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(54) **ACOUSTIC IN-EAR DETECTION FOR EARPIECE**

AKUSTISCHE DETEKTION IM OHR FÜR EINE HÖRKAPSEL

DÉTECTION INTRA-AURICULAIRE ACOUSTIQUE POUR UNE OREILLETTE

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Description

Technical field

[0001] The present invention relates to an apparatus, a method, and a computer program for detecting application of an earpiece. In particular, the invention relates to detection of the application made from an acquired sound signal.

Background

[0002] Devices utilizing earphones, wired or wireless, for providing speech, music, etc. to a user have become popular. Such devices can be portable media players, mobile telephones, and portable digital assistants. Detection of whether the earphone is in listening position, i.e. applied at the ear, has been utilized for reducing power consumption when the user is not able to listen to any provided audio content. For example in US 2006/0045304 A1, it is disclosed that a detection element comprising two electrodes on an outer surface of the earphone body such that when the earphone is applied at the ear, skin within the ear comes into contact with the electrodes. The head of the user conducts electricity between the electrodes whereby application of the earphone at the ear can be detected.

[0003] However, since the devices are intended to be used by any ordinary user, it is considered uncertain that detection of application is ensured since any of the electrodes may have poor contact with tissue of user. It is therefore a further desire to provide gear that provides a more reliable detection while it is still easy to use by an ordinary user. US 2008/0123882 transmits a test signal to check if a hearing device is located at the ear. US 2008/0146890 describes an earpiece that measures physiological sounds in the ear canal, such as the heart beat. US 2008/0298606 describes an earpiece that measures biometric information, such as the user's heart rate. This information is provided to the user. EP1594344 describes a hearing aid with two microphones. The microphone signals are compared to decide whether the earpiece is at the user's ear.

Summary

[0004] 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 sounds present at the earphone. From the acquired sounds, detection can be made to determine whether the earphone is applied at the user's ear.

[0005] According to a first aspect, there is provided an apparatus comprising an earpiece and a signal processor. The earpiece is suitable to be applied at an auditory opening of a user's ear. The earpiece comprises a speaker enabled to be supplied with an audio signal for rendering, and a microphone arranged in vicinity of the speaker to acquire a sound signal from sounds present inside the auditory opening when the earpiece is applied at the ear. The signal processor is arranged to determine whether the earpiece is applied at the user's ear by analysis of the acquired sound signal comprising any of a sound signal component of an in-ear sound type present when the earpiece is applied or an outside-ear sound type present when the earpiece is not applied.

[0006] The in-ear sound type signal component comprises a physiological sound signal. The physiological sound signal may comprise a signal component associated with breathing sounds of the user. The physiological sound signal comprises a signal component associated with heart beat sounds of the user. The signal processor is arranged to extract the heartbeat by low pass filtering the physiological sound signal in a low pass filter to detect a heart beat signal. The low pass filter may have a cutoff frequency between 3 and 10 Hz, preferably between 3 and 5 Hz, preferably 4 Hz.

[0007] The outside-ear sound type may comprise ambient noise, and the signal processor may be arranged to determine the earpiece not be applied when ambient noise sounds exceeds a threshold level. The threshold level may be determined by measurement of actual ambient noise by another microphone associated with the earpiece and arranged to always acquire a sound signal from sounds present outside the auditory opening.

[0008] The signal processor may be arranged to subtract the audio signal from the sound signal to provide the sound signal component.

[0009] The apparatus may further comprise an application arranged to control features of the application based on the determination whether the earpiece is applied or not. The application may be arranged to interrupt rendering associated with the audio signal when the earpiece is determined to not be applied, and arranged to resume the rendering when the earpiece is determined to be applied. Alternatively, or additionally, the application may be arranged to establish communication associated with the audio signal when the earpiece is determined to be applied, and arranged to terminate the communication when the earpiece is determined to not be applied.

[0010] The analysis may be based on any of frequency chacteristics and periodicity of the acquired sound signal.

[0011] According to a second aspect, there is provided a method suitable for an apparatus comprising an earpiece suitable to be applied at a user's ear for rendering an audio signal in the user's ear when the earpiece is applied at the ear. The method comprises acquiring a sound signal by a microphone of the earpiece arranged in vicinity of the speaker to acquire the sound signal from sounds present in an auditory opening of the ear of the user when the earpiece is applied at the ear; and determining whether the earpiece is applied at the user's ear by analyzing of the acquired sound signal comprising any of a sound signal component of an in-ear sound type

present when the earpiece is applied or an outside-ear sound type present when the earpiece is not applied.

[0012] The in-ear sound type signal component comprises a physiological sound signal. The physiological sound signal may comprise a signal component associated with breathing sounds of the user, and the determining may comprise determining that the earpiece is applied when breathing sounds are detectable. The physiological sound signal comprises a signal component associated with heart beat sounds of the user, and the determining comprises determining that the earpiece is applied when heart beat sounds are detectable. The method further comprises extracting the heartbeat by low pass filtering the physiological sound signal in a low pass filter to provide a heart beat signal. The low pass filter may have a cutoff frequency between 3 and 10 Hz, preferably between 3 and 5 Hz, preferably 4 Hz.

[0013] The outside-ear sound type may comprise ambient noise, and the determining may comprise determining that the earpiece is not applied when ambient noise sounds exceeds a threshold level. The method may further comprise determining the threshold by measurement of actual ambient noise outside the auditory opening by another microphone associated with the earpiece.

[0014] The method may further comprise subtracting the audio signal from the sound signal to provide the sound signal component.

[0015] The method may further comprise controlling features of an application based on the determination. The method may further comprise interrupting rendering associated with the audio signal when the earpiece is determined to not be applied; and resuming the rendering when the earpiece is determined to be applied. The method may additionally, or alternatively further comprise establishing communication associated with the audio signal when the earpiece is determined to be applied; and terminating the communication when the earpiece is determined to not be applied.

[0016] The analyzing may be based on any of frequency chacteristics and periodicity of the acquired sound signal. There is provided a computer readable medium comprising program code comprising instructions which when executed by a processor is arranged to cause the processor to perform the method according to the second aspect.

