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(54) **METHODS OF GENERATING TACTILE USER FEEDBACK UTILIZING HEADPHONE DEVICES AND RELATED SYSTEMS**

VERFAHREN ZUR ERZEUGUNG VON TAKTILEM BENUTZERFEEDBACK UNTER VERWENDUNG VON KOPFHÖRERVORRICHTUNGEN UND ZUGEHÖRIGE SYSTEME

PROCÉDÉS DE GÉNÉRATION D'UNE RÉTROACTION D'UTILISATEUR TACTILE UTILISANT DES DISPOSITIFS DE CASQUES D'ÉCOUTE ET DES SYSTÈMES ASSOCIÉS

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Description

PRIORITY CLAIM

[0001] This application claims the benefit of U.S. Provisional Patent Application Serial No. 62/098,936, filed December 31, 2014. The subject matter of this application is related to the subject matter of U.S. Patent App. Pub. No. 2014/0056459, published February 27, 2014, and titled "SPEAKERS, HEADPHONES, AND KITS RELATED TO VIBRATIONS IN AN AUDIO SYSTEM, AND METOHDS FOR FORMING SAME,".

FIELD

[0002] This disclosure relates generally to methods of generating tactile user feedback utilizing headphone devices, and systems including headphone devices configured to generate tactile user feedback. More specifically, disclosed embodiments relate to generating user feedback in ways that may be less intrusive than aural or visual feedback utilizing headphone devices configured to generate tactile user feedback.

BACKGROUND

[0003] Conventional portable audio systems often include a headphone that is connected to a media player (e.g., by one or more wires or by wireless technology). Conventional headphones may include one or more speaker assemblies having an audio driver that produces audible sound waves with a diaphragm. Such headphones may be connected to computing devices, such as, tablet devices, smartphones, video game consoles (e.g., portable video game consoles), and in-car infotainment systems. Such computing devices may provide user feedback, such as incoming text notifications or directions to follow a prescribed route, in the form of aural communications, which may be played over the headphones. Other devices connected to the computing devices, such as smart glasses and dash projectors, may provide user feedback in the form of visual communications displayed on such devices. US2010/0239115 describes a headphone with a loudspeaker and a tactile bass vibrator. US2006/0171553 describes a headphone with a loudspeaker and a haptic feedback device.

BRIEF SUMMARY

[0004] Embodiments according to the invention are in particular disclosed in the attached claims, wherein any feature mentioned in one claim category can be claimed in another claim category as well. The dependencies or references back in the attached claims are chosen for formal reasons only. However any subject matter resulting from a deliberate reference back to any previous claims (in particular multiple dependencies) can be claimed as well, so that any combination of claims and the features thereof is disclosed and can be claimed regardless of the dependencies chosen in the attached claims. The subject-matter which can be claimed comprises not only the combinations of features as set out in the attached claims but also any other combination of features in the claims, wherein each feature mentioned in the claims can be combined with any other feature or combination of other features in the claims. Furthermore, any of the embodiments and features described or depicted herein can be claimed in a separate claim and/or in any combination with any embodiment or feature described or depicted herein or with any of the features of the attached claims. The present disclosure includes methods of generating tactile user feedback utilizing a headphone device. In accordance with such methods, a feedback signal is sent from a computing device to a headphone device operatively connected to the computing device. A tactile vibration is generated utilizing a tactile bass vibrator of the headphone device in response to the feedback signal. The present disclosure includes a system for generating tactile user feedback utilizing a headphone device. The system includes a headphone device operatively connected to a computing device. The headphone device has a tactile bass vibrator configured to generate a tactile vibration in response to a feedback signal received from the computing device, and the computing device is programmed to send a feedback signal to the headphone device in response to a predetermined event.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] While this disclosure concludes with claims particularly pointing out and distinctly claiming specific embodiments, various features and advantages of embodiments within the scope of this disclosure may be more readily ascertained from the following description when read in conjunction with the accompanying drawings, in which:

FIG. 1 is a flowchart diagram of a method of generating tactile user feedback utilizing a headphone device according to the present disclosure;

FIG. 2 is a simplified view of a system for generating tactile user feedback utilizing a headphone device according to the present disclosure; and

FIG. 3 is a simplified block diagram of a driver system of the headphone device of FIG. 2.

MODE(S) FOR CARRYING OUT THE INVENTION

[0006] The illustrations presented in this disclosure are not meant to be actual views of any particular apparatus or component thereof, but are merely idealized representations employed to describe illustrative embodiments. Thus, the drawings are not necessarily to scale.

[0007] Disclosed embodiments relate generally to generating user feedback in ways that may be less intrusive

than aural or visual feedback by utilizing headphone devices configured to generate tactile user feedback. More specifically, disclosed are embodiments of headphone devices including tactile bass vibrators that may generate tactile user feedback in response to receiving a feedback signal from a connected computing device.

[0008] A "speaker" is defined herein as an acoustic device configured to contribute to the generation of sound waves, such as with the reproduction of speech, music, or other audible sound. A speaker may also produce tactile vibrations that may be felt by a person. Thus, a speaker may include a tactile bass vibrator. A tactile bass vibrator may also be referred to as a transducer, a driver, a shaker, etc.

