Title: A SYSTEM AND METHOD FOR PROVIDING A PACKET-BASED ELECTRONIC STETHOSCOPE

Abstract: A system and method for providing a packet-based electronic stethoscope to assist in remote medical assessment is disclosed. A detection device (102) detects bodily sounds and transmits the sounds to an interface unit (104). The interface unit (104) prepares the sounds to be transmitted as data packets (132), to a patient unit (53). The patient unit (53) stores patient related information and transfers the data packets (132) to a receive unit (112). The receive unit (112) then prepares the data packets (132) such that a caregiver may listen (114) to the detected bodily sounds from a remote location.
A SYSTEM AND METHOD FOR PROVIDING A
PACKET-BASED ELECTRONIC STETHOSCOPE

FIELD OF THE INVENTION

The present invention generally relates to medical analysis and, more
particularly, is related to a system and method for providing a packet-based electronic
stethoscope to assist in the medical assessment of a patient.

BACKGROUND OF THE INVENTION

With the advancement of technology, methods of performing and obtaining
local services from a remote site have been introduced into the modern day home. In
fact, modern work environments promote working from home using the technological
advancements in telecommunications.

One area where remote services are desirable is in the field of medical
assessment. Patients often are not capable of traveling distances for medical
treatment due to physical inability and financial difficulty. The financial cost of
obtaining regular medical check-ups, where a patient’s vital signs are taken and
reviewed, is of concern to patients and individuals paying for a patient’s treatment. In
addition, time spent in a waiting room awaiting medical attention also provides a large
inconvenience to patients. In an emergency situation, waiting long periods of time for
medical attention, or traveling to a hospital or care center, can be detrimental to a
patient’s health.

The most costly patients to the health care system are those who routinely
utilize expensive health care resources such as an emergency room visits or
hospitalizations. In many cases, these patients are living with chronic illnesses and
are hospitalized on an average of 4-5 times per year. Patients living in institutional
settings without an adequate health care support system are also vulnerable to
excessive hospitalizations and/or emergency room visits. The overriding cause for
excessive use of expensive health care resources is the inability for the patient to
manage their own clinical condition. Support systems, outside intervention by family
members, are inadequate due to the cost of providing health care services on an
individual basis. The result is an increasing population of individuals who are unable
to remain healthy and who are costing the health care system enormous sums of money.

Tele-Homecare technology has emerged as a potential solution to managing patients more effectively. This technology allows a care provider at a remote location to monitor patients in their residences using telecommunications lines. Significant cost savings can be realized by more effectively managing the patient and the patient’s overall health can be improved substantially. Tele-Homecare technologies have been developed that allow patients to videoconference with their care provider and perform vital signs measurements in a point-to-point fashion. That is, patients are only able to call their assigned care provider through a pre-established dialing arrangement. There is no ability to route the patients to other care providers or store their vital signs measurements on a remote server.

Various electronic stethoscopes have been developed for use in a Tele-Homecare environment in which the patient and provider are connected in a point-to-point arrangement. In general, these devices are designed to operate in an analog fashion over the Plain Old Telephone Service (POTS). Regardless, existing electronic stethoscopes that allow a remote care provider to listen to a patient’s heart and lung sounds utilize a point-to-point communication arrangement for transmitting audio signals. This is a severe limitation since the patient’s heart and lung sounds cannot be routed through a network to allow multiple care providers to listen simultaneously, to store that data in a central database for retrieval by care providers at will, or to route the data to other care providers individually.

Thus, a heretofore unaddressed need exists in the industry to address the aforementioned deficiencies and inadequacies.

SUMMARY OF THE INVENTION

In light of the forgoing, the preferred embodiment of the present invention generally relates to a system and method for providing a packet-based electronic stethoscope for monitoring patients from a remote location.

Generally, describing the structure of the stethoscope system, the system utilizes a detection device for detecting bodily sounds which is connected to an interface unit that prepares the sounds to be transferred, as data packets, to a patient
unit. The patient unit transfers the sounds, as data packets, to a receive unit that prepares the sounds to be heard by a caregiver.