[0017] The instruction may be adapted to cause supplying an audio signal to a speaker of an earpiece suitable to be applied at a user's ear for rendering the audio signal in the user's ear when the earpiece is applied at the ear; acquiring a sound signal by a microphone of the earpiece arranged in vicinity of the speaker to acquire the sound signal from sounds present in an auditory opening of the ear of the user when the earpiece is applied at the ear; and determining whether the earpiece is applied at the user's ear by analysis of the acquired sound signal comprising any of a sound signal component of an in-ear sound type present when the earpiece is applied or an outside-ear sound type present when the earpiece is not applied.

[0018] The in-ear sound type signal component comprises a physiological sound signal. The physiological sound signal may comprise a signal component associated with breathing sounds of the user, and the instructions for determining may comprise instructions for determining that the earpiece is applied when breathing sounds are detectable. The physiological sound signal comprises a signal component associated with heart beat sounds of the user, and the instructions for determining comprises instructions for determining that the earpiece is applied when heart beat sounds are detectable. The computer program further comprises instructions for extracting the heart beat by low pass filtering the physiological sound signal in a low pass filter to provide a heart beat signal. The computer program may further comprise instructions to arrange the low pass filter to have a cutoff frequency between 3 and 10 Hz, preferably between 3 and 5 Hz, preferably 4 Hz.

[0019] The outside-ear sound type may comprise ambient noise, and the instructions for determining may comprise instructions for determining that the earpiece is not applied when ambient noise sounds exceeds a threshold level. The computer readable medium may further comprise instructions for determining the threshold by measurement of actual ambient noise outside the auditory opening by another microphone associated with the earpiece.

[0020] The computer program may further comprise instructions for subtracting the audio signal from the sound signal to provide the sound signal component.

[0021] The computer program may further comprise instructions for controlling features of an application based on the determination. The computer program may further comprise instructions for interrupting rendering associated with the audio signal when the earpiece is determined to not be applied; and resuming the rendering when the earpiece is determined to be applied.

[0022] The computer program may further comprise instructions for establishing communication associated with the audio signal when the earpiece is determined to be applied; and terminating the communication when the earpiece is determined to not be applied.

[0023] The instructions may be adapted to make the analysis be based on any of frequency chacteristics and periodicity of the acquired sound signal.

[0024] According to a fourth aspect, there is provided an apparatus comprising two earpieces suitable to be applied at auditory openings of a user's ear, each earpiece comprising the features of claim 1.

Brief description of drawings

[0025]

Fig. 1 schematically illustrates an apparatus.

Fig. 2 is a flow chart illustrating a method.

Fig. 3 schematically illustrates a computer readable medium.

Detailed description

[0026] Fig. 1 schematically illustrates an apparatus 100. The apparatus 100 comprises a speaker arrangement 102, i.e. an earpiece arranged to be applied at an auditory opening of a user's ear, having 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 or speech, which preferably is provided by an amplifier 108, which in turn may get the audio content from an application element 109, e.g. a media player or audio output of a telephone. The microphone 106, which is arranged to acquire sounds present in the auditory opening of the ear, e.g. heart or breathing sounds and of course the audio sound generated by the speaker 104 when the earpiece is applied at the ear, or acquire ambient noise when not applied, can provide its output signal to an optional subtractor 110, which subtracts the audio signal from the microphone signal. Further 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 the optional subtractor 110. The output from the optional subtractor 110 essentially comprises a heart and/or breathing sound signal when the earpiece is applied, and ambient noise when not applied since the signal components emanating from the audio sound are deleted. The heart and breathing sound signal or ambient noise signal is provided to a sound type detector 112. Here, it should be noted that a filter 111c can be arranged between the subtractor 110 and the sound type detector 112 instead of, or in addition to, the filter 111a between the microphone 106 and the subtractor 110 and/or the filter 111b between the amplifier 108 and the subtractor 110.

[0027] The sound type detector 112, which preferably is implemented by a signal processor 114, is arranged to determine whether the earpiece is applied at the user's ear. This is done by analysis of the acquired sound signal which is input to the sound type detector 112. The sound signal can comprise any of a sound signal component of an in-ear sound type present when the earpiece is applied or an outside-ear sound type present when the earpiece is not applied. Which one of these that is present, or at least dominant, can be determined by detecting certain sounds. For example, if physiological sounds, such as breathing sounds or heart beat sounds, are present, the sound type detector 112 will determine that the sound type is of in-ear type, i.e. the earpiece 102 is applied, or if ambient noise is dominant, the sound type detector 112 will determine that the sound type is of outside-ear type, i.e. the earpiece is not applied at the ear.

[0028] The subtractor 110, the optional filter(s) 111a, b, c, and the sound type detector 112 can be part of the signal processor 114 performing the functions of the elements 110, 111 (a, b, c), 112, for example in analog or digital domain.

[0029] Detection of breathing sound is performed by identifying sound characteristics which the breathing has when the air is flowing in the head, and which breathing sound can be acquired by the microphone 106 when the earpiece 102 is applied.

[0030] By nature, the heartbeat produces a weak sound in the head of the user with frequency components mainly corresponding to the heart rate. The sound signal acquired by the microphone 106 can be amplified, filtered and processed to enable detection of the heart beat sounds. The filtering can comprise low-pass filtering, since the heartbeat itself normally is within the range of 0.5 to 3 Hz. Since sound provided by the speaker 104 normally is very low at these frequencies, a narrow filter can enhance the heart sound signal significantly.

[0031] Ambient noise, i.e. sounds present in the environment of the user or else where the apparatus 100 is present, is attenuated, by the earpiece 102 covering the auditory opening of the user's ear, before reaching the microphone 106 when the earpiece 102 is applied. Thus, sound components of ambient noise is less when the earpiece 102 is applied compared to when not applied. Detection of outside-ear sound type can thus be determined from analysis of presence of ambient noise in the acquired sound signal. The determination can be made from changes in ambient noise level, i.e. observing application and detaching, respectively, of the earpiece, or comparing the ambient noise level with a threshold level. The threshold level can be based on experience, or be determined by measurement of actual ambient noise by another microphone 118, e.g. the another microphone 118 being associated with the earpiece 102, e.g. when part of a headset comprising the earpiece 102 and the another microphone 118, which is intended for input of speech from the user.

