

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
8 June 2006 (08.06.2006)

PCT

(10) International Publication Number
WO 2006/059354 A1

(51) International Patent Classification:

A61B 5/00 (2006.01) A61B 5/0408 (2006.01)

(21) International Application Number:

PCT/IT2005/000696

(22) International Filing Date:

28 November 2005 (28.11.2005)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

MI2004A 002305

30 November 2004 (30.11.2004) IT

(71) Applicant and

(72) Inventor: **ROSSETTI, Walter** [IT/IT]; Via Savona, 69/a,
I-20144 Milano (IT).

(81) Designated States (*unless otherwise indicated, for every
kind of national protection available*): AE, AG, AL, AM,

AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,

KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV,
LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI,
NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG,
SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US,
UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every
kind of regional protection available*): ARIPO (BW, GH,

GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,
FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT,
RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA,
GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

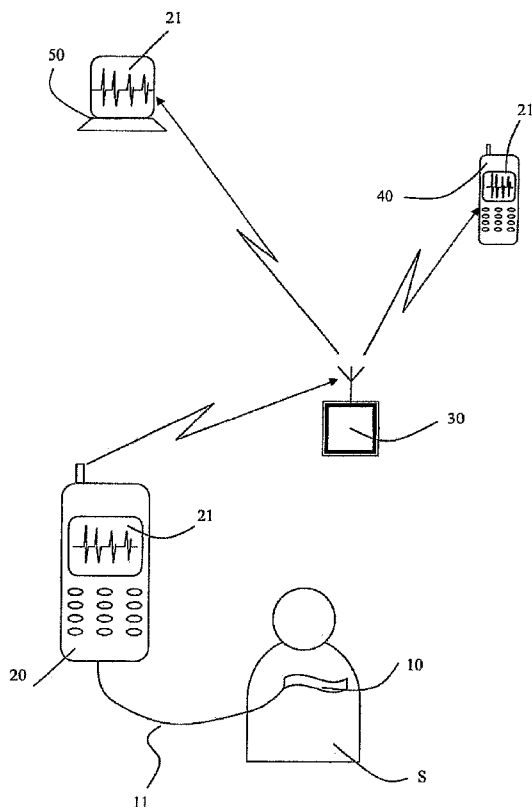
— of inventorship (Rule 4.17(iv))

Published:

— with international search report
— before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments

[Continued on next page]

(54) Title: SYSTEM FOR DETECTION AND PROCESSING OF PHYSICAL PARAMETERS OF HUMAN BODY AND METHOD THEREOF



(57) Abstract: What is disclosed is a system and a method for the detection and processing of physical parameters of the human body, which comprises a plurality of sensors which can be applied to the skin of a subject. Said system comprises at least an interface circuit for the processing of the signals coming from said sensors and at least a reception/transmission circuit for the transmission of the signals processed by the interface circuit.

WO 2006/059354 A1



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Title

“SYSTEM FOR DETECTION AND PROCESSING OF PHYSICAL PARAMETERS OF HUMAN BODY AND METHOD THEREOF”

Technical field

The present invention refers to a system and a method for the detection and processing of physical parameters of the human body. The invention refers in particular, but not exclusively, to the detection and processing of signals of an electrocardiogram of a patient. Systems for telemedicine have been known for a long time and continuously evolve; said systems for telemedicine allow patients who suffer from particular pathologies to be remotely monitored by means of telecommunication equipment. Said telecommunication equipment allows transmitting the signal detected by particular sensors applied to a patient to a diagnostic centre of choice. Nevertheless, several pathologies can arise without any notice also in subjects considered basically healthy. In particular, several cardiac problems may suddenly arise and, if not promptly faced, may constitute a serious danger for health, or even for life itself. Such an event may happen not only to people subjected to particular strain conditions, like athletes or other sports people during sports competition or training, but also to people in everyday life. Time is therefore a relevant factor in order to be able to help and try effective treatments to a subject struck, for example, by a heart attack. In fact, it is deemed that a prompt intervention, which is tried within 20 minutes since arising of a heart attack, could allow limiting damages due to such a pathology or even saving a person's life. Nevertheless, a person who is considered healthy, and for this reason is not normally subjected to a remote monitoring of his health conditions, is often unable to report the arising of such problems. For this reason, the need to provide to everyone a practical and easy-to-use system, which allows a quick reporting of significant information on the nature of the problems to a remote unit exists. In general, the object of the present invention is to provide a system for detection and processing of physical parameters of the human body that can be available to a person in order to report possible health problems to a remote unit.