[0009] A "bass frequency" is a relatively low audible frequency generally considered to be within the range extending from approximately 16 Hz to approximately 512 Hz. For purposes of this disclosure, a "low bass frequency" refers to bass frequencies that may be felt as well as heard. Such low bass frequencies may be within the range extending from approximately 16 Hz to approximately 200 Hz.

[0010] Referring to FIG. 1, a flowchart diagram of a method 100 of generating tactile (e.g., haptic) user feedback utilizing a headphone device is shown. The method 100 involves sending a feedback signal from a computing device to a headphone device operatively connected to the computing device, as indicated at act 102. The feedback signal may be, for example, an audio signal from an audio file stored in memory of the computing device. In such an example, the feedback signal may be sent by any audio-enabled application running on the computing device. In other words, sending the feedback signal may not require installing a dedicated application on the computing device. The feedback signal may be, for example, an audio file composed of bass frequency waves. More specifically, the feedback signal may be, for example, an audio file composed of low bass frequency waves, in analog or digital format.

[0011] The feedback signal is sent from the computing device to the headphone device in response to various inputs. The inputs may be generated by the computing device itself, by another device connected to the computing device (e.g., a peripheral or accessory), or by user input to the computing device. The inputs may relate to activities about which the user may desire feedback. For example, the inputs may relate to health information (e.g., heart rate, distance traveled while exercising, pace maintained while exercising, etc.), navigation information (e.g., distance to destination, turning and lane directions, distance traveled, etc.), or other activities a user may engage in while using the headphone device and computing device (e.g., sports activities, leisure activities, work activities, etc.). A feedback signal relating to any such input may be sent from the computing device to the headphone device.

[0012] As one example, the feedback signal may be sent from the computing device to the headphone device in response to a signal from a heart rate monitor of the computing device or operatively connected to the computing device. More specifically, the feedback signal may be sent from the computing device to the headphone device in response to a signal from a heart rate monitor indicating that a user's heart rate has exceeded a predetermined threshold or is within a predetermined range.

[0013] As another example, the feedback signal may be sent from the computing device to the headphone device in response to location information gathered by the computing device (e.g., utilizing a global positioning system (GPS) of the computing device). More specifically, the feedback signal may be sent from the computing device to the headphone device in response to traveling a predetermined distance, travelling at a calculated rate over a predetermined distance interval, or approaching a change of course in a predetermined route. In some embodiments, the feedback signal may be sent to a particular channel or a particular tactile bass vibrator of the headphone device. For example, the feedback signal may be sent to a left-side tactile bass vibrator or a right-side tactile bass vibrator of the headphone device corresponding to a direction in which a user is to turn to follow navigation directions.

[0014] As yet another example, the feedback signal may be sent from the computing device to the headphone device in response to a signal from an altimeter that a predetermined altitude threshold has been crossed. More specifically, the feedback signal may be sent from the computing device to the headphone device in response to descending past a threshold altitude beyond which deployment of a parachute is recommended.

[0015] As still another example, the feedback signal may be sent from the computing device to the headphone device in response to a user input received at the computing device. More specifically, the feedback signal may be sent from the computing device to the headphone device in response to user interaction with one or more user interface devices (e.g., buttons, switches, touchscreens, etc.) of the computing device.

[0016] Such feedback signals may convey useful information for, for example, exercise tracking, navigation, adventure sports, operation of the computing device, and other activities users may engage in while using the computing device and the headphone device. While certain illustrative examples have been given of inputs for sending feedback signals, those examples are not limiting. Feedback signals may be sent from the computing device to the headphone device in response to any input received, or generated, by the computing device.

[0017] In some embodiments, another audio signal may be sent from the computing device to the headphone device. The other audio signal may be distinct from the feedback signal. For example, the other audio signal may not be configured to provide user feedback. More specifically, the other audio signal may be, for example, media audio (e.g., music, radio, or movie audio) or conversational audio (e.g., a telephone call) unconnected with

the feedback audio. The other audio signal may be sent concurrently with the feedback signal. In other words, the headphone device may be actively emitting audible sound, such as during conventional use of a headphone for purposes of listening to music, voice, or other audible sounds, and, at the same time, the headphone may be used to provide haptic feedback to the user by actuating one or more one or more tactile bass vibrators of the headphone responsive to receipt of the feedback signal by the one or more tactile base vibrators from the computing device.

[0018] The method 100 further involves generating a tactile vibration utilizing the tactile bass vibrator of the headphone device in response to the feedback signal, as indicated at action 104. The tactile vibration may be of an amplitude such that vibrations generated by the tactile bass vibrator are felt by a user wearing the headphone device, giving the user feedback associated with the tactile vibration. In addition, the tactile bass vibrator may produce some audible sound in addition to the tactile vibration. For example, the tactile bass vibrator may produce audible sound at bass frequencies. More specifically, the tactile bass vibrator may produce audible sound at low bass frequencies. The primary mechanism for giving the user feedback may be tactile. The audible sound generated in connection with the tactile vibration may be incidental to the vibratory sensation that is the primary means of sending feedback to the user.