[0032] For example, in case both a high level of ambient noise and breathing sounds are present, the detection of ambient noise can be discriminated since the presence can be due to an extremely high ambient noise level, or that attenuation of the ambient noise is moderate and a relatively high amount of the ambient noise reaches the auditory opening of the ear although an earpiece is applied. However, the detection of breathing sounds is only likely to emanate from an applied earpiece. Detection of heart beat sounds, which are weaker by nature, is in turn regarded as a relatively certain sign of an applied earpiece. The signal type detector 112 is preferably arranged to make determinations as discussed above to find the dominant sound type also in regard of which sounds that can be present when, and not only on their sound level. For example, a ranking between the three sounds discussed above upon determination whether the earpiece is applied can be 1) heart beat, 2) breathing sound, 3) ambient noise.

[0033] Other sounds present in the head of a user and thus at the auditory opening of the ear can be speech with certain sound characteristics due to its propagation

inside the head, chewing sounds, etc.

[0034] Analysis of the sound signal to detect breathing or heart beat sounds is preferably determined based on analysis of periodicity and/or frequency content of the sound signal.

[0035] The type of the sounds can also be determined based on their frequency properties, since high frequencies are normally attenuated more by tissue of the user than low frequencies. Thus, by observing acquired sound signal, preferably when any audio provided by the speaker 104 is subtracted by subtractor 110, and determining distribution over frequency, the sound type can be determined.

[0036] Based on the analysis of the sound type, i.e. whether the sound type is determined to be in-ear type or outside ear-type, and thus the determination whether the earpiece 102 is applied or not, an application controller 115 which is arranged to receive the result of the determination can control behavior of one or more applications 116. An application 116 can comprise the application element 109 arranged to output the audio content. One example on control of the application 116 can be routing audio related to music or incoming/outgoing calls to the earpiece 102 only when the earpiece is applied in the user's ear. Another example is to adjust ring tone volume to lower levels if it is detected that the earpiece 102 is applied in the user's ear since the apparatus then most probably is close to the user. Further another example is to enable input from another microphone 118 associated with the earpiece 102, e.g. when it is a part of a headset comprising the earpiece 102 and the another microphone 118, only when the earpiece 102 is applied. Still another example is to turn on a wireless headset comprising the earpiece 102 when the earpiece 102 is applied, or turn it off when not applied. Another example is to determine if mono or stereo audio is to be output to earpiece or earpieces 102, 102b depending on if one or two earpieces 102, 102b are applied. Here, when only one earpiece of the two is applied, the audio output is routed only to the earpiece applied. Further another example is call acceptance, i.e. picking up an incoming call, when the earpiece 102 is applied or upon application. Still another example is to start or resume audio rendering, e.g. from a media player upon application of the earpiece 102, and stopping or pausing when detaching the earpiece 102 from the ear. Any combination of these is of course possible for adapting to the nature of the application 116.

[0037] Here, it should be noted that the above demonstrated approach for determining if the earpiece 102 is applied can also be applicable for an earpiece without a speaker 104, such as an earplug for protection against harmful noise. For example, a noisy machine, such as a drilling or grinding machine, cannot be started unless ear protectors are applied. Preferably, logic circuitry for enabling the starting of the machine is arranged to enable starting only if both ears are protected by earpieces 102. Of course, the ear protectors can be provided with speaker 104 as well, and any of the other features elucidated above can be combined with this embodiment.

[0038] Fig. 2 is a flow chart illustrating a method according to an embodiment. The method is suitable for an earpiece to be applied at a user's ear for rendering an audio signal in the user's ear when the earpiece is applied at the ear, as demonstrated above with reference to Fig. 1. The method comprises a sound acquisition step 202 where sounds present in the auditory opening of the ear are acquired by a microphone, which is arranged to acquire, e.g. heart or breathing sounds when the earpiece is applied at the ear, or acquire ambient noise when not applied. The method further comprises a determination step 208 where it is determined whether the earpiece is applied at the user's ear. This is performed by analysis of the acquired sound signal regarding comprising of any of a sound signal component of an in-ear sound type present when the earpiece is applied or an outside-ear sound type present when the earpiece is not applied. This can be performed as demonstrated with reference to Fig. 1.

[0039] The method can comprise an audio provision step 200 where an audio signal is rendered by a speaker of the earpiece. The provided audio signal will be highly present in the acquired sound signal. Therefore, the audio signal, which is known, can be subtracted from the acquired sound signal in an audio subtracting step 204. Further optionally, the acquired sound signal or the audio signal can be filtered before any subtraction, or the sound signal after the subtraction can be filtered in a signal filtering step 206.

[0040] Based on the determination of whether the earpiece is considered to be applied or not, one or more applications can be controlled in an application control step 210. The controlling can for example comprise interrupting rendering associated with the audio signal based on the determination when the earpiece is determined to not be applied, and resuming the rendering when the earpiece is determined to be applied. Another example is establishing communication associated with the audio signal based on the determination when the earpiece is determined to be applied, e.g. picking up a telephone call, and terminating the communication when the earpiece is determined to not be applied, e.g. hanging up.

[0041] An example of an in-ear sound type signal component is a physiological sound signal, such as breathing or heart beat sounds. When these are determined to be present, it is very likely that the user has applied the earpiece. Extracting the heartbeat can be made by low pass filtering the physiological sound signal in a low pass filter to provide a heart beat signal. The low pass filter preferably has a cutoff frequency between 3 and 10 Hz, preferably between 3 and 5 Hz, preferably 4 Hz, since the main frequency, i.e. the heart beat itself, is limited in frequency by its nature.

