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(54) **APPARATUS AND METHOD FOR DETECTING A PHYSIOLOGICAL MEASUREMENT FROM A PHYSIOLOGICAL SOUND SIGNAL**

VORRICHTUNG UND VERFAHREN ZUR ERFASSUNG EINER PHYSIOLOGISCHEN MESSUNG AUS EINEM PHYSIOLOGISCHEN SCHALLSIGNAL

APPAREIL ET PROCÉDÉ PERMETTANT DE DÉTECTER UNE MESURE PHYSIOLOGIQUE DANS UN SIGNAL SONORE PHYSIOLOGIQUE

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(73) Proprietor: **Sony Ericsson Mobile Communications AB**
221 88 Lund (SE)

(72) Inventors:
- **HAARTSEN, Jacobus**
  NL-7772 BG Hardenberg (NL)
- **SAMPIMON, Gerrit**
  NL-7843 PV Erm (NL)

(74) Representative: **Banzer, Hans-Jörg**
Kraus & Weisert
Patentanwälte PartGmbB
Thomas-Wimmer-Ring 15
80539 München (DE)

(56) References cited:
WO-A-2006/050512
GB-A- 2 419 946
US-A1- 2002 091 049
US-A1- 2006 064 037
US-A1- 2006 107 822
US-A1- 2008 146 890

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Description

Technical field

[0001] The present invention relates to an apparatus and a method for detecting a physiological measurement from a physiological sound signal.

Background

[0002] Devices for exercising aid and applications in other devices for the same, or applications for other purposes, such as just for amusement have become popular. Such other devices can be portable media players, mobile telephones, and portable digital assistants. Positioning information means, accelerometers, altitude meters, etc. included in such devices may be used for added value. Applications for gaming, exercise aid, log functions, etc. may rely on these measured quantities.

[0003] Still, further measured quantities could enhance the devices. It is therefore a desire to add available quantities to measure. However, since the devices are intended to be used by an ordinary user without particular skills and the user normally appreciates gear that is easy to handle, sensors that are used for professional measurements are many times not suitable for these kinds of devices. It is therefore a further desire to provide gear that is easy to use by an ordinary user for the measurements.

[0004] US 2008/146890 A1 discloses a telemetric apparatus for health and environmental monitoring with an apparatus as an earpiece module according to the preamble of claim 1.

[0005] US 2006/0064037 A1 discloses a system for detecting non-verbal acoustic energy generated by a subject. The system includes a sensor mountable on or in a body region of the subject, wherein the sensor is capable of sensing the non-verbal acoustic energy and a processing unit being capable of processing the non-verbal acoustic energy sensed by the sensor and deriving an activity related signature therefrom.

Summary

[0006] The present invention provides an apparatus for detecting a physiological measurement from a physiological sound signal as defined in claim 1 and a corresponding method as defined in claim 10. The dependent claims define preferred and advantageous embodiment of the invention. The present invention is based on the understanding that an ordinary user is comfortable with using earphones, and that addition of a microphone in an earphone can be used for acquiring sounds from which measurements on physiological sounds present in the user's ear can be made. The physiological sounds are extracted by subtracting sounds provided by the speaker of the earphone. From the physiological sounds, desired quantities and/or qualities are determined, such as heart rate or breathing pattern.

Brief description of drawings

[0007]

Fig. 1 schematically illustrates an apparatus according to an embodiment.

Fig. 2 is a flow chart illustrating a method according to embodiments.

Fig. 3 is a diagram illustrating functions between provided music beat rate and breathing pattern or heart rate.

Fig. 4 is a block diagram schematically illustrating an application according to an embodiment.

Fig. 5 schematically illustrates a computer readable medium.

Detailed description

[0008] Fig. 1 schematically illustrates an apparatus 100 according to an embodiment. The apparatus 100 comprises a speaker arrangement 102, e.g. an earphone, which has a speaker 104 and a microphone 106 arranged together with the speaker 104. The speaker 104 is provided with an audio signal, e.g. music, which preferably is provided by an amplifier 108, which in turn may get the audio content from a media player element 109. As will be demonstrated below, the audio signal can also comprise a sub-signal for heartbeat measurements. The microphone 106, which is arranged to acquire heart or breathing sounds and of course the audio sound generated by the speaker 104, provides its output signal to a subtractor 110, which subtracts the audio signal from the microphone signal. Optionally, the microphone signal is filtered by a filter 111a. In addition, or alternatively, the audio sound provided by amplifier 108 may be filtered by a filter 111b before input to subtractor 110. The output from the subtractor 110 essentially comprises a heart and/or breathing sound signal since the signal components emanating from the audio sound are deleted. The heart and/or breathing sound signal is provided to a physiological sound detector 112. Here, it should be noted that a filter 111c can be arranged between the subtractor 110 and the physiological sound detector 112 instead of, or in addition to, the filter 111a between the microphone 106 and the subtractor 112 and/or the filter 111b between the amplifier 108 and the subtractor 110. The breathing sound pattern can for example distinguish between breathing through the nose or the mouth. The breathing sound pattern can alternatively or additionaly be a measure on breathing rate, e.g. breaths per minute or period between breaths, duty cycle of inhaling and/or exhaling, etc. From the breathing sound pattern, the physical status of a user can be estimated, e.g. during physical exercising. Similar applies for heart sounds, where heart rate and/or amplitude of heart sound can be determined. The subtractor 110, the optional filter(s) 111 a, b, c, and the pattern detector 112 can be part of a signal processor 114 performing the functions of the elements 110, 111

(a, b, c), 112, for example in analog or digital domain.

[0009] In an embodiment, the breathing pattern can be used for controlling an application 115 such that features of the application are adapted to the breathing pattern and/or the heartbeat.