[0019] The tactile vibration may be generated by the tactile bass vibrator of the headphone device in, for example, a predetermined vibration pattern. More specifically, the tactile vibration generated by the tactile bass vibrator of the headphone device may be, for example, a burst of vibratory tactile feedback at a predetermined frequency (e.g., a bass frequency or a low bass frequency) or a series of bursts of vibratory tactile feedback. As a specific, nonlimiting example, the tactile vibration generated by the tactile bass vibrator of the headphone device may be a predetermined series of bursts of vibratory tactile feedback separated by a predetermined series of rests between bursts, during which no vibratory tactile feedback associated with the feedback signal is generated.

[0020] In some embodiments, the predetermined vibration pattern of the tactile vibration generated by the tactile bass vibrator of the headphone device may be customizable by the user. For example, the predetermined vibration pattern for a particular notification to be sent to the user may be selected from a set of predetermined vibration patterns (and associated feedback signals) stored in memory of the computing device. More specifically, the predetermined vibration pattern for a particular notification to be sent to the user may be selected from a set of audio files composed of bass frequency waves stored in memory of the computing device. As a specific, nonlimiting example, the predetermined vibration pattern for a particular notification to be sent to the user may be selected from a set of audio files composed of low bass frequency waves stored in memory of the computing device. As another example of customizable vibration patterns, the predetermined vibration pattern may be defined by a user in response to user input at the computing device. More specifically, user interaction with a user input device (e.g., a button, switch, touchscreen, etc.) of the computing device may define the amplitude, frequency, duration, or any combination of amplitude, frequency, and duration of bursts of vibratory tactile feedback as well as the duration of rests between bursts, during which no vibratory tactile feedback associated with the feedback signal is generated.

[0021] As previously mentioned, audible sound may be generated by speakers (e.g., audio drivers) of the headphone device concurrently as tactile vibration is generated by the tactile bass vibrators. For example, audible sound corresponding to an audio signal may be generated by the speakers, and optionally by the tactile bass vibrators, while tactile vibrations corresponding to a feedback signal may be generated by the tactile bass vibrators alone. More specifically, the speakers, and optionally the tactile bass vibrators, may play, for example, media audio or telephone call audio at the same time as the tactile bass vibrators generate tactile vibrations.

[0022] Because the feedback given to the user by the tactile bass vibrators is felt, and optionally heard, as opposed to solely being heard, solely being seen, or being heard and seen, the feedback may be less intrusive than conventional feedback from computing devices. Moreover, the tactile feedback given to the user may not interrupt the experience of the user using the computing device (e.g., may not interrupt the audio played by the speakers, and optionally by the tactile bass vibrators) because its primary communication mechanism may be tactile, rather than aural or visual.

[0023] As one example of generating tactile feedback for a user while using the headphone device and computing device, a user may wear the headphone device connected to a computing device (e.g., a smartphone or fitness band wirelessly connected to a smartphone) while engaging in physical exercise (e.g., running, cycling, hiking, etc.). The fitness band may include a heart rate monitor, and information from the heart rate monitor may be sent from the fitness band to the smartphone for storage and processing. The smartphone may include a GPS unit and other wireless signal transceivers for generation and processing of location data.

[0024] The user may listen to one or more audio files (e.g., music, audiobooks, or radio programming, such as podcasts) while engaging in the physical exercise. The headphone device may produce audible sound and tactile vibrations in response to receiving the audio signals associated with the audio files.

[0025] When an event relating to the physical exercise has occurred, such as, for example, a user's heart rate entering a desired range or the user traveling a predetermined distance, a feedback signal may be sent from the computing device to the headphone device. The feed-

back signal may cause the headphone device to generate tactile vibrations distinct from the tactile vibrations generated in response to the audio signal, such as, for example, a series of short bursts of vibration. Depending on the specific pattern of the tactile vibrations and the predetermined semantic meaning assigned to the specific pattern of the tactile vibrations, the user may understand that his or her heart rate has entered a desired range, he or she has traveled a predetermined distance (e.g., a notification for each mile or kilometer traveled), or that he or she has maintained a predetermined pas over the predetermined distance. As specific, nonlimiting examples, the headphone device may produce two short bursts of vibration, followed by a brief pause, followed by two additional short bursts of vibration (e.g., mimicking a heartbeat) to indicate that the user's heart rate has entered a desired range; may produce a single, sustained burst of vibration followed by a pause for each mile or kilometer traveled since the physical exercise began; and may produce a single, sustained burst of vibration followed by a pause for each mile or kilometer traveled since the physical exercise began followed by a short burst of vibration for each minute passed during the most recent mile or kilometer, each of which may occur while the headphone device simultaneously generates the audible sound and tactile vibrations in response to the audio signal.

[0026] As another example of generating tactile feedback for a user while using the headphone device and computing device, a user may wear the headphone device connected to a computing device (e.g., a smartphone or in-car infotainment system) while navigating (e.g., while walking, cycling, or driving) to a desired destination. The smartphone or in-car infotainment system may include a GPS unit and other wireless signal transceivers for generation and processing of location data.

[0027] The user may listen to one or more audio files (e.g., music, audiobooks, or radio programming, such as podcasts) while navigating. The headphone device may produce audible sound and tactile vibrations in response to receiving the audio signals associated with the audio files.