The present invention can also be viewed as providing a method for implementing a packet-based electronic stethoscope. In this regard, the method can be broadly summarized by the following steps: detecting bodily sounds; preparing the sounds to be transferred as data packets; transmitting the data packets to a receive unit monitored by a caregiver; and preparing the received data packets to be heard by the caregiver.

The invention has numerous advantages, a few of which are delineated hereafter as examples. Note that the embodiments of the invention, which are described herein, possess one or more, but not necessarily all, of the advantages set out hereafter. One advantage of the invention is that it provides a means for monitoring the health of a patient, while a caregiver is not physically with the patient, so that patients are able to maintain their health without frequent visits to a doctor’s office.

Another advantage is that it provides a cost-effective means for monitoring the health of a patient. By closely monitoring patients in their residences, a caregiver is able to intervene when a problem arises rather than waiting until the situation becomes critical thus reducing the cost of care.

Another advantage is that it provides a means of extending the patient’s stay at home prior to entering an institutional facility such as an assisted living center or nursing home, since the patient is receiving home care electronically.

Another advantage is that data is broken into packets that can be transported over any type of communications link, including, but not limited to, POTS, ISDN, ADSL, cable modem, and satellite, thereby allowing the patient’s heart and lung sounds to be routed through a network for presentation to one or more care providers, and allows the data to be stored in a central database for retrieval at a later date.

Other features and advantages of the present invention will be or become apparent to one with skill in the art upon examination of the following drawings and detailed description. It is intended that all such additional features and advantages be included herein within the scope of the present invention, as defined by the accompanying claims.
BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more fully understood from the detailed description given below and from the accompanying drawings of the preferred embodiments of the invention, which, however, should not be taken to limit the invention to the specific embodiments, but are for explanation and better understanding. Furthermore, the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present invention. Finally, like reference numerals in the figures designate corresponding parts throughout the several drawings.

FIG. 1 is a block diagram illustrating a typical Internet based system that the stethoscope system of the present invention may utilize.

FIG. 2 is a block diagram that further illustrates the patient unit illustrated by FIG. 1.

FIG. 3 is a block diagram that further illustrates the caregiver digital processor illustrated by FIG. 1.

FIG. 4 is a block diagram that illustrates the structure of the packet based electronic stethoscope.

FIG. 5 is a block diagram that further illustrates the interface unit of FIG. 4.

FIG. 6 is a block diagram that further illustrates the receive unit of FIG. 4.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The stethoscope system of the present invention can be implemented in software, firmware, hardware, or a combination thereof. In the preferred embodiment of the invention, which is intended to be a non-limiting example, the system is implemented in software that is executed by a computer, for example, but not limited to, a personal computer, workstation, mini computer, or mainframe computer.

The software-based system, which comprises an ordered listing of executable instructions for implementing logical functions, can be embodied in any computer-readable medium for use by, or in connection with, an instruction execution system, apparatus, or device such as a computer-based processor-containing system, or other system that can fetch the instructions from the instruction execution system, apparatus, or device and execute the instructions. In the context of this document, a
“computer-readable medium” can be any means that can contain, store, communicate, propagate or transport the program for use by or in connection with the instruction execution system, apparatus or device. The computer-readable medium can be, for example, but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, device, or propagation medium. More specific examples (a nonexhaustive list) of the computer-readable medium would include the following: an electrical connection (electronic) having one or more wires, a portable computer diskette (magnetic), a random access memory (RAM) (magnetic), a read-only memory (ROM) (magnetic), an erasable programmable read-only memory (EPROM or Flash memory) (magnetic), an optical fiber (optical), and a portable compact disk read-only memory (CD ROM) (optical). Note that the computer-readable medium could even be paper or another suitable medium upon which the program is printed, as the program can be electronically captured, via for instance, optical scanning of the paper or other medium, then compiled, interpreted or otherwise processed in a suitable manner, if necessary, and then stored in a computer memory.