[0010] For example, the application can be a music selection application which selects music with a beat rate that depends on for example the breathing rate. This can for example be neat when listening to music while running or jogging, as breathing is related to the physical effort, and also has a relation to step pace. For example, at running exercise, a 4-4 breathing means inhaling during 4 steps and exhaling during 4 steps, and during different parts of an exercise, different breathing strategies can be used, such as changing to 3-3, 2-2, 2-1 etc. If the music is in pace with breathing and thus steps, the exercise can be improved.

[0011] Another example is by determining if breathing is nasal or oral. This can be determined on the different sound characteristics the breathing has when the air is flowing in the head. Nasal breathing can then be taken as a sign of low activity exercising, while oral breathing can be taken as a sign of high activity exercising. Music can then be selected accordingly.

[0012] Further another example is by determining if breathing is deep or shallow. This can also be determined from sounds the flowing air is causing in the head, and which sounds can be acquired in the user's ear. An example is to select a lower beat rate on the music if breathing is shallow to calm the user to get into a deep breathing state, which is known to lower heart rate and improve efficiency in exercise. Similarly, if period of breathing is too short to give proper oxygenation in the lungs, lowered music beat rate can improve breathing and exercise.

[0013] Still another example is a combination of any of the above breathing patterns, where a proper breathing according to a pre-configured or user-configured model is present, but still showing that pace of the exercise can be increased, and therefore an increased beat rate of the music is selected.

[0014] Alternatively, or in combination with any of the examples given above, the heart rate and/or intensity of heartbeat sounds can be used for exercising aid, and optionally in combination with the music selection feature.

[0015] Of course, the measured breathing pattern and/or heartbeat can also be used in an exercise aid application without controlling any music selection. Similar, the measured breathing pattern and/or heartbeat can also be used in an application without any connection to exercise aid.

[0016] The application can of course combine other measured or estimated values and their derivatives too, such as step counter, positioning data, altitude, etc. The settings can be pre-defined or user-defined. The settings can also be down-loadable from a remote location, e.g. over a wireless communication interface such as a cellular telecommunication system. The measured and estimated values can also be saved in a log for post-exercise analysis. Fig. 4 is a block diagram schematically illustrating an example on objects and features of an exercise enhancing application 400. A breathing pattern signal and/or heartbeat signal is input to the application 400, which is controlled by an application engine 402. The application engine 402 is also enabled to receive settings from a settings object 404, which for example can provide settings made by a user, pre-defined settings, or downloaded setting on age, weight, gender, body mass index, exercise limits, exercise type, music function, etc. to the application engine. The application engine can also control one or more function objects 406 for different features. The application 400 can also control other functions or applications, such as a media player, as demonstrated with reference to Fig. 1. The output interface for this control is preferably controlled by the application engine 402. Here, it should be noted that the example given with reference to Fig. 4 includes a multitude of functions 406. Other examples are any application comprising one or more of the functions given with reference to Fig. 4. The application 400 can for example be implemented as a feature in a mobile phone, a media player, a GPS receiver or a personal digital assistant.

[0017] The application can also be independent on physical exercising properties. Breathing can be used for controlling the apparatus 100 on the user's intention, where different breathing patterns are decoded to operation instructions for the apparatus 100, for example changing or pausing music provided by the media player 109.

[0018] By nature, the heartbeat produces a weak sound in the head of the user with frequency components mainly corresponding to the heart rate. The heartbeat sound signal acquired by the microphone 106 can be amplified, filtered and processed to produce a heart rate value. The filtering can comprise low-pass filtering, since the heartbeat itself normally is within the range of 0.5 to 3 Hz. Since music content normally is very low at these frequencies, a narrow filter can enhance the heart sound signal significantly.

[0019] Alternatively, the heartbeat signal is produced by providing a sub-signal to one of the user's ears by a second speaker, which can be done together with e.g. music. Preferably, the sub-signal is at a frequency not discernable by the user, e.g. an ultrasonic or a subsonic frequency should be used. As the sound of the sub-signal propagates through the head of the user to the other ear, the heartbeat will modulate, i.e. provide different attenuation, the sub-signal sound through the pulsation of the blood veins. The sound acquired by the microphone 106 in the other ear will comprise the modulated sub-signal sound. A low-pass filter in case of a subsonic sub-signal, and a high-pass filter in case of an ultrasonic sub-signal can be used to suppress the music signal while detecting the heartbeat. By similar signal processing as demonstrated above, the heart rate can be determined. This approach is particularly suitable for stereo earphones.

[0020] Fig. 2 is a flow chart illustrating a method according to embodiments, where hashed lines indicate optional actions. The flow chart is for illustrative purposes, and the order of the actions is not to be interpreted as a sequential order. Instead, the actions are preferably to be considered as real-time objects which can be performed in any order, or in parallel. In an audio supply step 200, an audio signal is provided to a speaker suitable for applying in a user's ear, such as an earphone, for rendering of the audio content of the audio signal. In a sound acquisition step 202, sound present in the user's ear is acquired by a microphone arranged together with the speaker. The sound present in the user's ear will be a mix of the rendered audio content and sounds generated in the user's head, such as breathing sounds which emanates from air flows in cavities of the head, and heartbeat sounds from blood pulsating in veins in the head according to any of the examples given with reference to Fig. 1. In an optional sound signal filtering step 203, the acquired sound signal can be filtered to enhance the signal, e.g. attenuating frequencies out of frequency range for breathing sounds and/or heartbeat sounds. In an audio signal subtracting step 204, the audio signal is subtracted from the sound signal to extract a breathing signal. In a physiological sound detection step 206, a breathing pattern and/or heartbeat is detected, as demonstrated with reference to Fig. 1. Optionally, heart rate can be estimated from the detected breathing pattern in a heart rate estimation step 207. Different models for estimating the heart rate from breathing pattern can be used. A user and/or exercise specific model can be used, where one or more characteristics of the breathing pattern are mapped to an expected heart rate. Alternatively, the heart rate can be estimated on the assumption that the faster the breathing rate, the faster the heart rate. Further alternatively, the heart rate can be estimated on the assumption that higher air flow, for example based on the amplitude and/or frequency components of the breathing signal, is mapped to a higher heart rate, and a shallow breathing is mapped to a higher heart rate then deep breathing. The optional heart rate estimation step 207 can be an alternative to the possible heartbeat determination of the physiological sound detection step 206, or a complement for comparison between detected and estimated heart rate, where the comparison can be used as input to an application. In an optional application feature controlling step 209, features of one or more applications can be controlled based on the breathing pattern, alternatively on the estimated heart rate.

