Antenne eindeutigen Vorspannadresse beinhaltet.

14. Verfahren nach Anspruch 12, wobei die Daten Sprachdaten sind.

Revendications

1. Système de surveillance de patients comprenant:

un émetteur portable (98) utilisable pour être connecté à un patient afin de recevoir des données physiologiques du patient, l'émetteur portable (98) comprenant un circuit émetteur (102);
au moins une antenne (54); et
un récepteur de système (42) connecté à l'antenne (54);
l'émetteur portable (98) comprenant en outre un circuit récepteur (114);
caractérisé en ce que
l'antenne (54) est adaptée pour générer une adresse et pour transmettre l'adresse à basse puissance à l'émetteur portable (98);
le circuit récepteur (114) de l'émetteur portable (98) est adapté pour recevoir l'adresse transmise par l'antenne (54) et pour combiner l'adresse avec les données physiologiques; et
le circuit émetteur (102) est adapté pour transmettre l'adresse et les données physiologiques combinées à l'antenne (54).

2. Système de surveillance de patients selon la revendication 1, comprenant en outre un dispositif de surveillance de patient portable (98) comprenant ledit circuit émetteur (102).

3. Système de surveillance de patients selon la revendication 1, comprenant en outre:

une station centrale (14) pour analyser et présenter des données de patients, la station centrale (14) étant connectée audit récepteur de système (42); et
dans lequel ladite au moins une antenne comprend un réseau d'antennes connecté au récepteur de système (42) et incluant une pluralité d'antennes, ayant chacune un émetteur respectif connecté à elle.

4. Système de surveillance de patients selon la revendication 1, comprenant en outre une station centrale (14) connectée au récepteur de système (42), et dans lequel le récepteur de système (42) est adapté pour transmettre des données de l'antenne à la station centrale et transmettre des données de la station centrale à l'émetteur d'antenne.

5. Système de surveillance de patients selon l'une quelconque des revendications 1 à 4, dans lequel l'émetteur portable (98) comprend un microphone (126) connecté à l'émetteur pour permettre la transmission de données vocales du patient à la station centrale (14), et un haut-parleur (122) connecté au récepteur pour permettre la transmission de données vocales de la station centrale au patient.

6. Système de surveillance de patients selon la revendication 2 ou la revendication 4, dans lequel le ou chaque émetteur est adapté pour générer un code d'emplacement particulier à l'antenne respective, et dans lequel des données transmises par l'émetteur sont combinées au code d'emplacement avant d'être transmises à la station centrale.

7. Système de surveillance de patients selon l'une quelconque des revendications 1 à 6, dans lequel les émetteurs respectifs sont des émetteurs de télémesure.

8. Système de surveillance de patients selon l'une quelconque des revendications 1 à 7, dans lequel la ou chaque antenne comprend une carte imprimée et dans lequel l'émetteur respectif est monté sur la carte imprimée.

9. Système de surveillance de patients selon l'une

quelconque des revendications 1 à 8, dans lequel la ou chaque antenne est un composant discret par rapport à l'émetteur respectif.

10. Procédé d'exploitation d'un système de surveillance de patients, dans lequel le système comprend:

un émetteur portable (98) destiné à être connecté à un patient pour recevoir des données physiologiques du patient, l'émetteur portable (98) comprenant un circuit émetteur (102) et un circuit récepteur (114);
au moins une antenne (54); et
un récepteur de système (42) connecté à l'antenne (54);

le procédé comprenant les étapes dans lesquelles:

l'antenne (54) génère une adresse et transmet l'adresse à basse puissance à l'émetteur portable (98);
le circuit récepteur (114) de l'émetteur portable (98) reçoit l'adresse transmise par l'antenne (54) et combine l'adresse avec les données physiologiques; et
le circuit émetteur (102) transmet l'adresse et les données physiologiques combinées à l'antenne (54).