[0042] An example on outside-ear sound type is ambient noise, and the earpiece is determined to not be

applied when ambient noise sounds exceeds a for example a threshold level. The threshold level can be determined as demonstrated with reference to Fig. 1.

[0043] The demonstrated approach is particularly suitable for an earpiece of closed type.

[0044] 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 300, as illustrated in Fig. 3, which can be loaded and executed by a processing means, processor, or computer 302 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 302, which can be present in the apparatus as illustrated in Fig. 1, and computer program product 300 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 302 is preferably what normally is referred to as an embedded system. Thus, the depicted computer readable medium 300 and computer 302 in Fig. 3 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
an earpiece (102, 102b) suitable to be applied at an auditory opening of a user's ear, the earpiece (102, 102b) comprising

a speaker (104) enabled to be supplied with an audio signal for rendering, and
a single microphone (106) arranged in vicinity of the speaker (104) to acquire a sound signal from sounds present inside the auditory opening when the earpiece (102, 102b) is applied at the ear; and
a signal processor (114), wherein the signal processor (114) is arranged to determine whether the earpiece (102, 102b) is applied at the user's ear by detection of a physiological sound signal from the acquired sound signal;

characterized in that
the physiological sound signal comprises a signal component associated with heart beat sounds of the user, wherein the signal processor (114) is arranged to extract the heart beat by low pass filtering the physiological sound signal in a low pass filter (111a, 111b, 111c) to detect a heart beat signal, wherein the signal processor (114) is arranged to determine that the earpiece (102, 102b) is applied at the user's ear if the signal processor (114) detects the heart beat signal in the physiological sound signal.

2. The apparatus (100) according to claim 1, wherein the physiological sound signal comprises a signal component associated with breathing sounds of the user.

3. The apparatus (100) according to claim 1 or claim 2, wherein the low pass filter (111a, 111b, 111c) has a cutoff frequency between 3 and 10 Hz, preferably between 3 and 5 Hz, preferably 4 Hz.

4. The apparatus (100) according to any one of claims 1 to 3, wherein the signal processor (114) is arranged to subtract the audio signal from the sound signal to provide the sound signal component.

5. The apparatus (100) according to any one of claims 1 to 5, further comprising an application (116) arranged to control features of the application (116) based on the determination whether the earpiece (102, 102b) is applied or not.

6. The apparatus (100) according to claim 5, wherein the application (116) is arranged to interrupt rendering associated with the audio signal when the earpiece (102, 102b) is determined to not be applied, and arranged to resume the rendering when the earpiece (102, 102b) is determined to be applied.

7. The apparatus (100) according to claim 6, wherein the application (116) is arranged to establish communication associated with the audio signal when the earpiece (102, 102b) is determined to be applied, and arranged to terminate the communication when the earpiece (102, 102b) is determined to not be applied.

8. The apparatus (100) according to any one of claims 1 to 8, wherein the signal processor (114) is arranged to perform the determining based on an analysis of frequency content and/or periodicity of the acquired sound signal.

9. A method, for an apparatus (100) comprising an earpiece (102, 102b) suitable to be applied at a user's ear for rendering an audio signal in the user's ear when the earpiece (102, 102b) is applied at the ear, comprising
acquiring (202) a sound signal by a single microphone (106) of the earpiece (102, 102b) arranged in

vicinity of the speaker (104) to acquire the sound signal from sounds present in an auditory opening of the ear of the user when the earpiece (102, 102b) is applied at the ear; and
determining (208) whether the earpiece (102, 102b) is applied at the user's ear by detection of a physiological sound from the acquired sound signal;
characterized in that
the physiological sound signal comprises a signal component associated with heart beat sounds of the user, and the method further comprises, extracting the heartbeat by low pass filtering the physiological sound signal in a low pass filter (111a, 111b, 111c) to provide a heart beat signal, wherein
the determining comprises determining that the earpiece (102, 102b) is applied when the heart beat signal is detectable in the physiological sound signal.

10. The method according to claim 9, wherein the physiological sound signal comprises a signal component associated with breathing sounds of the user, and the determining comprises determining that the earpiece (102, 102b) is applied when breathing sounds are detectable.

11. The method according to claim 9 or claim 10, wherein the low pass filter (111a, 111b, 111c) has a cutoff frequency between 3 and 10 Hz, preferably between 3 and 5 Hz, preferably 4 Hz.

12. The method according to any one of claims 9 to 11, further comprising controlling features of an application (116) of the apparatus (100) based on the determination.

13. The method according to claim 12, further comprising interrupting the rendering associated with the audio signal when the earpiece (102, 102b) is determined to be not applied; and resuming the rendering when the earpiece (102, 102b) is determined to be applied.

14. The method according to claim 13, further comprising establishing a communication associated with the audio signal when the earpiece (102, 102b) is determined to be applied; and terminating the communication when the earpiece (102, 102b) is determined to not be applied.

15. The method according to any one of claims 9 to 14, wherein the determining is based on an analysis of frequency content and/or periodicity of the acquired sound signal.

Patentansprüche

1. Eine Vorrichtung (100) umfassend

einen Ohrhörer (102, 102b), welcher an einer Gehöröffnung eines Ohres eines Benutzers angebracht werden kann, wobei der Ohrhörer (102, 102b) umfasst

einen Lautsprecher (104), welchem ein Audiosignal zur Wiedergabe zugeführt werden kann, und
ein einzelnes Mikrofon (106), welches in der Nähe des Lautsprechers (104) angeordnet ist, um ein Tonsignal von Geräuschen, welche im Inneren der Gehöröffnung vorhanden sind, wenn.der Ohrhörer (102, 102b) an dem Ohr angebracht ist aufzunehmen; und
ein Signalprozessor (114), wobei der Signalprozessor (114) derart ausgebildet ist, dass er durch eine Bestimmung eines physiologischen Tonsignals aus dem aufgenommenen Tonsignal feststellt, ob der Ohrhörer (102, 102b) an dem Ohr des Benutzers angebracht ist;

dadurch gekennzeichnet, dass
das physiologische Tonsignal eine Signalkomponente umfasst, welche Herzschlaggeräuschen des Benutzers zugeordnet ist, wobei der Signalprozessor (114) derart ausgebildet ist, dass er den Herzschlag durch ein Tiefpassfiltern des physiologischen Tonsignals in einem Tiefpassfilter (111a, 111b, 111c) extrahiert, um ein Herzschlagsignal zu detektieren, wobei der Signalprozessor (114) derart ausgebildet ist, dass er feststellt, dass der Ohrhörer (102, 102b) an dem Ohr des Benutzers angebracht ist, wenn der Signalprozessor (114) das Herzschlagsignal in dem physiologischen Tonsignal detektiert.