[0021] Fig. 3 is a diagram illustrating functions between provided music beat rate and breathing pattern or heart rate. For the case of breathing pattern, a determined breathing rate, periodicity, or duty cycle can be used for this type of relation. The solid line illustrates a linear relation between the breathing pattern or estimated heart rate and the music beat rate, while the dot-dashed lines illustrate different non-linear relations. The illustrated lines illustrate monotonic functions for the relation. The application of a monotonic function is particularly suitable when selecting music beat rate from heartbeat rate. Based on breathing pattern, a suitable model out of several non-linear models relating music to heartbeat rate, can be selected. This can further enhance an exercising aid.

[0022] The methods according to the present invention are suitable for implementation with aid of processing means, such as computers and/or processors. Therefore, there is provided computer programs, comprising instructions arranged to cause the processing means, processor, or computer to perform the steps of any of the methods according to any of the embodiments described with reference to Fig. 2, in the apparatus. The computer programs preferably comprises program code which is stored on a computer readable medium 500, as illustrated in Fig. 5, which can be loaded and executed by a processing means, processor, or computer 502 to cause it to perform the methods, respectively, according to embodiments of the present invention, preferably as any of the embodiments described with reference to Fig. 2. The computer 502, which can be present in the apparatus as illustrated in Fig. 1, and computer program product 500 can be arranged to execute the program code sequentially where actions of the any of the methods are performed stepwise, or be performed on a real-time basis, where actions are taken upon need and availability of needed input data. The processing means, processor, or computer 502 is preferably what normally is referred to as an embedded system. Thus, the depicted computer readable medium 500 and computer 502 in Fig. 5 should be construed to be for illustrative purposes only to provide understanding of the principle, and not to be construed as any direct illustration of the elements.

Claims

1. An apparatus (100) comprising:

a music selection means (115);
a media player element (109) arranged to provide audio content controlled by the music selection means (115);
a speaker (104) suitable to be applied at a user's ear and enabled to be supplied with an audio signal based on the audio content for rendering;
a microphone (106) arranged in vicinity of the speaker (104), wherein the speaker (104) and the microphone (106) form an earphone (102);
a signal processor (114), wherein the signal processor (114) comprises a subtractor (110) to provide a physiological sound signal, and the signal processor (114) is further arranged to detect a physiological measurement from the physiological sound signal by a physiological sound detector, wherein the physiological sound detector provides the physiological measure-

ment to the music selection means (115) for controlling the music selection; **characterized in that**
the apparatus further comprises an amplifier (108), wherein the audio signal is provided by the amplifier (108); and
the microphone (106) is configured to acquire a sound signal from sounds present in the ear of the user;

wherein the substractor (110) of the signal processor (114) is arranged to subtract the audio signal from the sound signal to provide the physiological sound signal.

2. The apparatus (100) according to claim 1, further comprising a filter (111a, 111b, 111 C) arranged to filter the sound signal, the audio signal to be subtracted or the physiological sound signal.

3. The apparatus (100) according to claim 1 or 2,
wherein the physiological measurement (112) comprises a breathing pattern;
wherein the signal processor (114) is arranged to determine a breathing rate from the breathing pattern; and
wherein the music is selected based on the music's beat rate such that the music's beat rate is a monotonic function of the breathing rate or such that the music's beat rate is a function of the breathing rate wherein the music's beat rate is increased until a predetermined breathing rate is reached.

4. The apparatus (100) according to claim 3, comprising a heart rate estimator arranged to estimate heart rate from the breathing pattern.

5. The apparatus (100) according to any one of claims 1 to 4, wherein the physiological measurement (112) comprises a heartbeat and the signal processor is arranged to determine a heartbeat rate from the heartbeat.

6. The apparatus (100) according to claim 5, wherein music of the audio signal is selected based on the music's beat rate such that the music's beat rate is a monotonic function of the heartbeat rate or such that the music's beat rate is a function of the heartbeat rate wherein the music's beat rate is increased until a predetermined heartbeat rate is reached.

7. The apparatus (100) according to any one of claims 4 to 6, wherein the signal processor (114) is arranged to extract the heartbeat by low pass filtering the physiological sound signal in a low pass filter to provide a heartbeat signal, wherein the low pass filter has a cut-off frequency between 3 and 10 Hz, preferably between 3 and 5 Hz, preferably 4 Hz.

8. The apparatus (100) according to any one of claims 4 to 7, further comprising a second speaker suitable to be provided at the user's other ear, wherein an audio signal provided to the second speaker comprises a sub-signal such that the sound signal comprises a signal component emanating from sound provided at the user's other ear and which sound is modulatedly attenuated by pulsating blood of veins of the user when the sound propagated through the head of the user, and such that the heartbeat is extractable from the signal component.

9. The apparatus (100) according to claim 4 and claim 5, wherein the apparatus (100) is further arranged to provide a comparison between the estimated heart rate and the determined heart rate.

10. A method comprising:

selecting music;
providing audio content based on the music selection;
supplying an audio signal based on the provided audio content to a speaker (104) suitable to be applied at a user's ear for rendering the audio signal in the user's ear;
acquiring (202) a sound signal by a microphone (106) arranged in the vicinity of the speaker (104) to provide a physiological sound signal; and
detecting a physiological measurement (112; 206) from the physiological sound signal, wherein the physiological measurement is used to control the music selection;
characterized in that
the sound signal is acquired by the microphone (106) from sounds present in the ear of the user; and
the physiological sound signal is provided by subtracting the audio signal from the sound signal.