11. Procédé selon la revendication 10, dans lequel l'au moins une antenne (54) est l'une d'une pluralité d'antennes; chaque antenne (54) ayant un emplacement respectif, et dans lequel le procédé comprend en outre le fait de programmer les emplacements respectifs des antennes dans une station centrale (14).

12. Procédé selon la revendication 11, comprenant en outre le fait de transmettre des données de la station centrale (14) au réseau d'antennes.

13. Procédé selon la revendication 11, dans lequel le fait de transmettre des données de la station centrale au réseau d'antennes comprend le fait de transmettre une adresse d'en-tête particulière à chaque antenne.

14. Procédé selon la revendication 12, dans lequel les données sont des données vocales.

FIG.1

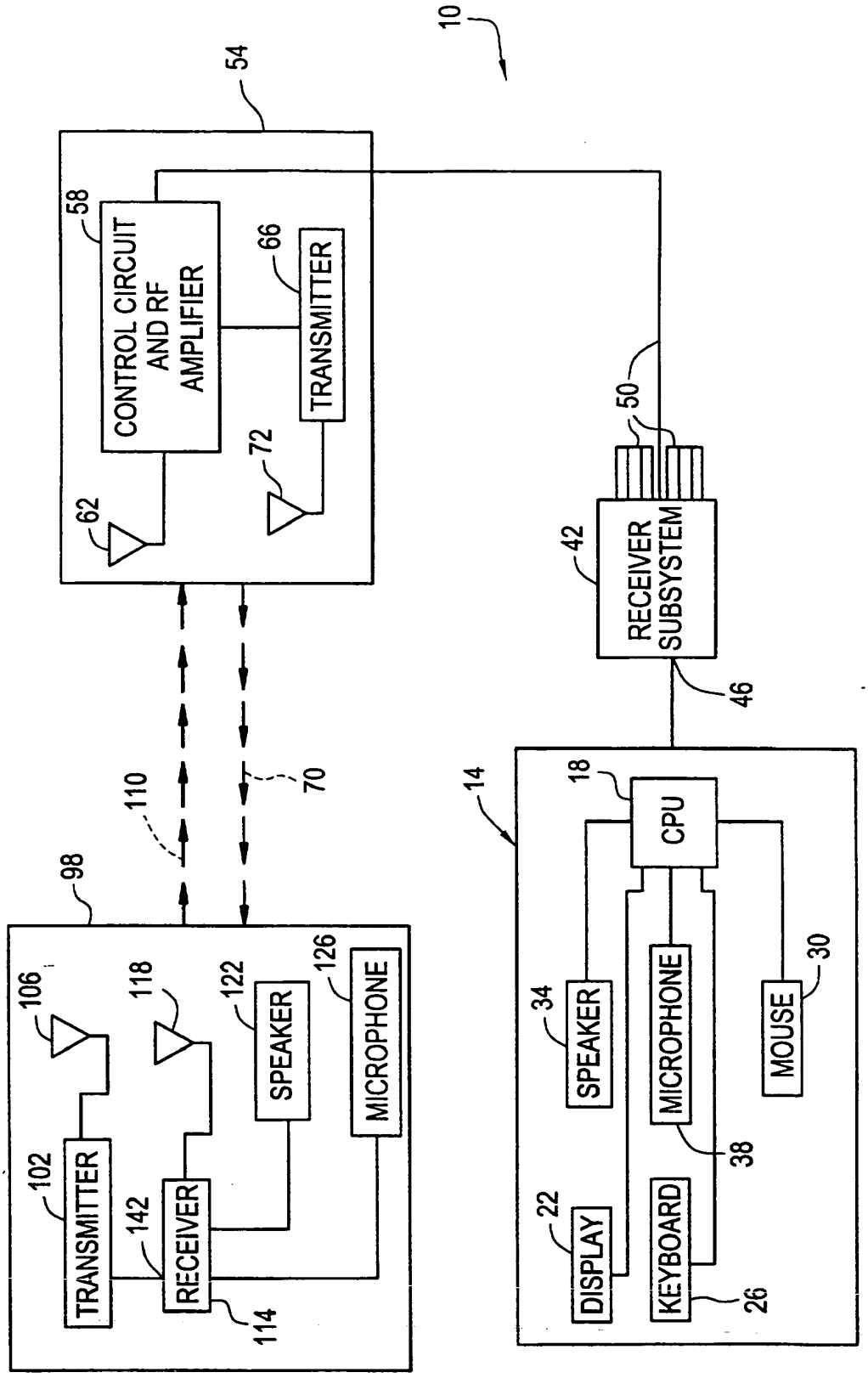

10
54
58
CONTROL CIRCUIT AND RF AMPLIFIER
66
TRANSMITTER
72
62
50
42
RECEIVER SUBSYSTEM
46
14
18
CPU
34
SPEAKER
MICROPHONE
30
MOUSE
38
22
DISPLAY
KEYBOARD
26
110
70
98
106
118
122
126
SPEAKER
MICROPHONE
102
TRANSMITTER
142
RECEIVER
114

FIG.2

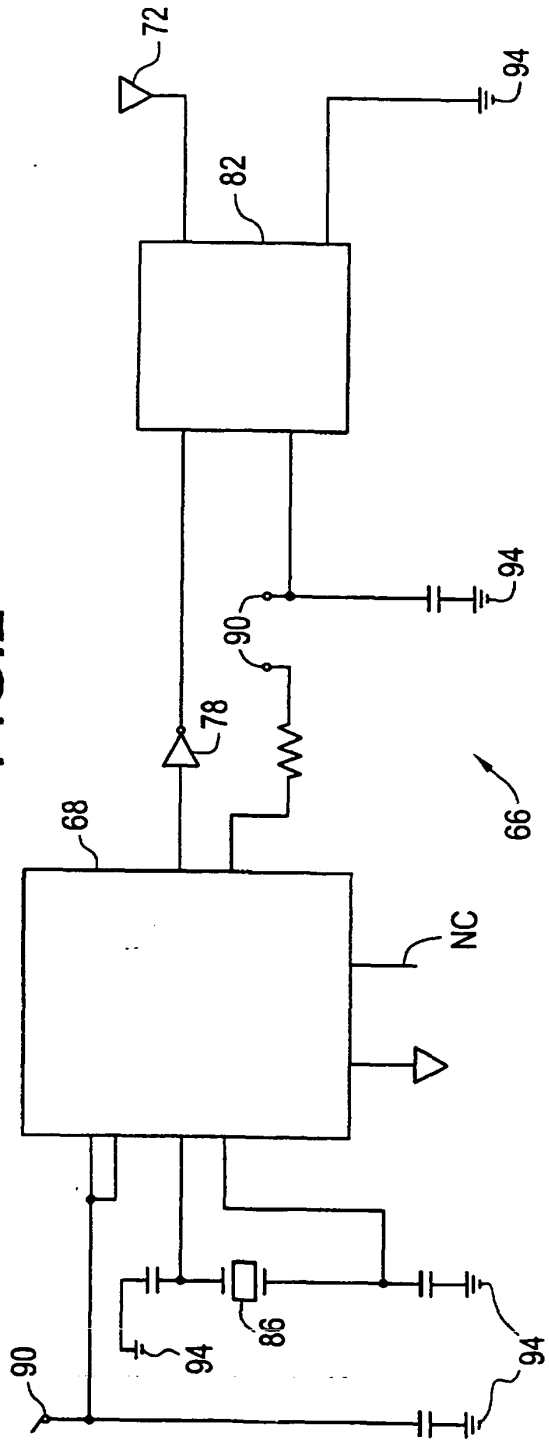
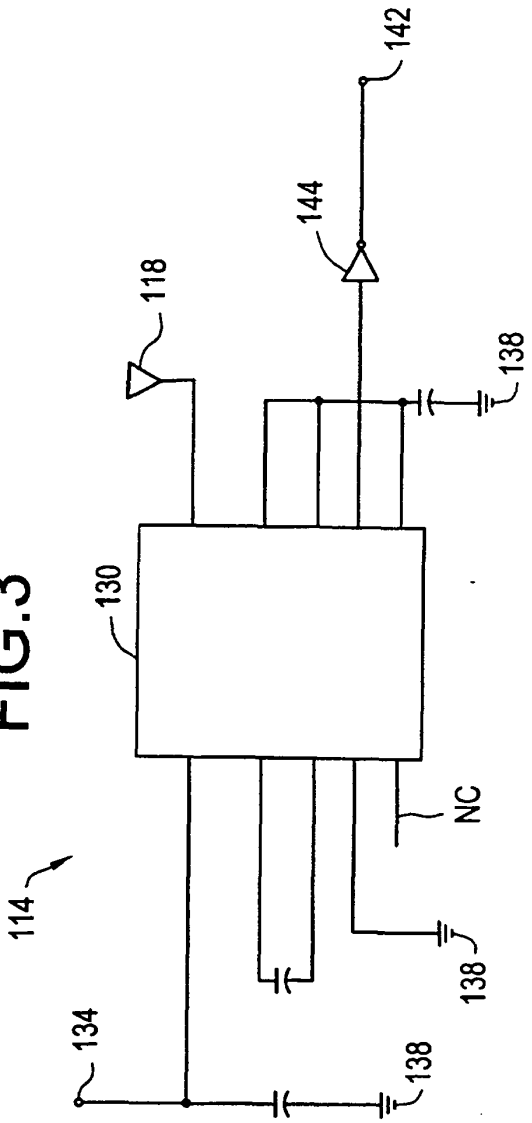