Description of the invention

A particular object of the present invention is to provide a system and a method that allows detecting and transmitting information of a person's electrocardiogram, at any time and in any condition. Such objects can be reached by the present invention thanks to a system according to claim 1 and to a method according to claim 8. Further characteristics and advantages of the present invention are detailed in the respective claims.

In a first aspect of the present invention, a system for the detection and the processing of physical parameters of human body is provided, which includes a plurality of sensors applicable to the skin of the subject, characterized by the fact that it comprises at least one interface circuit for processing sensor outputs and at least one reception/transmission circuit for the transmission of the signals processed by the interface circuit.

In the preferred embodiment, signals detected by the sensors are signals of an electrocardiogram of the subject. The detection of other physical parameters, for example body temperature, arterial blood pressure and other, can be possibly provided, as long as specific sensors for such purpose are available.

In a particularly advantageous aspect of the present invention, the reception/transmission circuit is included in a cellular phone. Since a cellular phone is an everyday object, such a solution allows everyone to be able to notify conveniently and in a particularly simple way to a remote unit the arising of cardiac problems.

In a possible embodiment of said system, also the interface circuit is included in a cellular phone. Said cellular phone being therefore arranged to process signals received by the sensors and to transmit on request significant information to a particular remote equipment, which can be either a cellular phone or a landline telephony equipment.

In the preferred embodiment, the cellular phone includes at least a compartment in which sensors can be kept when they are not applied to the skin of the subject. In such a way, sensors necessary for signal detection can be always provided to the person that uses the cellular phone and do not encumber when they are not used. Alternatively, a compartment to keep sensors can be realized in the cellular phone case, provided that the subject uses one. In this way it is possible to avoid that the sensors being separated from the cellular phone and unintentionally placed where they do not come handy.

In a possible embodiment, the connection between the sensors and the cellular phone is wireless, for example infrared transmission or radio-frequency transmission. Alternatively, said connection can also be a wired connection, by providing the set of sensors with a single connector, which is compatible with a suitable data link socket of the cellular phone it is associated with.

In a second aspect of the present invention, a method for the detection and the processing of physical parameters of the human body is provided, in which a plurality of sensors is applied to the skin of a subject, characterized by the fact that it comprises the following phases:

a) detecting sensors signals;

b) processing the detected signals in order to obtain one or more images representative of the signals;

c) transmitting images to a remote unit as radio-frequency signals.

In particular, the signals detected are preferably at least signals of an electrocardiogram of the subject, such signals being transformed into images. An image advantageously provides an information which is particularly significant and immediately decipherable by the person who receives them. Images are preferably transmitted by a cellular phone to a remote unit, for example the cellular phone of a trusted physician or to a telephony equipment, for example a telephone or a mobile phone equipped with a visualization screen, a facsimile or similar, which is present in a diagnostic centre or in a centre equipped for telemedicine services. The processing of the images is preferably realized by a suitable interface circuit included in a cellular phone. Alternatively, said interface circuit can be included in an external unit which can be connected, with a wired or wireless connection, to the mobile phone and to the sensors.

In a third aspect of the present invention, a set of sensors for the detection and the processing of physical parameters of human body is provided, characterized by the fact that it comprises a plurality of sensors applicable to the skin of a subject, said plurality of sensors being assembled on a flexible or foldable support. Such support is preferably shaped, in order to facilitate the right application of the sensors to the skin of the subject and the electrical conductors of the sensors are grouped in a single connection at their free end, thus allowing the connection to an interface circuit or to a cellular phone.

In a possible embodiment, the set of sensors comprises at least six sensors for the detection of the signals of an electrocardiogram. Obviously, further sensors can be added, for example a seventh sensor still aimed at detecting signals of an electrocardiogram or other sensors aimed at detecting further significant parameters.

The "cardiac stripe" or "component with sequence of sensors on a flexible support" can be easily used by everyone, because it realizes in a single semi-adhesive element, which is stripe-shaped, the guided placement of several measure points, which are necessary for the detection of an electrocardiogram.