2. Die Vorrichtung (100) nach Anspruch 1, wobei das physiologische Tonsignal eine Signalkomponente umfasst, welche Atemgeräuschen des Benutzers zugeordnet ist.

3. Die Vorrichtung (100) nach Anspruch 1 oder Anspruch 2, wobei der Tiefpassfilter (111a, 111b, 111c) eine Grenzfrequenz zwischen 3 und 10 Hz, vorzugsweise zwischen 3 und 5 Hz, vorzugsweise von 4 Hz aufweist.

4. Die Vorrichtung (100) nach einem Beliebigen der Ansprüche 1 bis 3, wobei der Signalprozessor (114) derart ausgebildet ist, dass er das Audiosignal von dem Tonsignal subtrahiert, um die Tonsignalkomponente bereitzustellen.

5. Die Vorrichtung (100) nach einem Beliebigen der Ansprüche 1 bis 5, weiter umfassend eine Applikation (116), welche derart ausgebildet ist, dass sie Merkmale der Applikation (116) basierend auf der Feststellung, ob der Ohrhörer (102, 102b) angebracht ist oder nicht, steuert.

6. Die Vorrichtung (100) nach Anspruch 5, wobei die Applikation (116) derart ausgebildet ist, dass sie eine Wiedergabe, welche mit dem Audiosignal verbunden ist, unterbricht, wenn festgestellt wird, dass der Ohrhörer (102, 102b) nicht angebracht ist, und dass sie die Wiedergabe wiederaufnimmt, wenn festgestellt wird, das der Ohrhörer (102, 102b) angebracht ist.

7. Die Vorrichtung (100) nach Anspruch 6, wobei die Applikation (116) derart ausgebildet ist, dass sie eine Kommunikation, welche mit dem Audiosignal verbunden ist, herstellt, wenn festgestellt wird, dass der Ohrhörer (102, 102b) angebracht ist, und dass sie die Kommunikation beendet, wenn festgestellt wird, dass der Ohrhörer (102, 102b) nicht angebracht ist.

8. Die Vorrichtung (100) nach einem Beliebigen der Ansprüche 1 bis 8, wobei der Signalprozessor (114) derart ausgebildet ist, dass er das Feststellen basierend auf einer Analyse eines Frequenzinhaltes und/oder einer Periodizität des aufgenommenen Tonsignals durchführt.

9. Ein Verfahren für eine Vorrichtung (100), welche einen Ohrhörer (102, 102b) umfasst, welcher an einem Ohr eines Benutzers angebracht werden kann zur Wiedergabe eines Audiosignals in das Ohr des Benutzers, wenn der Ohrhörer (102, 102b) an dem Ohr angebracht ist, umfassend
Aufnehmen (202) eines Tonsignals durch ein einzelnes Mikrofon (106) des Ohrhörers (102, 102b), welches in Nähe des Lautsprechers (104) angeordnet ist, um das Tonsignal von Geräuschen, welche in einer Gehöröffnung des Ohrs des Benutzers vorhanden sind, wenn der Ohrhörer (102, 102b) an dem Ohr angebracht ist, aufzunehmen; und
Feststellen (208), ob der Ohrhörer (102, 102b) an dem Ohr des Benutzers angebracht ist, durch ein Bestimmen eines physiologischen Geräuschs aus dem aufgenommenen Tonsignal;
dadurch gekennzeichnet, dass
das physiologische Tonsignal eine Signalkomponente umfasst, welche Herzschlaggeräuschen des Benutzers zugeordnet ist, und dass das Verfahren weiter ein Extrahieren des Herzschlag durch ein Tiefpassfiltern des physiologischen Tonsignals in einem Tiefpassfilter (111a, 111b, 111c) umfasst, um ein Herzschlagsignal bereitzustellen, wobei
das Feststellen ein Feststellen, dass der Ohrhörer (102, 102b) angebracht ist, wenn das Herzschlagsignal in dem physiologischen Tonsignal detektierbar ist, umfasst.

10. Das Verfahren nach Anspruch 9 wobei das physiologische Tonsignal eine Signalkomponente umfasst, welche Atemgeräuschen des Benutzers zugeordnet ist, und das Feststellen ein Feststellen, dass der Ohrhörer (102, 102b) angebracht ist, wenn Atemgeräusche detektierbar sind, umfasst.

11. Das Verfahren nach Anspruch 9 oder Anspruch 10, wobei der Tiefpassfilter (111a, 111b, 111c) eine Grenzfrequenz zwischen 3 und 10 Hz, vorzugsweise zwischen 3 und 5 Hz, vorzugsweise von 4 Hz aufweist.

12. Das Verfahren nach einem Beliebigen der Ansprüche 9 bis 11, weiter umfassend ein Steuern von Merkmalen einer Applikation (116) der Vorrichtung (100) basierend auf dem Feststellen.

13. Das Verfahren nach Anspruch 12, weiter umfassend ein Unterbrechen der Wiedergabe, welche mit dem Audiosignal verbunden ist, wenn festgestellt wird, dass der Ohrhörer (102, 102b) nicht angebracht ist; und ein Wiederaufnehmen der Wiedergabe, wenn festgestellt wird, dass der Ohrhörer (102, 102b) angebracht ist.