[0028] When an event relating to the navigation has occurred, such as, for example, a user approaching a required deviation from the path (e.g., a turn or lane change) to continue toward the destination or a user reaching the destination, a feedback signal may be sent from the computing device to the headphone device. The feedback signal may cause the headphone device to generate tactile vibrations distinct from the tactile vibrations generated in response to the audio signal, such as, for example, a series of short bursts of vibration. Depending on the specific pattern of the tactile vibrations and the predetermined semantic meaning assigned to the specific pattern of the tactile vibrations, the user may understand that he or she should turn right or left at the next intersection, he or she should merge right or left before the next highway lane event (e.g., interchange, exit, entrance, etc.), or he or she should stop at the destination. As specific, nonlimiting examples, the headphone device may produce two short bursts of vibration in a left-side or right-side ear cup to indicate that the user should turn left or right at the next intersection; may produce one sustained burst of vibration in a left-side or right-side ear cup to indicate that the user should merge left or right before the next highway lane event; and may produce three, sustained bursts of vibration to indicate that the user is approaching or has reached the destination, each of which may occur while the headphone device simultaneously generates the audible sound and tactile vibrations in response to the audio signal.

[0029] As yet another example of generating tactile feedback for a user while using the headphone device and computing device, a user may wear the headphone device connected to a computing device (e.g., a smartphone, portable video game console, or fitness tracker connected to a smartphone) while participating in adventure sports (e.g., snowboarding, skiing, skydiving, etc.). The computing device may include a GPS unit and other wireless signal transceivers for generation and processing of location data and the computing device or a peripheral device connected to the computing device may include an altimeter for generation and processing of altitude data.

[0030] The user may listen to one or more audio files (e.g., music, audiobooks, or radio programming, such as podcasts) while participating in the adventure sport. The headphone device may produce audible sound and tactile vibrations in response to receiving the audio signals associated with the audio files.

[0031] When an event relating to the adventure sport has occurred, such as, for example, a user crossing an altitude threshold (e.g., after which it is advisable to deploy a parachute), a feedback signal may be sent from the computing device to the headphone device. The feedback signal may cause the headphone device to generate tactile vibrations distinct from the tactile vibrations generated in response to the audio signal, such as, for example, a series of short bursts of vibration. Depending on the specific pattern of the tactile vibrations and the predetermined semantic meaning assigned to the specific pattern of the tactile vibrations, the user may understand that he or she should deploy a parachute. As specific, nonlimiting examples, the headphone device may produce five short bursts of vibration interspersed by long pauses to indicate that the user has crossed an upper threshold for deploying a parachute; may produce five short bursts of vibration interspersed by medium-length pauses to indicate that the user has crossed an middle threshold for deploying a parachute; and may produce five short bursts of vibration interspersed by short pauses to indicate that the user has crossed a lowest threshold for deploying a parachute, each of which may occur while the headphone device simultaneously generates the audible sound and tactile vibrations in response to the audio signal.

[0032] FIG. 2 is a simplified view of a system 200 for generating tactile user feedback utilizing a headphone device 202. The system 200 includes a computing device 204 connected to the headphone device 202. The computing device 204 may be any device configured for connecting to the headphone device 202, determining when to send a feedback signal, and sending the feedback signal or signals. For example, the computing device 204 may include an audio connector 206 (e.g., a female audio jack, a wireless connector, such as, for example, BLUETOOTH®, etc.), a control circuit 208 (e.g., a processor), a memory device 210 (e.g., flash memory), and user input devices 212 (e.g., a touchscreen, buttons, switches, etc.). As specific, nonlimiting examples, the computing device 204 may be a tablet device, a smartphone, a video game console (e.g., a portable video game console), or an in-car infotainment system.

[0033] The headphone device 202 may include one or more speakers 214 and one or more tactile bass vibrators 216. For example, the headphone device 202 may include left-side and right-side speakers 214 and left-side and right-side tactile bass vibrators 216. The speakers 214 may be distinct from the tactile bass vibrators 216.

[0034] The left-side and right-side speakers 214 and left-side and right-side tactile bass vibrators 216 may be configured as, for example, over-the-ear, on-ear, in-concha, or in-ear earphones. The left-side and right-side speakers 214 and left-side and right-side tactile bass vibrators 216 may be located within housings 218 of the headphone device 202. The left-side and right-side speakers 214 may be configured to generate audible sound in response to audio signals sent from the computing device 204 to the headphone device 202. The left-side and right-side speakers 214 may not generate any audible sound or any tactile vibration in response to feedback signals sent from the computing device 204 to the headphone device. The left-side, right-side, or left-side and right-side tactile bass vibrators 216 may be configured to generate audible sound and tactile vibrations in response to audio signals and feedback signals sent from the computing device 204 to the headphone device 202.

[0035] In embodiments where the headphone device 202 exhibits an over-the-ear or an on-ear configuration, the housings 218 may define left-side and right-side ear cups 220 of the headphone device 202. In such embodiments, the headphone device 202 may include a headband 222 supporting the ear cups 220 and size and shaped to rest on a user's head, and position the ear cups 220 proximate (e.g., over or on) the user's ears, when using the headphone device 202.

[0036] In some embodiments, the headphone device 202 may include an amplifier 224 operatively connected to the tactile bass vibrators 216. The amplifier 224 may be powered separately from the computing device 204. The amplifier 224 may be located, for example, within the one of the housings 218 of the headphone device 202, or an amplifier may be located in each housing 218 of the headphone device 202. As another example, the amplifier 224 may be located in-line with an audio cable 226 connecting the headphone device 202 to the computing device 204.