Preferably, the stethoscope system of the present invention is implemented with use of the Internet. As such, a brief description and explanation of terms associated with the Internet follow. It should be noted that although the following description provides for use of a Web browser, the preferred embodiment of the invention may be provided via the Internet, without use of a Web browser. A browser, or “Web” browser, allows for simple graphical user interface (GUI) access to network servers, which support documents formatted as so-called Web pages. The World Wide Web (WWW), or “Web”, is a collection of servers on the Internet that utilize a Hypertext Transfer Protocol (HTTP), which is an application protocol that provides users access to files (which can be in different formats such as text, graphics, images, sound, video, etc.) using a Standard Generalized Markup Language (SGML), which is an information management standard for providing platform-independent and application-independent documents that retain formatting, indexing, and linking information. SGML provides a grammar-like mechanism for users to define the structure of their documents and the tags they will use to denote the structure in individual documents. The page description language known as Hypertext Markup Language (HTML) is an application of SGML. HTML provides basic document
formatting of text and images and allows the developer to specify hyperlinks, or
"links," to other servers and files.

Use of an HTML-compliant client, such as a Web browser, involves
specification of an address via a Uniform Resource Locator (URL). Upon such
specification, the client makes a transmission control protocol/Internet protocol
(TCP/IP) request to the server identified in the URL and receives a "Web page"
(namely, a document formatted according to HTML) in return.

Electronic mail (e-mail) is another important part of online activity.
Conventional e-mail is the exchange of text messages and computer files over a
communications network, such as a local area network (LAN) or the Internet, usually
between computers or terminals. Routing of e-mail on the Internet is typically
accomplished through the use of a protocol for sending messages called the simple
mail transfer protocol (SMTP).

By way of example and illustration, FIG. 1 illustrates an Internet based
system, that may operate using a TCP/IP protocol, upon which the stethoscope system
100 of the present invention may be implemented. It should be noted that while the
present disclosure provides implementation of the stethoscope system 100 within an
Internet based system, the stethoscope system 100 need not be provided via use of the
Internet. Instead, one of reasonable skill in the art will appreciate that the stethoscope
system 100 may be implemented within other mediums, such as, for example, but not
limited to, a local area network (LAN), or wide area network (WAN).

Further, in accordance with an alternative embodiment of the invention, the
stethoscope system 100 may instead utilize a multi-point control unit (MCU), wherein
video conferencing systems located at several locations may be interconnected for
conferencing between users, as described below. As known in the art, to initiate a
conference using a MCU, a session host dials a number or makes some other
appropriate connection such as a TCP/IP link, and then presents a conference
identifier. The MCU then automatically sets up the conference and establishes
TCP/IP connections to each user. Alternatively, users may then join the conference
by dialing an access number to the MCU for instantaneous connection.

Referring to FIG. 1, a plurality of networks 21a, 21b are shown wherein each
network 21a, 21b includes multiple digital processors 33, 35, 37. Digital processors
33, 35, 37 within each network 21a, 21b may include, but are not limited to, personal
computers, mini computers, laptops, and the like. Each digital processor 33, 35, 37 is typically coupled to a host processor or server 31a, 31b for communication among processors 33, 35, 37 within the specific corresponding network 21a, 21b.

The host processor, or server, 31a, 31b is coupled to a communication line 41 that interconnects or links the networks 21a, 21b to each other, thereby forming an Internet. As such, each of the networks 21a, 21b are coupled along the communication line 41 to enable access from a digital processor 33a, 35a, 37a of one network 21a to a digital processor 33b, 35b, 37b of another network 21b.

Various end-user servers 51, 61, two of which are shown as an example, specifically, a patient server 51, and a caregiver server 61, are linked to the communication line 41, thus providing the patient and caregiver with access to the Internet. A caregiver digital processor 63 is coupled to the caregiver server 61 for purposes of allowing a caregiver to interact with patients via the Internet, as is further explained hereinbelow. Likewise, a patient digital processor, or patient unit 53, is coupled to the patient server 51 for purposes of allowing a patient to interact with the stethoscope system 100 via the Internet, as is further explained hereinbelow.