72
94
82
94
90
78
66
68
NC
90
94
86
94
94

FIG.3


142
144
118
138
130
NC
114
138
134
138

专利名称(译)	患者监护系统具有双向通信		
公开(公告)号	EP1038497B1	公开(公告)日	2006-12-20
申请号	EP2000302436	申请日	2000-03-24
申请(专利权)人(译)	GE MARQUETTE医疗系统，INC.		
当前申请(专利权)人(译)	GE MARQUETTE医疗系统，INC.		
[标]发明人	BRINSFIELD JAMES STEINIKE MICHAEL F		
发明人	BRINSFIELD, JAMES STEINIKE, MICHAEL F.		
IPC分类号	A61B5/00 H04Q9/10 H04B7/24 H04Q9/00		
CPC分类号	H04Q9/10		
优先权	09/275205 1999-03-24 US		
其他公开文献	EP1038497A1		
外部链接	Espacenet		

摘要(译)

一种患者监测系统（10），包括用于分析（18）和显示（22）患者数据的中心站（14）;系统接收器（42）连接到中心站;天线阵列（54）连接到系统接收器并包括多个天线（72），每个天线连接到相应的发射器（66）。便携式遥测监视器（98）连接到患者，并且包括发射器（102）和接收器（142），用于经由天线阵列与中心站通信。

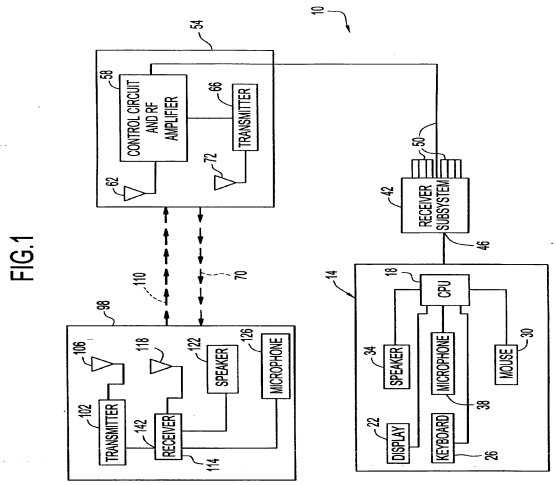


FIG.1