In fact, thanks to a proper shape of the said stripe, which can provide precise reference points on the user's body (for example, ribs, breast-bone, nipple, etc.), it is possible to apply said device in the correct way, without making any mistake. The flexible support comprises the proper spacing among each sensor, in such way allowing the guided positioning of the stripe. Said guided positioning and the adaptable conformations make said system quick and effective to apply, thus decreasing the sensor application time, as if the set of sensor was a single sensor. Furthermore,

the connection system facilitates the system's substitution, thus allowing its use as a disposable item.

Said system can be applied also to standard instruments, thanks to connectors and/or interface circuits which connect, also wireless, the stripe to a standard electrocardiogram. Fitness characteristics are specified, which easily allow proper stretching and shortening of the flexible support, thanks to, as a non binding example, one or more foldings. Moreover, the stripe can comprise integrated, overturnable or connectable branches, which can reach other relevant points on the subject which are not in sequence.

Brief description of the drawings

Further advantages and characteristics of the present invention will become more readily appreciated by reference to the following description, made by way of example and not restrictive, when taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a schematic representation which generally illustrates the main idea of the invention;

Figure 2 is a representation of a possible embodiment of the present invention;

Figure 3 is a representation of a further possible embodiment of the present invention;

Figure 4 is a schematic perspective view of a possible embodiment of a mobile phone suitable to the use in a system according to the present invention; and

Figure 5 schematically illustrates a possible embodiment of a set of sensors according to the present invention.

Figure 1 shows a subject **S**, who has been applied a set of sensors **10** for the detection of signals of an electrocardiogram. The sensors of the set of sensors **10** are electrically connected to a cellular phone **20** by means of conductors **11** preferably joined in a single cable or stripe provided at its free end with a connector **12** (Figure 5) suitable to the connection to a cellular phone **20**. In the possible embodiment shown in Figure 1, the cellular phone **20** includes an interface circuit which can process the signals coming from the set of sensors **10** in order to obtain an image **21** for each of the sensors **V1-V6** (Figure 5) which are present in the set of sensors **10**. Each image **21** is stored, possibly visualized on the screen of the cellular phone **20**, and transmitted over a cellular phone network, for example a GSM network or similar here schematized in a simple manner by a single node **30**, to a remote unit, like a cellular phone **40** belonging for example to a doctor or, alternatively or in combination, to the monitoring station **50** of a specialist centre provided with suitable telecommunications equipment or with systems for telemedicine.

As shown in **Figure 2**, the connection between the set of sensors **10** and the cellular phone **20** can be realized also wireless, for example by means of a suitable interface circuit **60** which uses

for example radio frequency signals, infrared signals or similar (for example a BlueTooth® system or a wi-fi hot spot), in order to transmit the detected signals to the cellular phone 20.

Figure 3 shows a possible embodiment where an interface circuit 70, which connects the set of sensors 10 to the cellular phone 20 is interposed. Said interface circuit 70 can directly process the received signals in order to produce images, possibly storing said images, and then transmit said images to the cellular phone 20. As an alternative, interface circuit 70 can also be arranged to perform only some of the signal processing operations (e.g., analog-to-digital conversion, storage and/or control of the data flow from the sensors to the cellular phone 20). Connection wires 11 and 71, which connect said interface circuit respectively with the set of sensors 10 and with the cellular phone 20, can obviously be replaced by a circuit like the one labeled 60 in Figure 2 for wireless transmission of the signal.

In an advantageous embodiment, schematically shown in **Figure 4**, the cellular phone 20 can be provided, for example in the posterior part of its shell, with a compartment 23 into which at least the set of sensors 10 can be folded. If necessary, also the possible interface circuit 70 can be kept in the said compartment 23, if there is enough space. A cover 25 allows locking the access to the compartment 23 in order to keep the sensors and/or the interface circuit when they are not used. In an alternative way or in combination, the sensors and the interface circuit can also be kept in a case (not represented) of the cellular phone 20.

In **Figure 5** a set of sensors 10, in which six sensors, labeled V1-V6, are provided, and assembled on a support 15 realized using a flexible and foldable material is shown. Said support 15 is preferably shaped in order to facilitate the right application of the sensors on the skin of the subject S, for example sensors V1 and V2 being applied to the sides of the breast bone and sensors V3-V6 applied immediately under the pectoral muscle. Said support 15 encloses also the electrical conductors associated with each sensor, said electrical conductors being connected, at their free end, to a single connector 12, which allows the connection of the said set of sensors 10 to the cellular phone 20 and/or to an interface circuit like the said interface circuits labeled 60 (Figure 2) and 70 (Figure 3).