In accordance with the preferred embodiment of the invention, the caregiver digital processor 63 stores patient information as described with reference to FIG. 2 described hereinbelow. Software for implementation of the stethoscope system 100 is provided by a software program stored within the patient unit 53 and the caregiver digital processor 63, which is operated on and connected to the Internet, for communication among the various networks 21a, 21b and/or digital processors 33, 35, 37 and other end-users connected to the Internet via respective end-user servers 51, 61. It should be noted that the patient unit 53 and caregiver digital processor 63 may run any form of operating system, such as, but not limited to, Microsoft Windows, to support operation of the present stethoscope system 100. Preferably, the networks 21a, 21b used by the stethoscope system 100 are secure and encrypted for purposes of ensuring the confidentiality of information transmitted within and between the networks 21a, 21b.

FIG. 2 is a block diagram that further illustrates the patient unit 51 of FIG. 1. As shown by FIG. 2, the patient unit 53 comprises a central processing unit (CPU) 54 having a program controller 55, and the stethoscope system software 56. The program controller 55 is capable of performing functionality required by the
stethoscope system 100, as described in detail herein below. The patient unit 53 also comprises a patient unit database 57 that may store information such as, but not limited to, a patient’s name, address, medical conditions and treatment patterns. It should be noted that the patient unit database 57 may be located remote to the patient unit 53, wherein data may be stored by transmission to the remote location via the patient server 51. The locating and updating of data within the patient unit 53, as required by the stethoscope system 100, is performed by the program controller 55.

FIG. 3 is a block diagram that further illustrates the caregiver digital processor 63 of FIG. 1. As shown by FIG. 3, the caregiver digital processor 63 comprises a CPU 64 having a program controller 65, and the stethoscope system software 66. The program controller 65 is capable of performing functionality required by the stethoscope system 100, as described in detail herein below. The caregiver digital processor 63 also comprises a caregiver database 67 for storing received patient information. It should be noted that the caregiver database 67 may be located remote to the caregiver digital processor 63, wherein data may be stored by transmission to the remote location via the caregiver server 61. In fact, both the patient database 57 and the caregiver database 67 may be located remote from the patient unit 53 and caregiver digital processor 63, respectively, or even share a single database. The locating and updating of data within the caregiver digital processor 63, as required by the stethoscope system 100, is performed by the program controller 65.

FIG. 4 is a block diagram that illustrates the structure of the packet based electronic stethoscope system 100. As shown by FIG. 4, a detection device 102 is provided, which is connected to an interface unit 104, as described in detail hereinbelow with reference to FIG. 5. Preferably, a stethoscope is used as the detection device 102, wherein the stethoscope comprises a diaphragm and/or a bell, having a sensitive microphone attached thereto. Preferably, the frequency response of the microphone is chosen so as to pick up bodily sounds, such as, but not limited to, heart, lung, and bowel sounds, typically in the range of 20Hz to 2,000Hz. A connection device 106 is located between the detection device 102 and the interface unit 104. Preferably, the connection device 106 is a shielded cable that can electrically transfer detected bodily sounds to the interface unit 104 without allowing disturbance of the sounds.
The interface unit 104 prepares the detected sounds to be transmitted to the patient unit 53. The patient unit 53 may then store characteristics of the detected sounds within the patient unit database 57 (FIG. 2) for future reference. The patient unit 53 then transfers the detected sounds to the patient server 51, and then, to a network 108, as further described with reference to FIG. 5. It should be recalled that the patient unit database 57 (FIG. 2) may also store other patient information, such as, but not limited to, the patient’s name, address, medical conditions and treatment patterns.