11. The method according to claim 10, further comprising filtering (203) the sound signal, the audio signal to be subtracted or the physiological sound signal.

12. The method according to claim 10 or 11, wherein the physiological measurement (112; 206) comprises a breathing pattern, and the controlling of music selection is based on the breathing pattern, wherein the music is selected based on the music's beat rate such that the music's beat rate is a monotonic function of a breathing rate determined from the breathing pattern or such that the music's beat rate is increased until a predetermined breathing rate is reached.

13. The method according to claim 12, further compris-

ing extracting a heartbeat by low pass filtering the physiological sound signal in a low pass filter to provide a heartbeat signal.

14. The method according to claim 12, wherein the physiological measurement comprises a heartbeat, and the method further comprises
providing an audio signal which comprises a subsignal to a second speaker suitable to be applied at the user's other ear, such that the sound signal comprises a signal component emanating from sound provided at the user's other ear and which sound is modulatedly attenuated by pulsating blood of veins of the user when the sound propagates through the head of the user; and
detecting the heartbeat from the signal component.

15. The method according to claim 14, further comprising low pass filtering the physiological sound signal in a low pass filter to provide the signal component signal, wherein the low pass filter has a cut-off frequency between 3 and 10 Hz, preferably between 3 and 5 Hz, preferably 4 Hz.

Patentansprüche

1. Vorrichtung (100), umfassend:

ein Musikauswahlmittel (115);
ein Mediaplayerelement (109), das angeordnet ist, einen Audioinhalt bereitzustellen, der durch das Musikauswahlmittel (115) gesteuert wird;
einen Lautsprecher (104), der geeignet ist, an einem Ohr eines Benutzers angewendet zu werden, und in der Lage ist, mit einem Audiosignal basierend auf dem Audioinhalt zur Wiedergabe versorgt zu werden;
ein Mikrofon (106), das in der Nähe des Lautsprechers (104) angeordnet ist, wobei der Lautsprecher (104) und das Mikrofon (106) einen Ohrhörer (102) bilden;
einen Signalprozessor (114), wobei der Signalprozessor (114) einen Subtrahierer (110) umfasst, um ein physiologisches Tonsignal bereitzustellen, und der Signalprozessor (114) weiterhin angeordnet ist, eine physiologische Messung aus dem physiologischen Tonsignal durch einen physiologischen Tondetektor zu erfassen, wobei der physiologische Tondetektor die physiologische Messung dem Musikauswahlmittel (115) zur Steuerung der Musikauswahl bereitstellt;
dadurch gekennzeichnet, dass
die Vorrichtung weiterhin einen Verstärker (108) umfasst, wobei das Audiosignal durch den Verstärker (108) bereitgestellt wird; und
das Mikrofon (106) ausgestaltet ist, ein Tonsignal aus Tönen zu erfassen, die im Ohr des Benutzers vorhanden sind;
wobei der Subtrahierer (110) des Signalsprozessors (114) angeordnet ist, das Audiosignal vom Tonsignal zu subtrahieren, um das physiologische Tonsignal bereitzustellen.

2. Vorrichtung (100) nach Anspruch 1, weiterhin umfassend einen Filter (111a, 111b, 111C), der angeordnet ist, das Tonsignal, das zu subtrahierende Audiosignal oder das physiologische Tonsignal zu filtern.

3. Vorrichtung (100) nach Anspruch 1 oder 2,
wobei die physiologische Messung (112) ein Atemmuster umfasst;
wobei der Signalprozessor (114) angeordnet ist, eine Atemfrequenz aus dem Atemmuster zu bestimmen; und
wobei die Musik basierend auf der Schlagfrequenz der Musik so ausgewählt wird, dass die Schlagfrequenz der Musik eine monotone Funktion der Atemfrequenz ist oder die Schlagfrequenz der Musik eine Funktion der Atemfrequenz ist, wobei die Schlagfrequenz der Musik gesteigert wird, bis eine vorbestimmte Atemfrequenz erreicht wird.

4. Vorrichtung (100) nach Anspruch 3, umfassend einen Herzfrequenzschätzer, der angeordnet ist, eine Herzfrequenz aus dem Atemmuster abzuschätzen.

5. Vorrichtung (100) nach einem der Ansprüche 1-4, wobei die physiologische Messung (112) einen Herzschlag umfasst und der Signalprozessor angeordnet ist, eine Herzschlagfrequenz aus dem Herzschlag zu bestimmen.

6. Vorrichtung (100) nach Anspruch 5, wobei Musik des Audiosignals basierend auf der Schlagfrequenz der Musik so ausgewählt wird, dass die Schlagfrequenz der Musik eine monotone Funktion der Herzschlagfrequenz ist oder die Schlagfrequenz der Musik eine Funktion der Herzschlagfrequenz ist, wobei die Schlagfrequenz der Musik gesteigert wird, bis eine vorbestimmte Herzschlagfrequenz erreicht wird.

7. Vorrichtung (100) nach einem der Ansprüche 4-6, wobei der Signalprozessor (114) angeordnet ist, den Herzschlag durch Tiefpassfiltern des physiologischen Tonsignals in einem Tiefpassfilter zu extrahieren, um ein Herzschlagsignal bereitzustellen, wobei der Tiefpassfilter eine Abschneidefrequenz zwischen 3 und 10 Hz, vorzugsweise zwischen 3 und 5 Hz, vorzugsweise 4 Hz, hat.