CLAIMS

What is claimed is:

1. A system for the detection and processing of physical parameters of the human body, comprising a plurality of sensors applicable to the skin of a subject, characterized by the fact that it comprises at least an interface circuit for the processing of the signals coming from said sensors and at least an reception/transmission circuit for the transmission of the signals processed by said interface circuit
2. System according to claim 1, where signals detected by said sensors are signals of an electrocardiogram of the subject.
3. System according to claim 1, where said reception/transmission circuit is included in a cellular phone
4. System according to claim 1, where said interface circuit is included in a cellular phone.
5. System according to claim 3 or 4, where the shell of said cellular phone comprises at least one compartment to keep at least said sensors when they are not applied to the skin of a subject.
6. System according to claim 3 or 4, further comprising at least one case, for at least said cellular phone, where said case comprises at least one compartment to keep at least said sensors when they are not applied to the skin of a subject.
7. System according to any of the previous claims, where wireless connections which allow the transmission of signal flow from said sensors to said cellular phone are provided.
8. Method for the detection and processing of physical parameters of the human body, where a plurality of sensors are applied to the skin of a subject, characterized by the fact that it comprises the phases of:
 - a) Detecting sensor output signals;
 - b) Processing said detected signals in order to obtain one or more images representative of said signals;
 - c) Transmitting to a remote unit said one or more images as radio-frequency signals.
9. Method according to claim 8, where signals detected by said sensors are signals of an electrocardiogram of the subject.
10. Method according to claim 8, where an image for each of the said sensors is created.
11. Method according to claim 8, where said one or more images are transmitted by means of a cellular phone.
12. Method according to claim 11, where the processing of said images is realized by a suitable circuit included in a cellular phone.
13. Method according to claim 11, where said sensors are lodged in a compartment obtained in the shell of said cellular phone when said sensors are not applied to the skin of a subject .

14. Method according to claim 8, where said remote unit is another cellular phone.
15. Method according to claim 8, where said remote unit is a centre for telemedicine services.
16. Set of sensors for the detection and processing of physical parameters of the human body, characterized by the fact that it comprises a plurality of sensors applicable to the skin of a subject, assembled on a flexible and/or foldable support.
17. Set of sensors according to claim 16, where said support is properly shaped in order to facilitate the right application of said sensors to the skin of a subject.
18. Set of sensors according to claim 16, where the electrical conductors of said sensors are grouped in a single connection at their free end in order to allow the connection of said set of sensors to an interface circuit and/or to a cellular phone.
19. Set of sensors according to claim 16, where at least six sensors applied in suitable positions on said flexible and/or foldable support are provided.
20. A system which comprises at least a wireless transmission or a reception/transmission circuit and a cardiac stripe; said cardiac stripe comprises at least one connector, in order to facilitate the replacement of the stripe itself; the cardiac stripe is characterized as a sensor sequence; said sensors are conductive and semi-conductive electrical elements in contact with the skin, which can detect signals related to heart activity; said sensors are placed in sequence thanks to a suitable flexible support which guarantees the proper positioning and distancing among the conductive and semi-conductive sensing elements; said sensors or skin connection points are connected with the external points of connection or connectors by means of conductive parts which are integrated in the flexible support; said flexible support comprises pivot and/or extensible and/or overturnable joints, thus allowing to reach suitable positions on the subject, also thanks to the shaped support, which guides the subject and allows the right positioning on the body.
21. A system according to claim 20, which comprises, in addition to the transmission system, a reception system which can be directly interfaced with a graphic display and/or storage circuit of the cardiac tracing, as well as to a standard electrocardiogram, in alternative or in addition to a cellular phone; said receiving system can be a Bluetooth receiver or a wi-fi hot spot and/or any other possible access system to the internet.
22. A cardiac stripe according to claim 20 or 21, which comprises adhesive parts which, in contact with the skin, create a temporary connection for a time period suitable to the use; said adhesive part can be also electrically conductive, or it can keep the contact with the electrically conductive part.

23. A cardiac stripe according to claim 22, which comprises, as well as the sequence of contacts with the skin, one or more branches realized by stripes, which have one or more points of contact with the skin.