[0037] Suitable headphone devices incorporating tactile bass vibrators 216 are disclosed in U.S. Patent App. Pub. No. 2014/0056459, published February 27, 2014, and titled "SPEAKERS, HEADPHONES, AND KITS RELATED TO VIBRATIONS IN AN AUDIO SYSTEM, AND METOHDS FOR FORMING SAME,". In addition, suitable headphone devices are commercially available from Skullcandy, Inc., of Park City, UT, under the trademark SKULLCRUSHERS®.

[0038] FIG. 3 is a simplified block diagram of a driver system 300 of the headphone device 202 of FIG. 2. The driver system 300 may be located within housings 218 of the ear cups 220 of the headphone device 202 of FIG. 2 to convert audio signals 301 to audible sound and a tactile response and feedback signals 309 to a tactile response and optionally audible sound. The driver system 300 may include a speaker 340 (e.g., an audio driver) configured to emit sound at audible frequencies, and an additional, distinct tactile bass vibrator 350 configured to emit audible sound at bass frequencies (e.g., low bass frequencies) and to generate tactile vibrations within the speaker assemblies ear cups 220 that may be felt by the user. The driver system 300 may include a signal splitter/controller 304 configured to receive audio signals 301 and feedback signals 309 (e.g., from the computing device (FIG. 3)), and transmit a first split audio signal 303 to the audio driver 340 and a second split audio signal 305 and a feedback signal 311 to the tactile bass vibrator 350. The signal splitter 304 may include filters (e.g., low-pass, high-pass, etc.) such that the first split audio signal 303 includes medium to high frequencies (i.e., non-bass frequencies), while the second split audio signal 405 and the feedback signal 311 include the bass frequencies (including low bass frequencies). In some embodiments, at least some of the frequencies of the first split audio signal 303 and the second split audio signal 305 may at least partially overlap. For example, the audio driver 340 may be configured to emit some bass frequencies that are further enhanced by the tactile bass vibrator 350. In some embodiments, none of the frequencies of the first split audio signal 303 and the feedback signal 311 may overlap. For example, the audio driver 340 may be configured not to emit any low bass frequencies that are emitted by the tactile bass vibrator 350 as tactile vibrations.

[0039] The signal splitter/controller 304 may further include control logic configured to modify the split audio signals 303 and 305, and optionally the feedback signal 311, responsive to a control signal 307. For example, the control signal 307 may control characteristics, such as volume. The signal splitter/controller 304 may be configured to control the first split audio signal 303, the second split audio signal 405, and optionally the feedback signal 311 independently. For example, a user may desire louder bass frequencies and a stronger tactile response at the bass frequencies, or a user may desire more intense,

detectable haptic feedback relative to the volume of audio. As a result, more power may be supplied to the tactile bass vibrator 450 relative to the power supplied to the audio driver 440.

[0040] The various illustrative logical blocks, modules, circuits, and algorithm acts described in connection with embodiments disclosed herein may be implemented or performed with one or more control circuits such as a general-purpose processor, a special-purpose processor, a Digital Signal Processor (DSP), an Application Specific Integrated Circuit (ASIC), a Field Programmable Gate Array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein.

[0041] A general-purpose processor may be a microprocessor, but in the alternative, the general-purpose processor may be any processor, controller, microcontroller, or state machine suitable for carrying out processes of the present disclosure. A processor may also be implemented as a combination of computing devices, such as a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0042] A general-purpose processor may be part of a general-purpose computer, which should be considered a special-purpose computer when configured to execute computing instructions (e.g., software code) for carrying out embodiments of the present disclosure. Moreover, when configured according to embodiments of the present disclosure, such a special-purpose computer improves the function of a general-purpose computer because, absent the present disclosure, the general-purpose computer would not be able to carry out the processes of the present disclosure. The present disclosure also provides meaningful limitations in one or more particular technical environments that go beyond an abstract idea. For example, embodiments of the present disclosure provide improvements in the technical field of haptic feedback generation and provision.

[0043] While certain illustrative embodiments have been described in connection with the figures, those of ordinary skill in the art will recognize and appreciate that the scope of this disclosure is not limited to those embodiments explicitly shown and described in this disclosure. Rather, many additions, deletions, and modifications to the embodiments described in this disclosure may result in embodiments within the scope of this disclosure, such as those specifically claimed, including legal equivalents. In addition, features from one disclosed embodiment may be combined with features of another disclosed embodiment while still being within the scope of this disclosure, as contemplated by the inventors.

Claims

1. A method of generating tactile user feedback utilizing a headphone device, comprising:

   generating signal indicative of a real-world condition utilizing at least one sensor selected from the group consisting of a heart-rate monitor, a GPS, and an altimeter, the at least one sensor operatively connected to a headphone device and a computing device;
   sending a feedback signal from the computing device to the headphone device in response to the signal from the at least one sensor, the headphone device being operatively connected to the computing device; and
   generating a tactile vibration utilizing a tactile bass vibrator of the headphone device in response to the feedback signal.