14. Das Verfahren nach Anspruch 13, weiter umfassend ein Herstellen einer Kommunikation, welcher mit dem Audiosignal verbunden ist, wenn festgestellt wird, dass der Ohrhörer (102, 102b) angebracht ist; und ein Beenden der Kommunikation wenn festgestellt wird, dass der Ohrhörer (102, 102b) nicht angebracht ist.

15. Das Verfahren nach einem Beliebigen der Ansprüche 9 bis 14, wobei das Feststellen auf einer Analyse eines Frequenzinhalts und/oder einer Periodizität des aufgenommenen Tonsignals basiert.

Revendications

1. Appareil (100) comprenant
une oreillette (102, 102b) adaptée à être appliquée à une ouverture auditive de l'oreille d'un utilisateur, l'oreillette (102, 102b) comprenant

un haut-parleur (104) activé pour être alimenté par un signal audio pour le rendu, et
un seul microphone (106) agencé au voisinage du haut-parleur (104) pour acquérir un signal sonore parmi des sons présents à l'intérieur de l'ouverture auditive lorsque l'oreillette (102, 102b) est appliquée au niveau de l'oreille ; et
un processeur de signaux (114), dans lequel le processeur de signaux (114) est conçu pour déterminer si l'oreillette (102, 102b) est appliquée au niveau de l'oreille de l'utilisateur par la détection d'un signal sonore physiologique provenant du signal sonore acquis ;

caractérisé en ce que

le signal sonore physiologique comprend une composante de signal associée aux sons des battements cardiaques de l'utilisateur, dans lequel le processeur de signaux (114) est conçu pour extraire les battements cardiaques par filtrage passe-bas du signal sonore physiologique dans un filtre passe-bas (111a, 111b, 111c) pour détecter un signal de battement cardiaque, dans lequel le processeur de signal (114) est conçu pour déterminer que l'oreillette (102, 102b) est appliquée au niveau de l'oreille de l'utilisateur si le processeur de signal (114) détecte le signal de battement cardiaque dans le signal sonore physiologique.

2. Appareil (100) selon la revendication 1, dans lequel le signal sonore physiologique comprend une composante de signal associée aux sons respiratoires de l'utilisateur.

3. Appareil (100) selon la revendication 1 ou la revendication 2, dans lequel le filtre passe-bas (111a, 111b, 111c) présente une fréquence de coupure comprise entre 3 et 10 Hz, de préférence entre 3 et 5 Hz, de préférence de 4 Hz.

4. Appareil (100) selon l'une quelconque des revendications 1 à 3, dans lequel le processeur de signaux (114) est conçu pour soustraire le signal audio du signal sonore pour fournir la composante de signal sonore.

5. Appareil (100) selon l'une quelconque des revendications 1 à 5, comprenant en outre une application (116) conçue pour commander des caractéristiques de l'application (116) en fonction de la détermination consistant à déterminer si l'oreillette (102, 102b) est appliquée ou non.

6. Appareil (100) selon la revendication 5, dans lequel l'application (116) est conçue pour interrompre le rendu associé au signal audio lorsqu'il est déterminé que l'oreillette (102, 102b) n'est pas appliquée, et conçue pour mettre fin au rendu lorsqu'il est déterminé que l'oreillette (102, 102b) est appliquée.

7. Appareil (100) selon la revendication 6, dans lequel l'application (116) est conçue pour établir une communication associée au signal audio lorsqu'il est déterminé que l'oreillette (102, 102b) est appliquée, et conçue pour mettre fin à la communication lorsqu'il est déterminé que l'oreillette (102, 102b) n'est pas appliquée.

8. Appareil (100) selon l'une quelconque des revendications 1 à 8, dans lequel le processeur de signaux (114) est conçu pour effectuer la détermination en fonction d'une analyse du contenu de la fréquence et/ou de la périodicité du signal sonore acquis.

9. Procédé, pour un appareil (100) comprenant une oreillette (102, 102b) adaptée à être appliquée à l'oreille d'un utilisateur pour le rendu d'un signal audio dans l'oreille de l'utilisateur lorsque l'oreillette (102, 102b) est appliquée au niveau de l'oreille, consistant à
acquérir (202) un signal sonore au moyen d'un seul microphone (106) de l'oreillette (102, 102b) agencé au voisinage du haut-parleur (104) pour acquérir le signal sonore parmi des sons présents à l'intérieur d'une ouverture auditive de l'oreille lorsque l'oreillette (102, 102b) est appliquée au niveau de l'oreille ; et
déterminer (208) si l'oreillette (102, 102b) est appliquée au niveau de l'oreille de l'utilisateur par détection d'un son physiologique provenant du signal sonore acquis ;
caractérisé en ce que
le signal sonore physiologique comprend une composante de signal associée aux sons des battements cardiaques de l'utilisateur, et le procédé consiste en outre à extraire le battement cardiaque par filtrage passe-bas du signal sonore physiologique dans un filtre passe-bas (111a, 111b, 111c) pour fournir un signal de battement cardiaque, dans lequel
la détermination consiste à déterminer que l'oreillette (102, 102b) est appliquée lorsque le signal de battement cardiaque est détectable dans le signal sonore physiologique.

10. Procédé selon la revendication 9, dans lequel le signal sonore physiologique comprend une composante de signal associée aux sons respiratoires de l'utilisateur, et la détermination consiste à déterminer que l'oreillette (102, 102b) est appliquée lorsque des sons respiratoires sont détectables.

11. Procédé selon la revendication 9 ou la revendication 10, dans lequel le filtre passe-bas (111a, 111b, 111c) présente une fréquence de coupure comprise entre 3 et 10 Hz, de préférence entre 3 et 5 Hz, de préférence de 4 Hz.

12. Procédé selon l'une quelconque des revendications 9 à 11, consistant en outre à commander les caractéristiques d'une application (116) de l'appareil (100) en fonction de la détermination.

13. Procédé selon la revendication 12, consistant en outre à interrompre le rendu associé au signal audio lorsqu'il est déterminé que l'oreillette (102, 102b) n'est pas appliquée, et pour mettre fin au rendu lorsqu'il est déterminé que l'oreillette (102, 102b) est appliquée.