In accordance with the preferred embodiment, the connection from the patient unit 51 to the network 108 is an Ethernet connection if the system 100 is implemented on a local access network, or, if the system 100 is implemented on a wide area network the connection may be a plain old telephone service (POTS), or digital subscriber line (DSL) connection. The detected sounds are then transferred from the patient unit 53, via the patient server 51, to the caregiver server 61 where the detected sounds are channeled to a receive unit 112. The receive unit 112 prepares the received detected sounds to be heard by a caregiver, and then transfers the received detected sounds to the caregiver digital processor 63 that is monitored by a care provider. The caregiver may then listen to the detected sounds via a listening device 114, such as, but not limited to, headphones, that is logically connected to the caregiver digital processor 63. The receive unit 112 is further described with reference to FIG. 6, the description of which is provided hereinafter.

Therefore, by use of the stethoscope system 100, a patient is capable of using the detection device 102 to enable a remotely located caregiver to hear bodily sounds of the patient. It should be noted that any number of patients may be provided with the described stethoscope system 100, such that a single caregiver is capable of listening to the bodily sounds of a number of different patients. Alternatively, if a first caregiver wishes for a second caregiver to listen to the detected bodily sounds of a patient, perhaps in a virtual conference, the first caregiver may contact the second caregiver, informing him to connect to the patient unit 53, via the patient server 51. The second caregiver may then establish a connection, via the Internet, to the patient server 51 using techniques known in the art. Thereafter, both caregivers may listen to the patient’s bodily sounds simultaneously.
As mentioned hereinabove, FIG. 5 further illustrates the structure of the interface unit 104 in accordance with the preferred embodiment of the invention. The interface unit 104 performs several functions to prepare bodily sounds detected by the detection device 102 for transmission over the network 108. Since detected bodily sounds are analog in nature, the analog signals are preferably filtered through a band-pass filter 122 having a frequency range from 20Hz to 2,000Hz. The filtered signals are then amplified by an amplifier 124 to a signal level compatible with that of an analog to digital converter circuit 126. Preferably, the interface unit 104 conditions the analog signal through filtering and amplification so that it can be digitized, as described hereinbelow. It should be noted that the interface unit 104 may also be located remote from the patient unit 53. The sampling rate of the interface unit 104 is preferably selected to be 8KHz to minimize the amount of data that may be transferred over the network 108 due to bandwidth limitation, yet preserve the fidelity of the bodily sounds between frequencies of 20Hz to 2,000Hz. Preferably a sampling rate of 8KHz is used which is well above the Nquist rate of 4KHz.

The analog to digital converter circuit 126 converts the detected bodily sound signals from analog to digital signals. After the analog signals have been converted to digital signals, a compression unit 128 applies a compression algorithm to further minimize the amount of data that should be transmitted over the network 108. A number of compression algorithms can be used, however, in accordance with the preferred embodiment of the invention, MPEG 3 is used.

The digital signals are then packetized by a packetize unit 132 for transmission over the network 108. TCP/IP protocol is preferably used, which involves breaking the audio data stream into small segments called packets, attaching a source, destination, and sequence header to the packet, and attaching a cyclical redundancy check (CRC) trailer to the packet. The complete data assembly comprises a TCP/IP packet. These packets, representing the patient’s complete bodily sounds, are then transmitted over the network 108, as described with reference to FIG. 3 hereinabove. It should be noted that devices located within the interface unit 104, may instead be located within the patient unit 53. As an example, the patient unit may include the compression unit 128 and the packetize unit 132 in accordance with an alternate embodiment of the invention.
FIG. 6, further illustrates the structure of the receive unit of FIG. 4. As known in the art, when packets traverse over an IP network, they travel many different routes to reach the same destination. Due to the varying times required for packets to traverse the network, some packets arrive in a different sequence from the order in which they were transmitted. In this case, the packets should be re-ordered prior to extracting the data so that the original data is reproduced correctly. Therefore, as the packets arrive from the network 108, they are sequenced by a sequence unit 142. A depacketize unit 144 is then used to break down each sequenced packet in order to extract the audio data, which is representative of the bodily sounds. Calculating the CRC value based on the received data and comparing it with the transmitted CRC value assists in ensuring data integrity.