2. The method of claim 1, further comprising:

   sending an audio signal from the computing device to the headphone device; and
   generating audible sound utilizing a speaker of the headphone in response to the audio signal, the speaker being distinct from the tactile bass vibrator.

3. The method of claim 2, wherein the feedback signal is sent concurrently with the audio signal and the tactile vibration is generated concurrently with the audible sound.

4. The method of any one of claims claim 1 through 3, wherein sending the feedback signal from the computing device to the headphone device comprises sending a feedback signal composed of bass frequency waves from the computing device to the headphone device.

5. The method of any one of claims 1 through 3, wherein sending the feedback signal from the computing device to the headphone device comprises sending the feedback signal from the computing device to the headphone device in response to a user input received at the computing device.

6. The method of any one of claims 1 through 3, wherein generating the tactile vibration utilizing the tactile bass vibrator of the headphone device in response to the feedback signal comprises generating a tactile vibration in a predetermined vibration pattern utilizing the tactile bass vibrator,
   preferably further comprising selecting the predetermined vibration pattern from a set of predetermined vibration patterns stored in memory of the computing device.

7. The method of any one of claims 1 through 3, wherein sending the feedback signal from the computing device to the headphone device comprises sending the feedback signal in response to at least one of:

    a signal relating to physical activity of the user;
    a signal relating to navigation for the user; and
    a signal relating to an adventure sport engaged in by the user,
    wherein preferably
    sending the feedback signal from the computing device to the headphone device comprises sending the feedback signal in response to a signal that the user is to turn in the predetermined direction generated by the computing device; and
    generating the tactile vibration utilizing the tactile bass vibrator of the headphone device in response to the feedback signal comprises generating the tactile vibration in a left-side tactile bass vibrator or a right-side tactile bass vibrator of the headphone device corresponding to the predetermined direction in which the user is to turn.

8. A system for generating tactile user feedback utilizing a headphone device, comprising: a headphone device and a computing device, where the headphone device is operatively connected to a computing device, the headphone device comprising a tactile bass vibrator configured to generate a tactile vibration in response to a feedback signal received from the computing device and at least one sensor selected from the group consisting of a heart-rate monitor, a GPS, and an altimeter;
    wherein the computing device is programmed to send the feedback signal to the headphone device in response to a signal indicative of a real-world condition from the at least one sensor.

9. The system of claim 8, wherein the headphone device comprises a speaker distinct from the tactile bass vibrator and the computing device is programmed to send an audio signal from the computing device to the headphone device, causing the speaker of the headphone to generate audible sound in response to the audio signal,
    wherein preferably the computing device is programmed to send the feedback signal concurrently with the audio signal, causing the tactile vibration to be generated concurrently with the audible sound.

10. The system of any one of claims 8 through 9, wherein the computing device is programmed to send a feedback signal composed of bass frequency waves from the computing device to the headphone device.

11. The system of any one of claims 8 through 10, wherein the computing device is programmed to send the feedback signal to cause the tactile bass vibrator of the headphone device to generate the tactile vibration in a predetermined vibration pattern.

12. The system of any one of claims 8 through 11, wherein the computing device is programmed to send the feedback signal from the computing device to the headphone device comprises sending the feedback signal in response to at least one of:

    a signal relating to physical activity of the user;
    a signal relating to navigation for the user; and
    a signal relating to an adventure sport engaged in by the user.

13. The system of claim 12, wherein the headphone device comprises a left-side tactile bass vibrator and a right-side tactile bass vibrator located within housings corresponding to a left-side ear cup and a right-side ear cup of the headphone device.

14. The system of claim 13, wherein the computing device is programmed to send the feedback signal from the computing device to the headphone device in response to a signal that the user is to turn in the predetermined direction generated by the computing device, causing the tactile bass vibrator of the headphone device to generate the tactile vibration in the left-side tactile bass vibrator or the right-side tactile bass vibrator of the headphone device corresponding to the predetermined direction in which the user is to turn.

Patentansprüche

1. Verfahren zur Erzeugung von taktiler Benutzerrückmeldung unter Verwendung einer Kopfhörervorrichtung, umfassend:

    Erzeugen eines Signals, das einen Realweltzustand angibt, unter Verwendung mindestens eines Sensors, ausgewählt aus der Gruppe bestehend aus einer Herzfrequenz-Überwachungsvorrichtung, einem GPS und einem Höhenmesser, wobei der mindestens eine Sensor wirksam mit einer Kopfhörervorrichtung und einer Datenverarbeitungsvorrichtung verbunden ist;
    Senden eines Rückmeldungssignals von der Datenverarbeitungsvorrichtung zu der Kopfhörervorrichtung als Reaktion auf das Signal von dem mindestens einen Sensor, wobei die Kopfhörervorrichtung wirksam mit der Datenverarbeitungsvorrichtung verbunden ist; und
    Erzeugen einer taktilen Vibration unter Verwendung eines Taktil-Bassvibrators der Kopfhörer-

vorrichtung als Reaktion auf das Rückmeldungssignal.

2. Verfahren nach Anspruch 1, ferner umfassend:

Senden eines Audiosignals von der Datenverarbeitungsvorrichtung zu der Kopfhörervorrichtung; und
Erzeugen eines hörbaren Klangs unter Verwendung eines Lautsprechers des Kopfhörers als Reaktion auf das Audiosignal, wobei der Lautsprecher von dem Taktil-Bassvibrator verschieden ist.