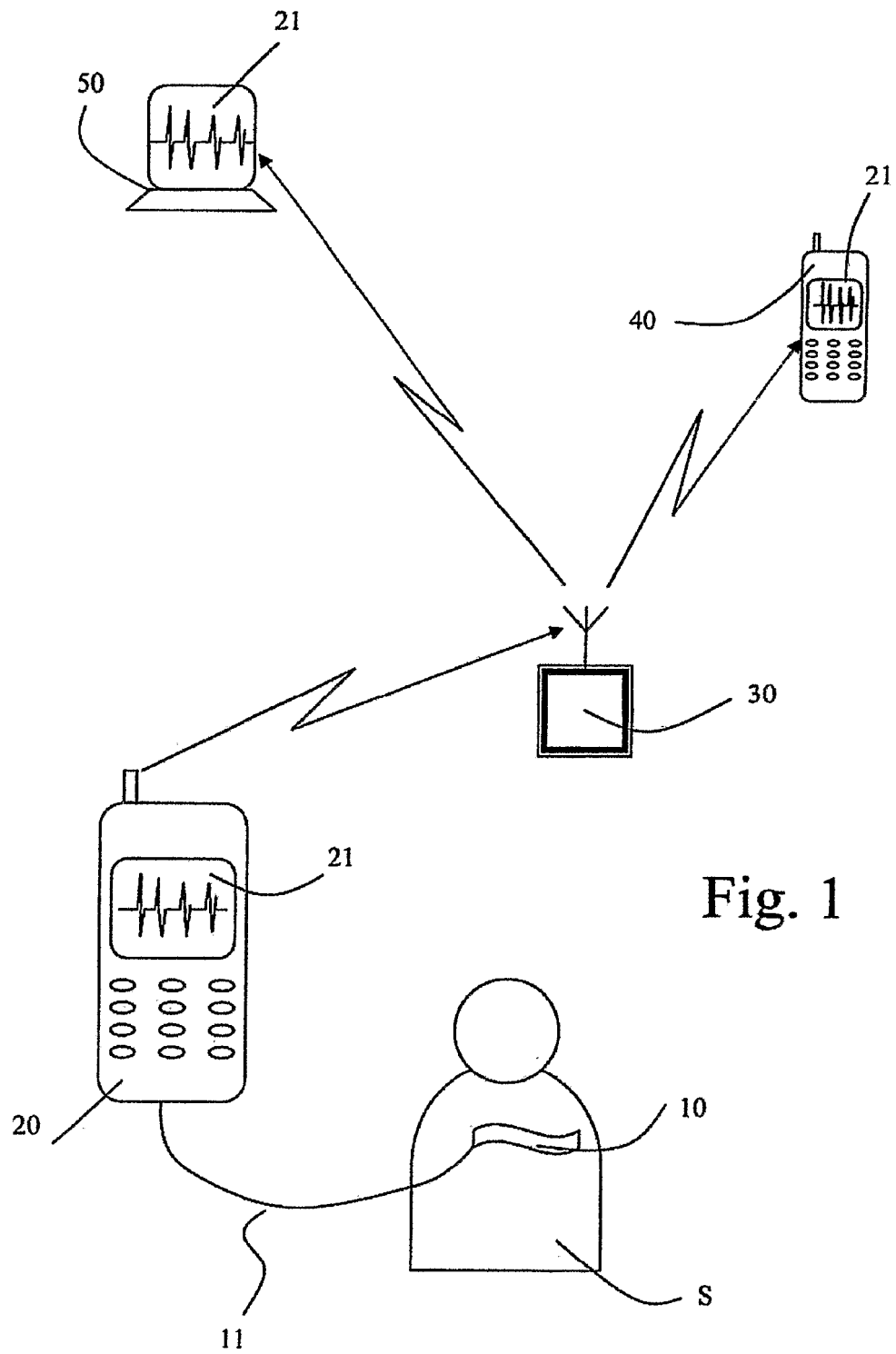


Fig. 1

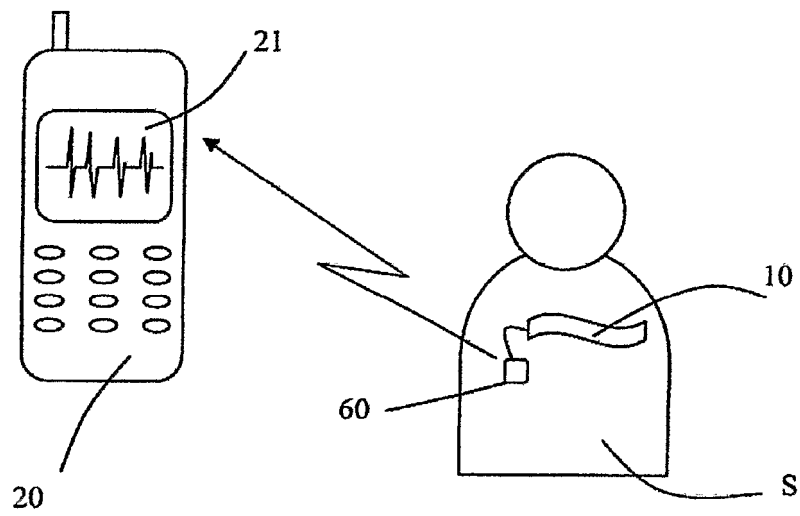


Fig. 2

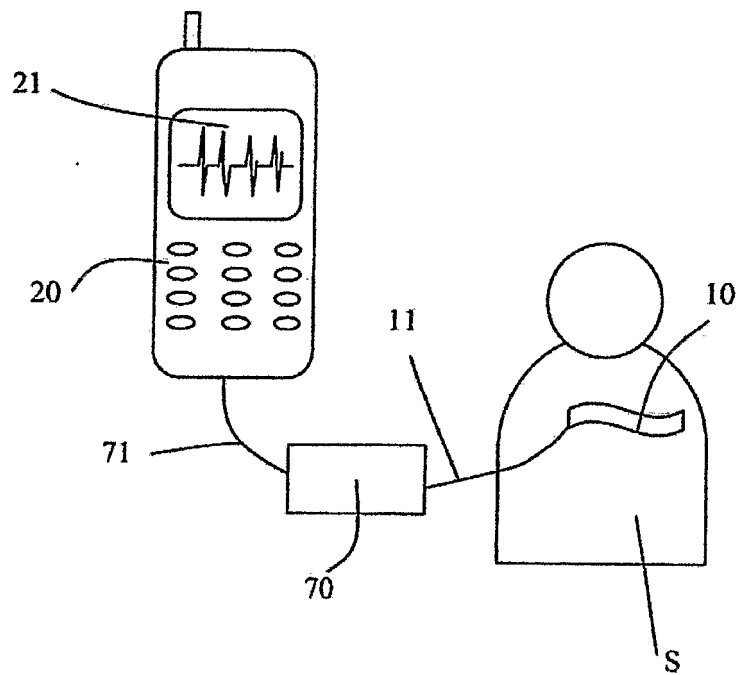


Fig. 3

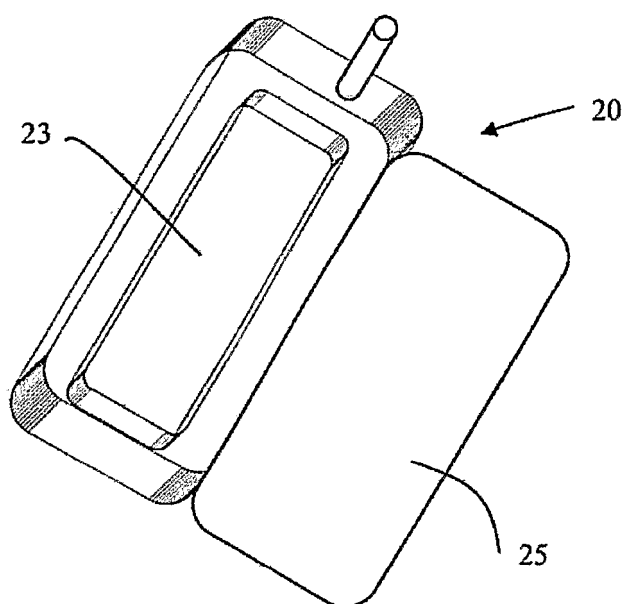


Fig. 4

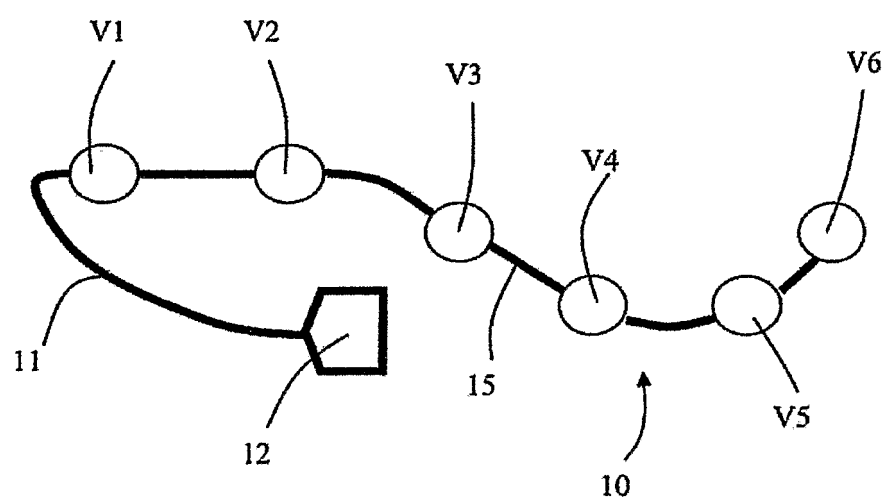


Fig. 5

INTERNATIONAL SEARCH REPORT

Int. application No
PCT/IL2005/000696

A. CLASSIFICATION OF SUBJECT MATTER
A61B5/00 A61B5/0408

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)
A61B A61N

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, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/059205 A1 (CARLSON SVEN-ERIK ET AL) 25 March 2004 (2004-03-25)	1-4,7
Y	paragraphs [0073], [0074]	5,6
Y	WO 01/32075 A (AEROTEL MEDICAL SYSTEMS LTD; NATALI - THE ISRAEL COMPANY FOR EMERGENC) 10 May 2001 (2001-05-10) page 4, line 16 - line 25 page 10, line 5 - line 10	5,6,13
X	US 2001/024949 A1 (YANAGIDA YO ET AL) 27 September 2001 (2001-09-27)	8-12, 14-19
Y	paragraphs [0065], [0066], [0068]	13