14. Procédé selon la revendication 13, consistant en outre à établir une communication associée au signal audio lorsqu'il est déterminé que l'oreillette (102, 102b) est appliquée, et pour mettre fin à la

communication lorsqu'il est déterminé que l'oreillette (102, 102b) n'est pas appliquée.

15. Procédé selon l'une quelconque des revendications 9 à 14, dans lequel la détermination est basée sur une analyse du contenu de la fréquence et/ou de la périodicité du signal sonore acquis.

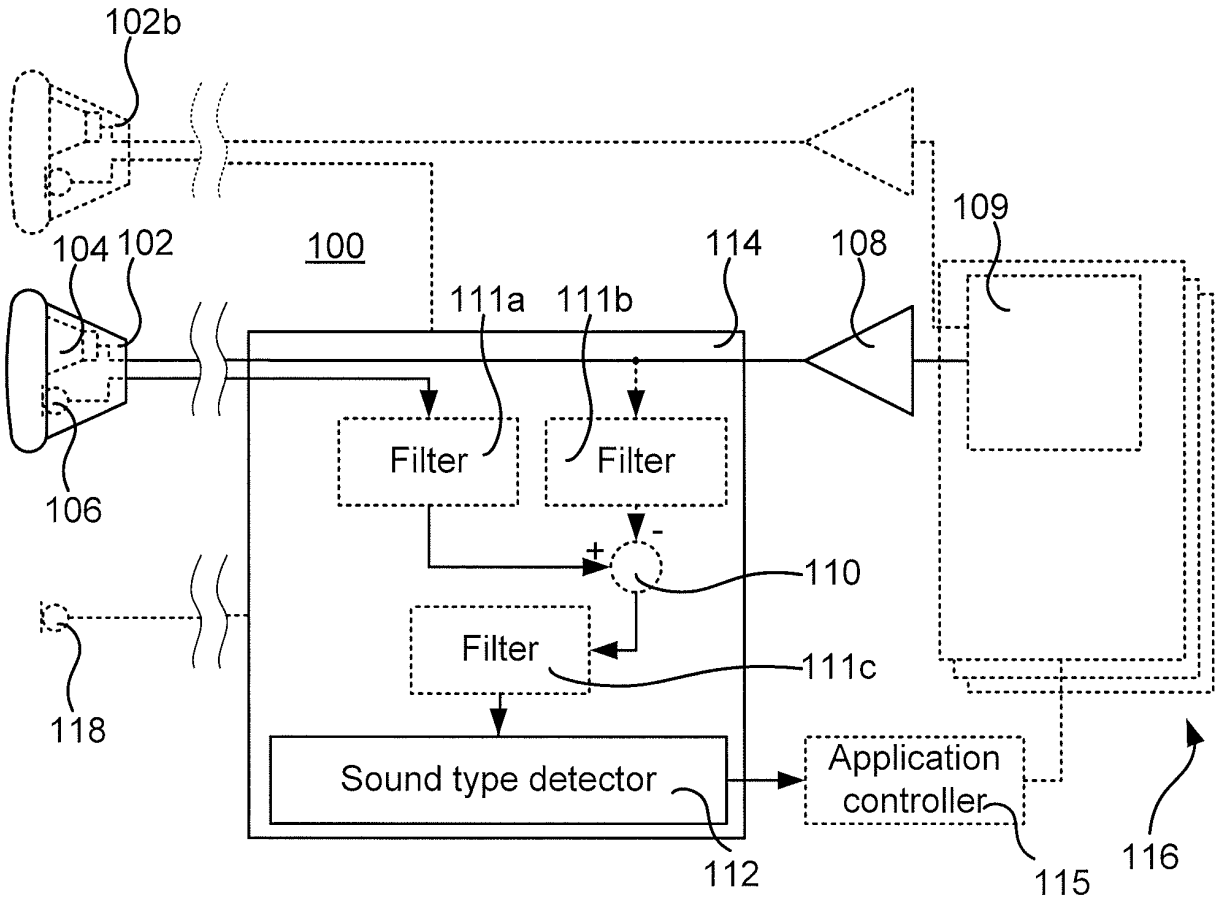
102b
104
102
100
114
108
109
111a
111b
Filter
Filter
106
+
-
110
Filter
111c
118
Sound type detector
Application controller
112
115
116