3. Verfahren nach Anspruch 2, wobei das Rückmeldungssignal gleichzeitig mit dem Audiosignal gesendet wird und die taktile Vibration gleichzeitig mit dem hörbaren Klang erzeugt wird.

4. Verfahren nach einem der Ansprüche 1 bis 3, wobei Senden des Rückmeldungssignals von der Datenverarbeitungsvorrichtung zu der Kopfhörervorrichtung Senden eines Rückmeldungssignals, das aus Bassfrequenzwellen zusammengesetzt ist, von der Datenverarbeitungsvorrichtung zu der Kopfhörervorrichtung umfasst.

5. Verfahren nach einem der Ansprüche 1 bis 3, wobei Senden des Rückmeldungssignals von der Datenverarbeitungsvorrichtung zu der Kopfhörervorrichtung Senden des Rückmeldungssignals von der Datenverarbeitungsvorrichtung zu der Kopfhörervorrichtung als Reaktion auf eine in der Datenverarbeitungsvorrichtung empfangene Benutzereingabe umfasst.

6. Verfahren nach einem der Ansprüche 1 bis 3, wobei Erzeugen der taktilen Vibration unter Verwendung des Taktil-Bassvibrators der Kopfhörervorrichtung als Reaktion auf das Rückmeldungssignal Erzeugen einer taktilen Vibration in einem vorbestimmten Vibrationsmuster unter Verwendung des Taktil-Bassvibrators umfasst,
vorzugsweise ferner umfassend Auswählen des vorbestimmten Vibrationsmusters aus einer im Speicher der Datenverarbeitungsvorrichtung gespeicherten Menge vorbestimmter Vibrationsmuster.

7. Verfahren nach einem der Ansprüche 1 bis 3, wobei Senden des Rückmeldungssignals von der Datenverarbeitungsvorrichtung zu der Kopfhörervorrichtung Senden des Rückmeldungssignals als Reaktion auf mindestens eines von Folgendem umfasst:

ein Signal in Bezug auf physische Aktivität des Benutzers;
ein Signal in Bezug auf Navigation für den Benutzer; und
ein Signal in Bezug auf einen Abenteuersport, an dem der Benutzer teilnimmt, wobei vorzugsweise Senden des Rückmeldungssignals von der Datenverarbeitungsvorrichtung zu der Kopfhörervorrichtung Senden des Rückmeldungssignals als Reaktion auf ein Signal umfasst, dass sich der Benutzer in der vorbestimmten Richtung drehen soll, das durch die Datenverarbeitungsvorrichtung erzeugt wird; und
Erzeugen der taktilen Vibration unter Verwendung des Taktil-Bassvibrators der Kopfhörervorrichtung als Reaktion auf das Rückmeldungssignal Erzeugen der taktilen Vibration in einem Taktil-Bassvibrator der linken Seite oder einem Taktil-Bassvibrator der rechten Seite der Kopfhörervorrichtung entsprechend der vorbestimmten Richtung, in der sich der Benutzer drehen soll, umfasst.

8. System zur Erzeugung von taktiler Benutzerrückmeldung unter Verwendung einer Kopfhörervorrichtung, das eine Kopfhörervorrichtung und eine Datenverarbeitungsvorrichtung umfasst, wobei die Kopfhörervorrichtung wirksam mit einer Datenverarbeitungsvorrichtung verbunden ist, wobei die Kopfhörervorrichtung einen Taktil-Bassvibrator, der dafür ausgelegt ist, eine taktile Vibration als Reaktion auf ein von der Datenverarbeitungsvorrichtung empfangenes Rückmeldungssignal zu erzeugen, und mindestens einen Sensor, ausgewählt aus der Gruppe bestehend aus einer Herzfrequenz-Überwachungsvorrichtung, einem GPS und einem Höhenmesser, umfasst;
wobei die Datenverarbeitungsvorrichtung dafür programmiert ist, das Rückmeldungssignal als Reaktion auf ein Signal, das einen Realweltzustand angibt, von dem mindestens einen Sensor zu der Kopfhörervorrichtung zu senden.

9. System nach Anspruch 8, wobei die Kopfhörervorrichtung einen von dem Taktil-Bassvibrator verschiedenen Lautsprecher umfasst und die Datenverarbeitungsvorrichtung dafür programmiert ist, ein Audiosignal von der Datenverarbeitungsvorrichtung zu der Kopfhörervorrichtung zu senden, wodurch bewirkt wird, dass der Lautsprecher des Kopfhörers als Reaktion auf das Audiosignal hörbaren Klang erzeugt,
wobei die Datenverarbeitungsvorrichtung vorzugsweise dafür programmiert ist, das Rückmeldungssignal gleichzeitig mit dem Audiosignal zu senden, wodurch bewirkt wird, dass die taktile Vibration gleichzeitig mit dem hörbaren Klang erzeugt wird.

10. System nach einem der Ansprüche 8 bis 9, wobei die Datenverarbeitungsvorrichtung dafür programmiert ist, ein Rückmeldungssignal, das aus Bassfrequenzwellen zusammengesetzt ist, von der Daten-

verarbeitungsvorrichtung zu der Kopfhörervorrichtung zu senden.