8. Vorrichtung (100) nach einem der Ansprüche 4-7, weiterhin umfassend einen zweiten Lautsprecher, der geeignet ist, am anderen Ohr des Benutzers be-

reitgestellt zu werden, wobei ein Audiosignal, das dem zweiten Lautsprecher bereitgestellt wird, ein Untersignal umfasst, so dass das Tonsignal eine Signalkomponente umfasst, die aus einem Ton hervorgeht, der an dem anderen Ohr des Benutzers bereitgestellt wird, und wobei der Ton durch pulsierendes Blut von Venen des Benutzers modulierend gedämpft wird, wenn der Ton sich durch den Kopf des Benutzers ausbreitet, und so dass der Herzschlag aus der Signalkomponente gewonnen werden kann.

9. Vorrichtung (100) nach Anspruch 4 und Anspruch 5, wobei die Vorrichtung (100) weiterhin angeordnet ist, einen Vergleich zwischen der geschätzten Herzfrequenz und der bestimmten Herzfrequenz bereitzustellen.

10. Verfahren, umfassend:

Auswählen von Musik;
Bereitstellen eines Audioinhalts basierend auf der Musikauswahl;
Zuführen eines Audiosignals basierend auf dem bereitgestellten Audioinhalt zu einem Lautsprecher (104), der geeignet ist, an einem Ohr des Benutzers angewendet zu werden, um das Audiosignal im Ohr des Benutzers wiederzugeben;
Erfassen (202) eines Tonsignals durch ein Mikrofon (106), das in der Nähe des Lautsprechers (104) angeordnet ist, um ein physiologisches Tonsignal bereitzustellen; und
Erfassen einer physiologischen Messung (112; 206) aus dem physiologischen Tonsignal, wobei die physiologische Messung benutzt wird, um die Musikauswahl zu steuern;
dadurch gekennzeichnet, dass
das Tonsignal durch das Mikrofon (106) aus Tönen erfasst wird, die im Ohr des Benutzers vorhanden sind; und
das physiologische Tonsignal durch Subtraktion des Audiosignals vom Tonsignal bereitgestellt wird.

11. Verfahren nach Anspruch 10, weiterhin umfassend Filtern (203) des Tonsignals, des zu subtrahierenden Audiosignals oder des physiologischen Tonsignals.

12. Verfahren nach Anspruch 10 oder 11, wobei die physiologische Messung (112; 206) ein Atemmuster umfasst und das Steuern der Musikauswahl auf dem Atemmuster basiert, wobei die Musik basierend auf der Schlagfrequenz der Musik so ausgewählt wird, dass die Schlagfrequenz der Musik eine monotone Funktion einer Atemfrequenz ist, die aus dem Atemmuster bestimmt wird, oder die Schlagfrequenz der Musik gesteigert wird, bis eine vorbestimmte Atemfrequenz erreicht wird.

13. Verfahren nach Anspruch 12, weiterhin umfassend Gewinnen eines Herzschlags durch Tiefpassfiltern des physiologischen Tonsignals in einem Tiefpassfilter, um ein Herzschlagsignal bereitzustellen.

14. Verfahren nach Anspruch 12, wobei die physiologische Messung einen Herzschlag umfasst, und wobei das Verfahren weiterhin umfasst
Bereitstellen eines Audiosignals, das ein Untersignal umfasst, an einen zweiten Lautsprecher, der geeignet ist, am anderen Ohr des Benutzers angewendet zu werden, so dass das Tonsignal eine Signalkomponente umfasst, die aus einem Ton hervorgeht, der an dem anderen Ohr des Benutzers bereitgestellt wird und wobei der Ton durch pulsierendes Blut der Venen des Benutzers modulierend gedämpft wird, wenn der Ton sich durch den Kopf des Benutzers ausbreitet; und
Erfassen des Herzschlags aus der Signalkomponente.

15. Verfahren nach Anspruch 14, weiterhin umfassend Tiefpassfiltern des physiologischen Tonsignals in einem Tiefpassfilter, um das Signalkomponentensignal bereitzustellen, wobei der Tiefpassfilter eine Abschneidefrequenz zwischen 3 und 10 Hz, vorzugsweise zwischen 3 und 5 Hz, vorzugsweise 4 Hz, hat.

Revendications

1. Appareil (100), comprenant :

des moyens de sélection de musique (115) ;
un élément de lecteur de media (109) configuré de façon à délivrer un contenu audio commandé par les moyens de sélection de musique (115) ;
un haut-parleur (104) approprié pour être appliqué sur l'oreille d'un utilisateur et pouvant se voir délivrer un signal audio en fonction du contenu audio pour le rendu ;
un microphone (106) disposé au voisinage du haut-parleur (104), le haut-parleur (104) et le microphone (106) formant un écouteur (102) ;
un processeur de signal (114), le processeur de signal (114) comprenant un soustracteur (110) de façon à délivrer un signal de son physiologique, et le processeur de signal (114) étant de plus configuré de façon à détecter une mesure physiologique à partir du signal de son physiologique à l'aide d'un détecteur de son physiologique, le détecteur de son physiologique délivrant la mesure physiologique aux moyens de sélection de musique (115) pour commander la sélection de musique ;
caractérisé en ce que :

l'appareil comprend de plus un amplifica-

teur (108), le signal audio étant délivré par l'amplificateur (108) ; et
le microphone (106) est configuré de façon à acquérir un signal sonore à partir de sons présents dans l'oreille de l'utilisateur ;

dans lequel le soustracteur (110) du processeur de signal (114) est configuré de façon à soustraire le signal audio à partir du signal sonore de façon à délivrer le signal de son physiologique.

2. Appareil (100) selon la revendication 1, comprenant de plus un filtre (111a, 111b, 111C) configuré de façon à filtrer le signal sonore, le signal audio devant être soustrait ou le signal de son physiologique.

3. Appareil (100) selon la revendication 1 ou 2,
dans lequel la mesure physiologique (112) comprend un motif de respiration ;
dans lequel le processeur de signal (114) est configuré de façon à déterminer un rythme respiratoire à partir du motif de respiration ; et
dans lequel la musique est sélectionnée en fonction du rythme de battement de la musique, de telle sorte que le rythme de battement de la musique soit une fonction monotone du rythme respiratoire, ou de telle sorte que le rythme de battement de la musique soit une fonction du rythme respiratoire dans laquelle le rythme de battement de la musique est augmenté jusqu'à ce qu'un rythme respiratoire prédéterminé soit atteint.

