PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : A61B	A2	(11) International Publication Number: **WO 00/44274** (43) International Publication Date: 3 August 2000 (03.08.00)

(21) International Application Number: PCT/US00/02418

(22) International Filing Date: 28 January 2000 (28.01.00)

(30) Priority Data:
60/117,966 29 January 1999 (29.01.99) US

(71)(72) Applicants and Inventors: POUGATCHEV, Vadim I. [RU/US]; 12422 Peacock Hill Ave. NW, Gig Harbor, WA 98332 (US). BOGOMOLOV, Evgueni N. [RU/US]; 12422 Peacock Hill Ave. NW, Gig Harbor, WA 98332 (US). IAROSLAVSTEV, Igor V. [RU/US]; 12422 Peacock Hill Ave. NW, Gig Harbor, WA 98332 (US). ZHIRNOV, Eugene N. [RU/US]; 12422 Peacock Hill Ave. NW, Gig Harbor, WA 98332 (US). GRIBKOV, Eugene N. [RU/US]; 12422 Peacock Hill Ave. NW, Gig Harbor, WA 98332 (US).

(74) Agent: JOHNSON, Larry, D.; Suite 130, 175 N. Redwood Drive, San Rafael, CA 94903 (US).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: PERSONAL PHYSIOLOGICAL MONITOR

(57) Abstract

A personal physiological monitor for evaluating autonomic nervous system functioning, said monitor including PPG, and/or GSR, and/or temperature sensors for acquiring raw physiological signals; a data processor for computing interbeat intervals from the raw PPG signal and re–sampling interbeat interval sequences with a linear interpolation procedure; transmission means for transmitting both raw signals and the interbeat intervals to a computer through a communication port; a visual display; and built–in flash memory.

Apple Inc.
APL1066

DOCKET ALARM
Find authenticated court documents without watermarks at docketalarm.com.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

DOCKET ALARM
Find authenticated court documents without watermarks at docketalarm.com.

PERSONAL PHYSIOLOGICAL MONITOR

DESCRIPTION

TECHNICAL FIELD

This invention is related to the subject of the monitoring and assessment of the specific physiological conditions reflecting the functions of the autonomic nervous system (ANS) - heart rate variability, blood volume pulse, galvanic skin reactions (GSR) and peripheral skin temperature (TMP).

BACKGROUND ART

It is known that the overall functioning of a living organism is controlled by the autonomic nervous system. The ANS has two antagonistic branches - the sympathetic and parasympathetic nervous systems. Every organ is activated by one branch and inhibited by the other. Generally when the organism is in a calm state (relaxation, sleep, etc.) several organs, including the heart, lungs and blood vessels, are under the dominance of parasympathetic control. When the organism is activated by physical activity, psycho-emotional arousal or stress, the organs are under dominant control of the sympathetic nervous system. A healthy organism is capable of adjusting to any outer influence by means of a quick and adequate sympathetic response. Once that factor disappears the parasympathetic activity increases balancing the organism's overall autonomic regulation.

It is important to have a means of measuring these specific physiological parameters used for the evaluation of the level of balance between the branches of autonomic nervous system and their reactions. With such means, specific provocative test factors are evaluated as well as the condition of both branches. Such a tool can help a human being learn how to cope with stress, thereby achieving an autonomic balance as well as measuring certain physiological effects of the autonomic nervous systems regulations.

DOCKET ALARM Find authenticated court documents without watermarks at docketalarm.com.

One of the most informative methods for the evaluation of the status of ANS sympathetic and parasympathetic branches is heart rate variability analysis. It is known that the time intervals between each two consecutive heartbeats vary and are under control of the autonomic nervous system. When the parasympathetic system is dominant the heart interbeat intervals (IBI) are oscillating with higher frequencies (0.15 - 0.4 Hz). When sympathetic arousal occurs, lower frequency oscillations take place.

There are two other physiological modalities that reflect the condition of autonomic regulation: skin conductance (galvanic skin response: GSR) and peripheral skin temperature. Skin conductance reflects changes in sweat gland activity driven by involuntary arousal of the sympathetic nervous system. These changes are rapid and varied as a reaction of the organism to outer events and slower changes reflecting variations of overall tonus of the sympathetic system. The skin temperature reflects a degree of vasoconstriction or dilation of the peripheral blood vessels, which also reflects a long-term process of the interaction of both branches of autonomic nervous systems. There is some disagreement regarding the efficacy of these latter two modalities for evaluating ANS balance, so they are noted here for reference purposes only.

Another physiological measure - blood volume pulse reflects the level of peripheral blood vessels constriction / dilation. Blood volume pulse is affected by the same autonomic function activity.

There is a standard mathematical procedure for short-term HRV evaluation, suggested by the Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (1996). It provides both time and frequency domain analysis of the IBI time series. There are three important parameters of frequency domain analysis of HRV that reflect the levels of sympathetic and parasympathetic activities and their balance. The high frequency range (0.15 Hz- 0.4 Hz) of the

DOCKET ALARM Find authenticated court documents without watermarks at docketalarm.com.

IBI power spectrum (HF) reflects parasympathetic influence on heart rate. The low frequency range (0.04 Hz -0.15 Hz) of the IBI power spectrum (LF) has a considerable input of the both branches of the autonomic nervous system.

To perform the HRV analysis an electrocardiograph (ECG) signal is usually measured. The IBI are derived from the ECG as the intervals between consecutive R-peaks. This method is very accurate and reliable but has a serious disadvantage - it requires the use of complex ECG equipment with the inconvenience of multiple site electrode placement. An alternative is to use a photoplethysmograph (PPG) measurement, which is a portable and convenient optical sensor that can be applied in many places to pick up peripheral blood flow changes (e.g. fingers, ear lobe, etc.). The PPG emits an infrared (IR) light on the skin. The emitted light is partially consumed by the blood flow. The degree of light consumption / reflection is proportional to the changes in blood flow. The PPG signal has periodic peaks that represent flow pulsation in blood vessels. It can be used to derive the IBI by measuring the time between two PPG peaks. Blood volume pulse information can be derived as well.

DISCLOSURE OF INVENTION

The personal physiological monitoring method of the present invention includes several possible hardware configurations of the physiological monitoring apparatus. Generally a physiological monitor continuously carries out any of the following functions depending on the particular hardware configuration:

1. Acquires raw signals any of the following physiological modalities: PPG, GSR or temperature;
2. Computes interbeat intervals from the raw PPG signal;
3. Re-samples interbeat interval sequence with a linear interpolation procedure;
4. Transmits both raw signals and the interbeat intervals to a computer through a communication port;

DOCKET ALARM Find authenticated court documents without watermarks at docketalarm.com.

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.