Fig. 1

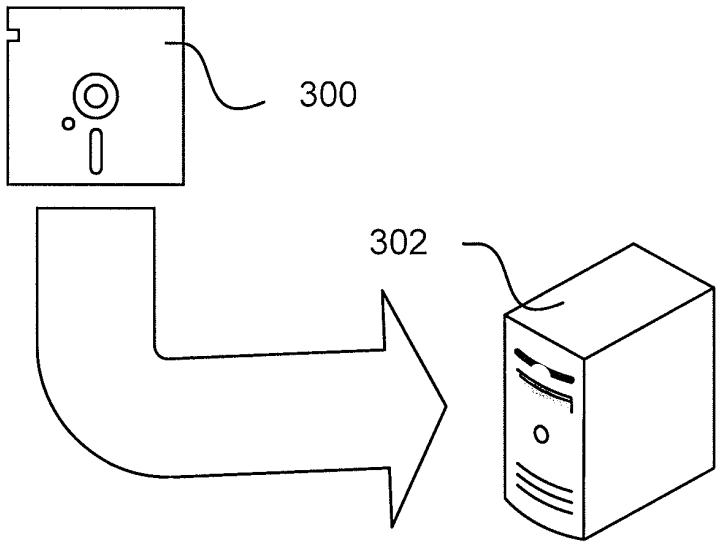
300
302

Fig. 3

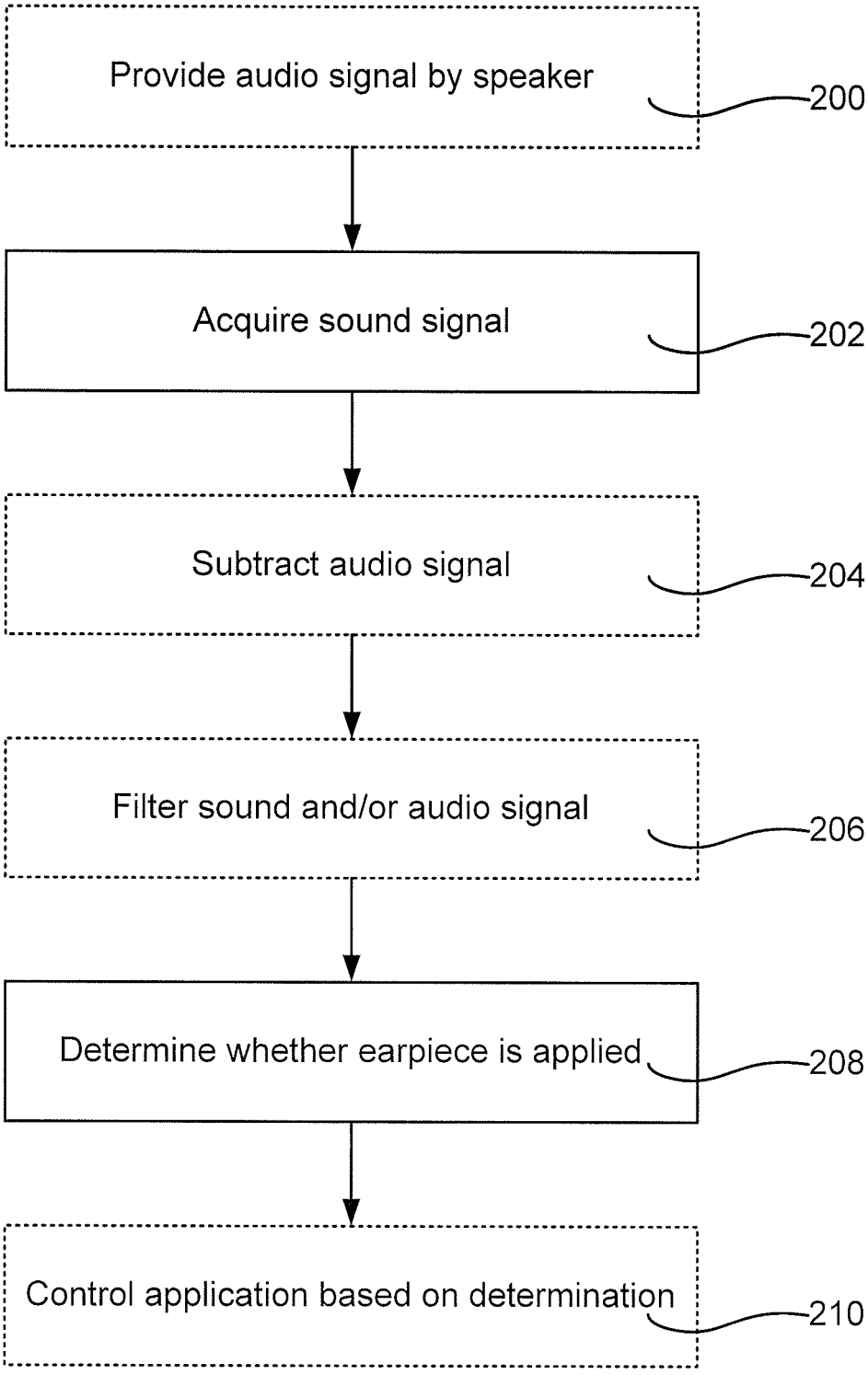
Provide audio signal by speaker
200
Acquire sound signal
202
Subtract audio signal
204
Filter sound and/or audio signal
206
Determine whether earpiece is applied
208
Control application based on determination
210

Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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- US 20080123882 A **[0003]**
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- US 20080298606 A **[0003]**
- EP 1594344 A **[0003]**

专利名称(译)	耳罩的声学入耳式探测器		
公开(公告)号	EP2382797B1	公开(公告)日	2017-08-23
申请号	EP2009780743	申请日	2009-07-16
[标]申请(专利权)人(译)	索尼移动通讯有限公司		
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)	索尼移动通信，INC		
[标]发明人	HAARTSEN JACOBUS SAMPIMON GERRIT TRIP BART B		
发明人	HAARTSEN, JACOBUS SAMPIMON, GERRIT TRIP, BART, B.		
IPC分类号	A61B5/00 H04R1/10 H04R29/00		
CPC分类号	A61B5/6817 H04R1/10 H04R29/00 H04R2460/15		
优先权	12/358285 2009-01-23 US		
其他公开文献	EP2382797A1		
外部链接	Espacenet		

摘要(译)

公开了一种包括耳机和信号处理器的装置。耳机适合应用于用户耳朵的听觉开口。耳机包括能够被提供用于渲染的音频信号的扬声器，以及布置在扬声器附近的麦克风，以在耳机被应用于耳朵时从听觉开口内存在的声音获取声音信号。信号处理器被布置成通过分析所获取的声音信号来确定耳机是否被应用在用户的耳朵处，所述声音信号包括当应用耳机时存在的耳内声音类型中的任何声音信号分量或者外耳声音类型当没有应用耳机时出现。还公开了一种方法和计算机程序。

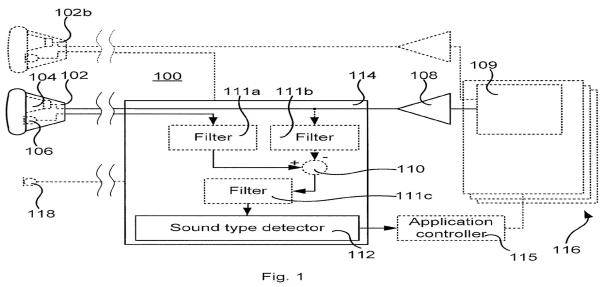

Fig. 1

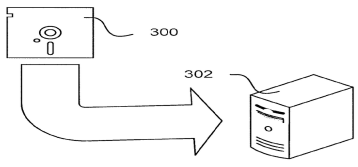

Fig. 3