4. Appareil (100) selon la revendication 3, comprenant un estimateur de rythme cardiaque configuré de façon à estimer un rythme cardiaque à partir du motif de respiration.

5. Appareil (100) selon l'une quelconque des revendications 1 à 4, dans lequel la mesure physiologique (112) comprend un battement cardiaque, et le processeur de signal est configuré de façon à déterminer un rythme de battement cardiaque à partir du battement cardiaque.

6. Appareil (100) selon la revendication 5, dans lequel une musique du signal audio est sélectionnée en fonction du rythme de battement de la musique, de telle sorte que le rythme de battement de la musique soit une fonction monotone du rythme de battement cardiaque, ou de telle sorte que le rythme de battement de la musique soit une fonction du rythme de battement cardiaque dans laquelle le rythme de battement de la musique est augmenté jusqu'à ce qu'un rythme de battement cardiaque prédéterminé soit atteint.

7. Appareil (100) selon l'une quelconque des revendications 4 à 6, dans lequel le processeur de signal (114) est configuré de façon à extraire le battement cardiaque par un filtrage passe-bas du signal de son physiologique dans un filtre passe-bas de façon à délivrer un signal de battement cardiaque, dans lequel le filtre passe-bas a une fréquence de coupure comprise entre 3 et 10 Hz, de préférence entre 3 et 5 Hz, de préférence de 4Hz.

8. Appareil (100) selon l'une quelconque des revendications 4 à 7, comprenant de plus un deuxième haut-parleur susceptible d'être disposé sur l'autre oreille de l'utilisateur, dans lequel un signal audio délivré au deuxième haut-parleur comprend un sous-signal, de telle sorte que le signal sonore comprenne une composante de signal émanant d'un son délivré à l'autre oreille de l'utilisateur, ce son étant atténué de façon modulée par le sang pulsant des veines de l'utilisateur lorsque le son est propagé à travers la tête de l'utilisateur, et de telle sorte que le battement cardiaque puisse être extrait à partir de la composante de signal.

9. Appareil (100) selon la revendication 4 et la revendication 5, dans lequel l'appareil (100) est de plus configuré de façon à délivrer une comparaison entre le rythme cardiaque estimé et le rythme cardiaque déterminé.

10. Procédé, comprenant :

la sélection d'une musique ;
la délivrance d'un contenu audio en fonction de la sélection de musique ;
la délivrance d'un signal audio en fonction du contenu audio délivré à un haut-parleur (404) approprié pour être appliqué sur l'oreille d'un utilisateur pour rendre le signal audio dans l'oreille de l'utilisateur ;
l'acquisition (202) d'un signal sonore par un microphone (106) disposé au voisinage du haut-parleur (104) de façon à délivrer un signal de son physiologique ; et
la détection d'une mesure physiologique (112 ; 206) à partir du signal de son physiologique, la mesure physiologique étant utilisée pour commander la sélection de musique ;
caractérisé en ce que :

le signal sonore est acquis par le microphone (106) à partir de sons présents dans l'oreille de l'utilisateur ; et
le signal de son physiologique est délivré par la soustraction du signal audio à partir du signal sonore.

11. Procédé selon la revendication 10, comprenant de plus le filtrage (203) du signal sonore, du signal audio devant être soustrait ou du signal de son physiolo-

gique.

12. Procédé selon la revendication 10 ou 11, dans lequel la mesure physiologique (112 ; 206) comprend un motif de respiration, et la commande de la sélection de musique est fonction du motif de respiration, la musique étant sélectionnée en fonction du rythme de battement de la musique, de telle sorte que le rythme de battement de la musique soit une fonction monotone d'un rythme respiratoire déterminé à partir du motif de respiration, ou de telle sorte que le rythme de battement de la musique soit augmenté jusqu'à ce qu'un rythme respiratoire prédéterminé soit atteint.

13. Procédé selon la revendication 12, comprenant de plus l'extraction d'un battement cardiaque par le filtrage passe-bas du signal de son physiologique dans un filtre passe-bas de façon à délivrer un signal de battement cardiaque.

14. Procédé selon la revendication 12, dans lequel la mesure physiologique comprend un battement cardiaque, et le procédé comprend de plus :

la délivrance d'un signal audio qui comprend un sous-signal à un deuxième haut-parleur approprié pour être appliqué sur l'autre oreille de l'utilisateur, de telle sorte que le signal sonore comprenne une composante de signal émanant d'un son délivré sur l'autre oreille de l'utilisateur, ce son étant atténué de façon modulée par le sang pulsant des veines de l'utilisateur lorsque le son se propage à travers la tête de l'utilisateur ; et
la détection du battement cardiaque à partir de la composante de signal.

15. Procédé selon la revendication 14, comprenant de plus un filtrage passe-bas du signal de son physiologique dans un filtre passe-bas de façon à délivrer le signal de composante de signal, dans lequel le filtre passe-bas a une fréquence de coupure comprise entre 3 et 10 Hz, de préférence entre 3 et 5 Hz, de préférence de 4 Hz.