X	DE 102 48 894 A1 (NIEHAUS, MICHAEL) 13 May 2004 (2004-05-13) paragraphs [0056], [0058]	16-19
	-/--	

☒ Further documents are listed in the continuation of Box C.

☒ 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

20 March 2006

Date of mailing of the international search report

29/03/2006

Name and mailing address of the ISA/

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

Authorized officer

Knüpling, M

INTERNATIONAL SEARCH REPORT

Int. application No
PCT/IT2005/000696

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 583 549 A (MANOLI ET AL) 22 April 1986 (1986-04-22) column 4, line 43 - line 55 -----	16-19
Y	US 5 467 773 A (BERGELSON ET AL) 21 November 1995 (1995-11-21) column 4, line 60 - column 5, line 6 column 9, line 51 - line 56 -----	20-23
Y	US 5 184 620 A (CUDAHY ET AL) 9 February 1993 (1993-02-09) column 5, line 43 - column 6, line 24 -----	20-23

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/JP2005/000696

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2004059205	A1	25-03-2004	AU 2003254690 A1 CA 2493527 A1 WO 2004026126 A1 CN 1681433 A EP 1545301 A1 JP 2005538784 T	08-04-2004 01-04-2004 01-04-2004 12-10-2005 29-06-2005 22-12-2005
WO 0132075	A	10-05-2001	AU 1172501 A	14-05-2001
US 2001024949	A1	27-09-2001	JP 2001262408 A	26-09-2001
DE 10248894	A1	13-05-2004	NONE	
US 4583549	A	22-04-1986	NONE	
US 5467773	A	21-11-1995	NONE	
US 5184620	A	09-02-1993	NONE	

专利名称(译)	用于检测和处理人体物理参数的系统及其方法		
公开(公告)号	EP1816952A1	公开(公告)日	2007-08-15
申请号	EP2005850967	申请日	2005-11-28
[标]申请(专利权)人(译)	ROSSETTI WALTER		
申请(专利权)人(译)	ROSSETTI , WALTER		
当前申请(专利权)人(译)	ROSSETTI , WALTER		
[标]发明人	ROSSETTI WALTER		
发明人	ROSSETTI, WALTER		
IPC分类号	A61B5/00 A61B5/0408		
CPC分类号	A61B5/0006 A61B5/0205 A61B5/04085		
优先权	MI2004002305 2004-11-30 IT		
外部链接	Espacenet		

摘要(译)

公开了一种用于检测和处理人体物理参数的系统和方法，其包括可以应用于受试者皮肤的多个传感器。所述系统至少包括用于处理来自所述传感器的信号的接口电路和至少一个用于传输由接口电路处理的信号的接收/传输电路。