Once the data has been extracted, a decompression algorithm is used on the data by a decompression unit 146 to reconstruct the original bodily sounds. The digitized audio is then routed through a digital-to-analog converter 148 where the received digital signals are converted to analog signals. The resultant analog signals are then filtered by a filter 152 to remove noise by methods known to those skilled in the art. In accordance with the preferred embodiment of the invention, the filter may be a 25KHz low pass filter. Finally, the filtered bodily sounds are amplified by an amplifier 154 such that the received bodily sounds may be heard through a listening device 114 (FIG. 4), such as, but not limited to, headphones.

It should be emphasized that the above-described embodiments of the present invention, particularly, any “preferred” embodiments, are merely possible examples of implementations, merely set forth for a clear understanding of the principles of the invention. Many variations and modifications may be made to the above-described embodiment(s) of the invention without departing substantially from the spirit and principles of the invention. All such modifications and variations are intended to be included herein within the scope of this disclosure and the present invention and protected by the following claims.
CLAIMS

At least the following is claimed:

1. A system for providing a packet based electronic stethoscope, comprising:

   a detection device for detecting bodily sounds;
   an interface unit for preparing said bodily sounds to be transmitted as data packets;
   a patient unit for receiving said data packets from said interface unit and transmitting said data packets; and
   a receive unit for receiving said transmitted data packets from said patient unit and preparing said transmitted data packets such that a caregiver may hear said detected bodily sounds.

2. The system of claim 1, wherein said bodily sounds are selected from the group consisting of heart, lung, and bowel sounds.

3. The system of claim 1, wherein said detection device is an electronic stethoscope comprising a diaphragm, a bell, and a microphone.

4. The system of claim 3, wherein said microphone has a frequency response selected to detect sounds associated with bodily sounds.

5. The system of claim 1, wherein said patient unit is capable of storing said bodily sounds and notes regarding said sounds taken by said caregiver.

6. The system of claim 1, wherein said interface unit converts said bodily sounds from analog signals to digital signals.

7. The system of claim 1, wherein said receive unit depacketizes said transmitted data packets in order to extract said bodily sounds.
8. The system of claim 1, wherein said data packets are transmitted over an Internet protocol (IP) network.

9. The system of claim 1, wherein said patient unit is capable of storing personal patient information.

10. The system of claim 9, wherein said personal patient information is selected from the group consisting of a patient's name, address, medical conditions and treatment patterns.

11. The system of claim 10, wherein said personal patient information is transmitted to said receive unit, such that said caregiver may observe said information while listening to said bodily sounds.

12. The system of claim 11, wherein said receive unit preparing said transmitted data packets to be heard by said caregiver is performed by said receive unit converting said transmitted data packets to analog signals.

13. A method for providing a packet-based electronic stethoscope, comprising the steps of:
   - detecting bodily sounds;
   - preparing said detected sounds to be transferred as data packets;
   - transmitting said data packets to a receive unit;
   - receiving said transmitted data; and
   - preparing said received data such that a caregiver may listen to said detected bodily sounds.

14. The method of claim 13, wherein said bodily sounds are selected from the group consisting of heart, lung, and bowel sounds.

15. The method of claim 13, wherein said step of detecting bodily sounds is performed with use of an electronic stethoscope comprising a diaphragm and/or bell -having a microphone attached thereto.
16. The method of claim 13, wherein said step of preparing said detected sounds to be transferred comprises the steps of:
   converting said detected sounds from an analog signal to a digital signal;
   compressing said digital signal; and
   packetizing said compressed digital signal.

17. The method of claim 16, wherein said step of preparing said received data comprises the steps of:
   sequencing said packetized compressed digital data;
   decompressing said data;
   converting said data from digital to analog signals;
   filtering said analog signals to remove noise from said analog signals; and
   amplifying said analog signals so that they made be heard by said caregiver.