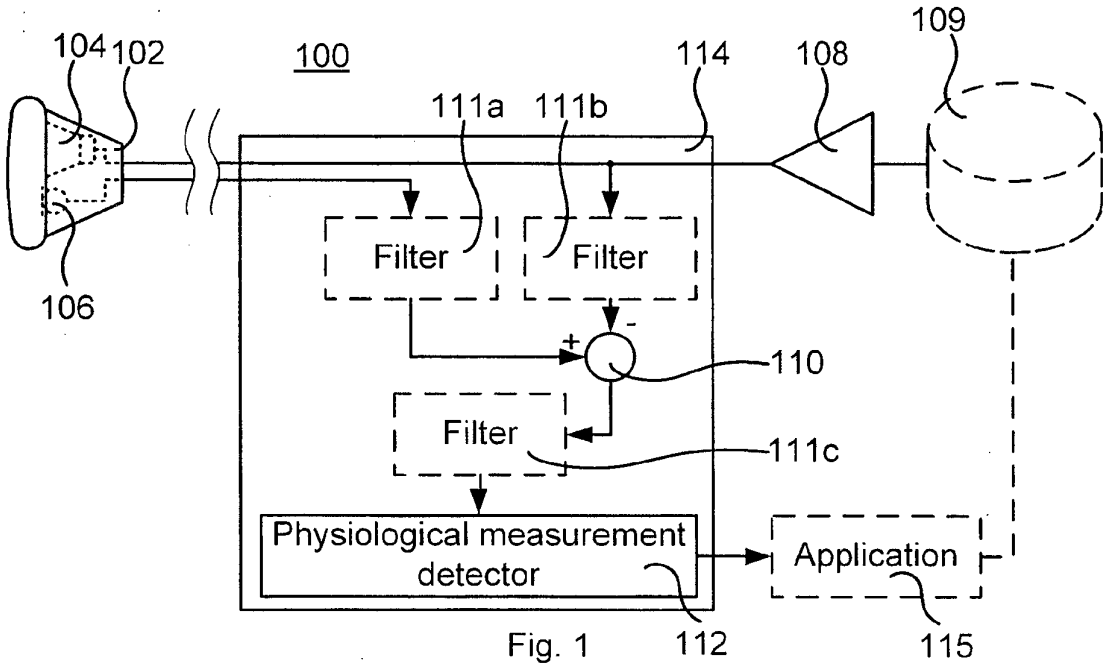
104
102
100
114
108
109
111a
111b
Filter
Filter
106
+
-
110
Filter
111c
Physiological measurement detector
Application
112
115

Fig. 1

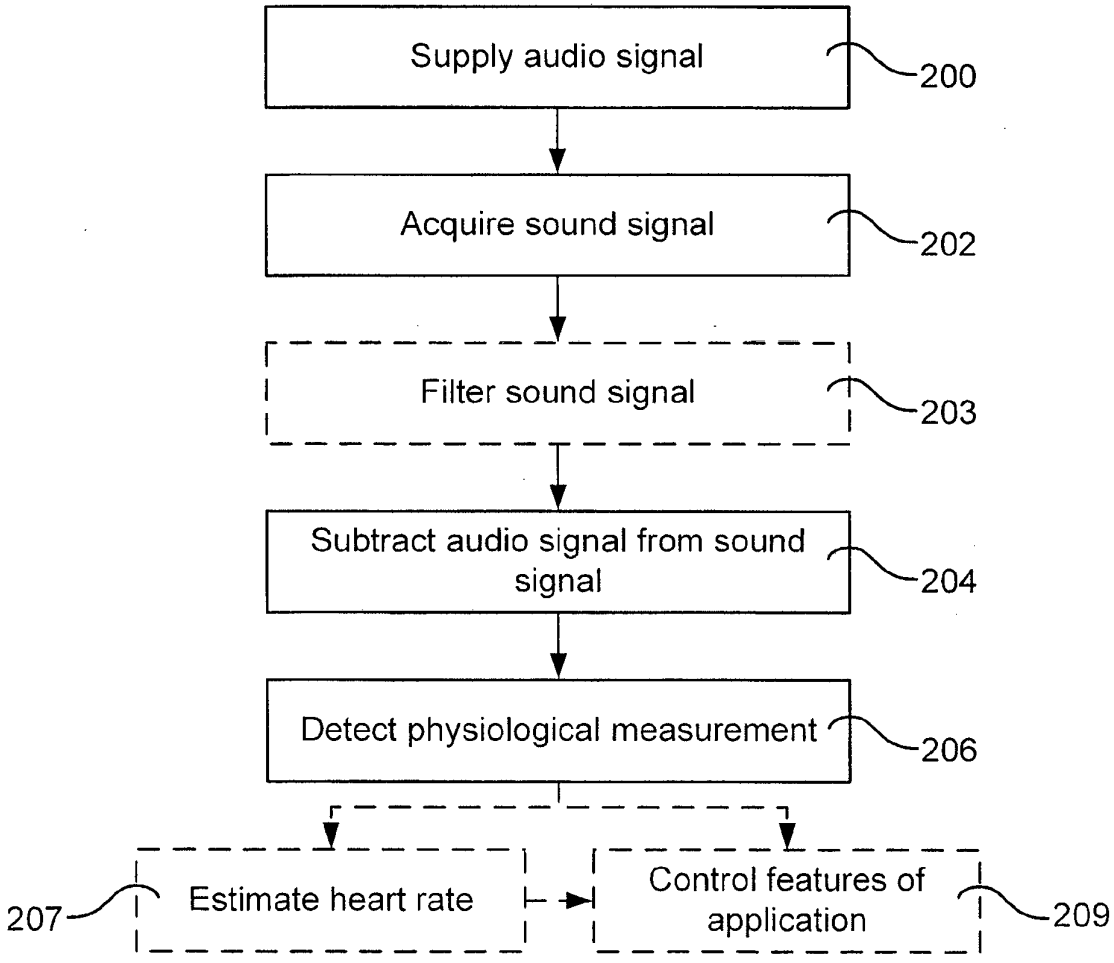
Supply audio signal
200
Acquire sound signal
202
Filter sound signal
203
Subtract audio signal from sound signal
204
Detect physiological measurement
206
207
Estimate heart rate
Control features of application
209