18. The method of claim 13, wherein said step of transmitting said data packets to said receive unit is performed over an IP network.

19. A system for providing a packet based electronic stethoscope, comprising:
   means for detecting bodily sounds;
   means for preparing said bodily sounds to be transmitted as data packets;
   means for receiving said data packets from said preparing means and
   transmitting said data packets, said means for receiving said data packets from said preparing means being capable of storing personal patient information; and
   means for receiving said transmitted data packets from said means for receiving said data packets from said preparing means and preparing said transmitted data packets such that a caregiver may listen to said detected bodily sounds.

20. The system of claim 19, wherein said bodily sounds are selected from the group consisting of heart, lung, and bowel sounds.
21. The system of claim 19, wherein said means for detecting is an electronic stethoscope comprising a diaphragm and/or bell and a microphone.

22. The system of claim 19, wherein said personal patient information is selected from the group consisting of a patient's name, address, medical conditions and treatment patterns.

23. The system of claim 22, wherein said personal patient information is transmitted to said means for receiving said transmitted data packets, such that said caregiver may observe said information while listening to said data packets.

24. A system for providing a packet based electronic stethoscope, comprising:
   a detection device for detecting bodily sounds;
   an interface unit for preparing said bodily sounds to be transmitted as data packets; and
   a patient unit for receiving said data packets from said interface unit and transmitting said data packets.

25. The system of claim 24, wherein said bodily sounds are selected from the group consisting of heart, lung, and bowel sounds.

26. The system of claim 24, wherein said detection device is an electronic stethoscope comprising a diaphragm, a bell, and a microphone.

27. The system of claim 26, wherein said microphone has a frequency response selected to detect sounds associated with bodily sounds.

28. The system of claim 24, wherein said patient unit is capable of storing said bodily sounds and notes regarding said sounds taken by said caregiver.

29. The system of claim 24, wherein said interface unit converts said bodily sounds from analog signals to digital signals.
30. The system of claim 24, wherein said data packets are transmitted over an Internet protocol (IP) network.

31. A method for providing a packet-based electronic stethoscope, comprising the steps of:
   detecting bodily sounds;
   preparing said bodily sounds to be transmitted as data packets;
   receiving said data packets; and
   transmitting said data packets.

32. The method of claim 31, wherein said bodily sounds are selected from the group consisting of heart, lungs and bowel sounds.

33. The method of claim 31, further comprising the step of storing said bodily sounds and notes regarding said sounds.

34. The method of claim 31, further comprising the step of converting said bodily sounds from analog to digital signals.

35. The method of claim 31, further comprising the step of transmitting said data packets over an (IP) network.
FIG. 3
FIG. 5

FILTER 122

AMPLIFIER 124

CONVERTER 126

COMPRESSION UNIT 128

PACKETIZE UNIT 132

104
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) : A61B 7/04
US CL : 381/67; 181/131; 600/586
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)

U.S. : 381/67; 181/131, 137; 600/528, 586; 128/715; D24/134

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

None.

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

BRS.

Search terms: stethoscope, remote, packets, transmitting, network (IP), class 379 and stethoscope, interface.

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
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<tbody>
<tr>
<td>Y</td>
<td>US 5,301,679 A (TAYLOR) 12 April 1994, see figure 1 and its description.</td>
<td>1-35</td>
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<tr>
<td>X</td>
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<td>1-35</td>
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[X] Further documents are listed in the continuation of Box C. □ See patent family annex.

* Special categories of cited documents:
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  *O* document referring to an oral disclosure, use, exhibition or other means
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**Date of the actual completion of the international search**

21 FEBRUARY 2001

**Date of mailing of the international search report**

13 MAR 2001

Name and mailing address of the ISA/US Commissioner of Patents and Trademarks

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Form PCT/ISA/210 (second sheet) (July 1998)
### INTERNATIONAL SEARCH REPORT

**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
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<th>Category*</th>
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