Fig. 2

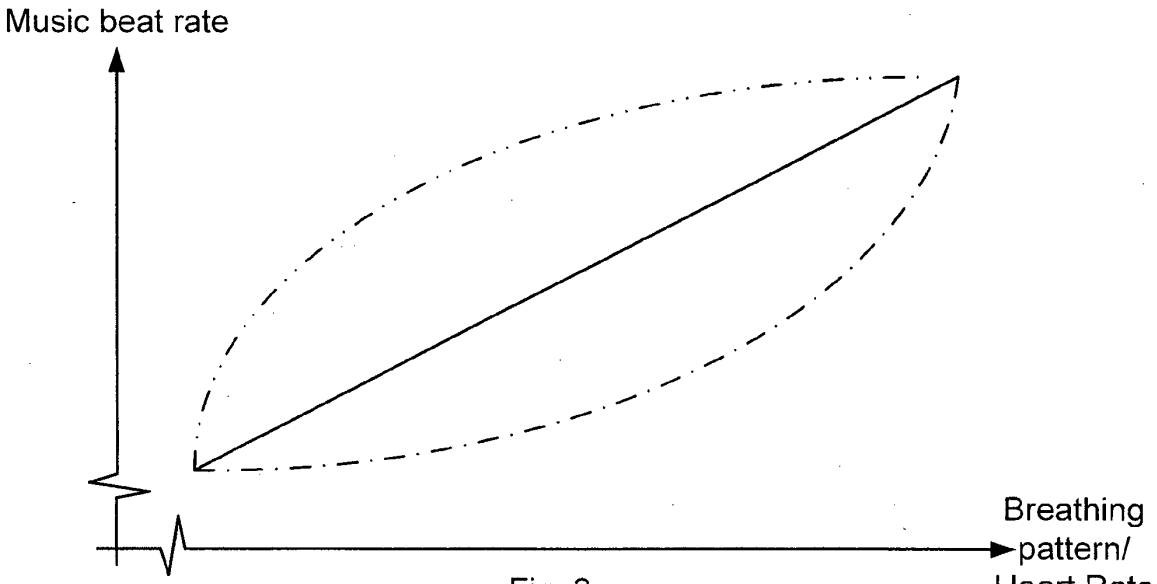

Fig. 3

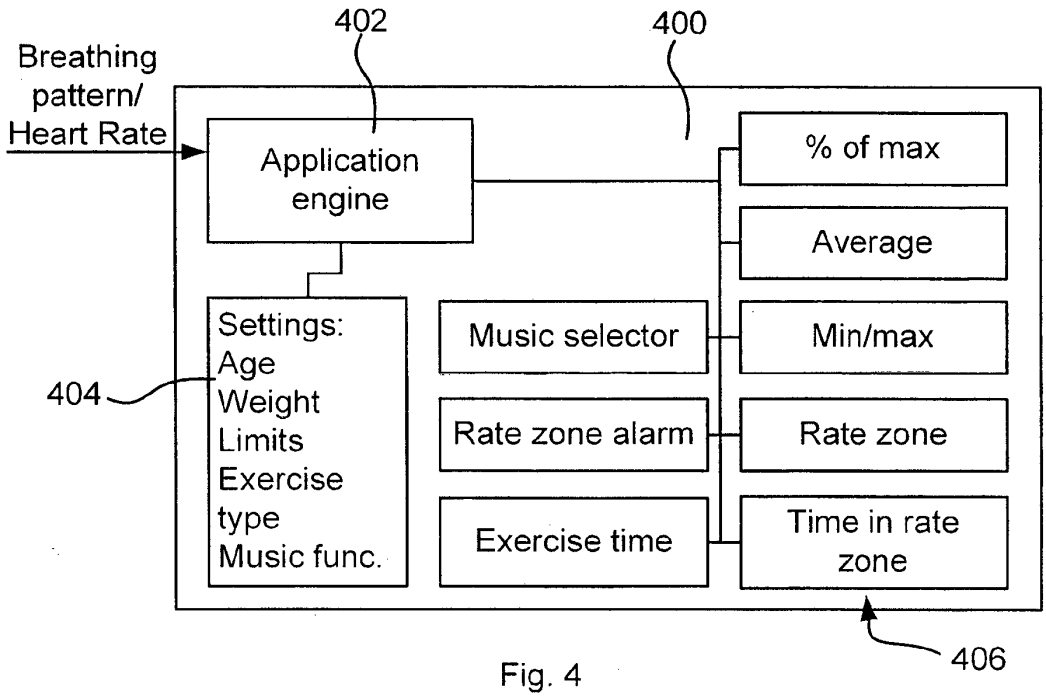

Fig. 4

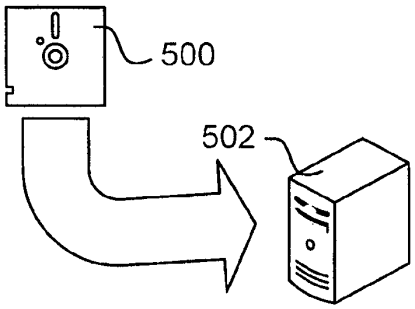

Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2008146890 A1 **[0004]**
- US 20060064037 A1 **[0005]**

专利名称(译)	用于从生理声音信号检测生理测量的设备和方法		
公开(公告)号	EP2358264B1	公开(公告)日	2015-02-25
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申请(专利权)人(译)	索尼爱立信移动通信AB		
当前申请(专利权)人(译)	索尼爱立信移动通信AB		
[标]发明人	HAARTSEN JACOBUS SAMPIMON GERRIT		
发明人	HAARTSEN, JACOBUS SAMPIMON, GERRIT		
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优先权	12/272072 2008-11-17 US		
其他公开文献	EP2358264A1		
外部链接	Espacenet		

摘要(译)

公开了一种装置，包括适于在用户的耳朵处应用并且能够被提供用于呈现的音频信号的扬声器;麦克风设置在扬声器附近，以从用户耳朵中存在的声音中获取声音信号;信号处理器，其中信号处理器用于从声音信号中减去音频信号以提供生理声音信号，并且信号处理器还用于从生理声音信号中检测生理测量值。还公开了一种方法和计算机程序。