11. System nach einem der Ansprüche 8 bis 10, wobei die Datenverarbeitungsvorrichtung dafür programmiert ist, das Rückmeldungssignal zu senden, um zu bewirken, dass der Taktil-Bassvibrator der Kopfhörervorrichtung die taktile Vibration in einem vorbestimmten Vibrationsmuster erzeugt.

12. System nach einem der Ansprüche 8 bis 11, wobei die Datenverarbeitungsvorrichtung dafür programmiert ist, das Rückmeldungssignal von der Datenverarbeitungsvorrichtung zu der Kopfhörervorrichtung zu senden
Senden des Rückmeldungssignals als Reaktion auf mindestens eines von Folgendem umfasst:

ein Signal in Bezug auf physische Aktivität des Benutzers;
ein Signal in Bezug auf Navigation für den Benutzer; und
ein Signal in Bezug auf einen Abenteuersport, an dem der Benutzer teilnimmt.

13. System nach Anspruch 12, wobei die Kopfhörervorrichtung einen Taktil-Bassvibrator der linken Seite und einen Taktil-Bassvibrator der rechten Seite umfasst, die sich in Gehäusen entsprechend einer Schale des linken Ohrs und einer Schale des rechten Ohrs der Kopfhörervorrichtung befinden.

14. System nach Anspruch 13, wobei die Datenverarbeitungsvorrichtung dafür programmiert ist, das Rückmeldungssignal als Reaktion auf ein Signal, dass sich der Benutzer in der vorbestimmten Richtung drehen soll, das durch die Datenverarbeitungsvorrichtung erzeugt wird, von der Datenverarbeitungsvorrichtung zu der Kopfhörervorrichtung zu senden, wodurch bewirkt wird, dass der Taktil-Bassvibrator der Kopfhörervorrichtung entsprechend der vorbestimmten Richtung, in der sich der Benutzer drehen soll, die taktile Vibration in dem Taktil-Bassvibrator der linken Seite oder dem Taktil-Bassvibrator der rechten Seite der Kopfhörervorrichtung erzeugt.

Revendications

1. Procédé de génération d'un retour tactile pour un utilisateur au moyen d'un dispositif faisant casque d'écoute, comprenant:

la génération d'un signal représentatif d'une condition du monde réel au moyen d'au moins un capteur choisi dans le groupe constitué par un moniteur de fréquence cardiaque, un GPS et un altimètre, l'au moins un capteur fonctionnellement relié à un dispositif faisant casque d'écoute et un dispositif informatique;
l'envoi d'un signal de retour du dispositif informatique au dispositif faisant casque d'écoute en réponse au signal issu de l'au moins un capteur, le dispositif faisant casque d'écoute étant fonctionnellement relié au dispositif informatique; et
la génération d'une vibration tactile au moyen d'un vibreur tactile basse fréquence du dispositif faisant casque d'écoute en réponse au signal de retour.

2. Procédé de la revendication 1, comprenant en outre:

l'envoi d'un signal audio du dispositif informatique au dispositif faisant casque d'écoute; et
la génération d'un son audible au moyen d'un haut-parleur du casque d'écoute en réponse au signal audio, le haut-parleur étant distinct du vibreur tactile basse fréquence.

3. Procédé de la revendication 2, dans lequel le signal de retour est envoyé simultanément au signal audio et la vibration tactile est générée simultanément au son audible.

4. Procédé de l'une quelconque des revendications 1 à 3, dans lequel l'envoi du signal de retour du dispositif informatique au dispositif faisant casque d'écoute comprend l'envoi d'un signal de retour composé d'ondes à basse fréquence du dispositif informatique au dispositif faisant casque d'écoute.

5. Procédé de l'une quelconque des revendications 1 à 3, dans lequel l'envoi du signal de retour du dispositif informatique au dispositif faisant casque d'écoute comprend l'envoi du signal de retour du dispositif informatique au dispositif faisant casque d'écoute en réponse à une entrée d'utilisateur reçue au niveau du dispositif informatique.

6. Procédé de l'une quelconque des revendications 1 à 3, dans lequel la génération de la vibration tactile au moyen du vibreur tactile basse fréquence du dispositif faisant casque d'écoute en réponse au signal de retour comprend la génération d'une vibration tactile selon un motif de vibration prédéterminé au moyen du vibreur tactile basse fréquence,
de préférence comprenant en outre la sélection du motif de vibration prédéterminé à partir d'un ensemble de motifs de vibration prédéterminés stockés dans une mémoire du dispositif informatique.

7. Procédé de l'une quelconque des revendications 1 à 3, dans lequel l'envoi du signal de retour du dispositif informatique au dispositif faisant casque d'écoute comprend l'envoi du signal de retour en ré-

ponse à au moins un des éléments suivants:

un signal relatif à une activité physique de l'utilisateur;
un signal relatif à une navigation pour l'utilisateur; et
un signal relatif à un sport d'aventure pratiqué par l'utilisateur,
dans lequel de préférence

l'envoi du signal de retour du dispositif informatique au dispositif faisant casque d'écoute comprend l'envoi du signal de retour en réponse à un signal indiquant que l'utilisateur doit tourner dans la direction prédéterminée générée par le dispositif informatique; et
la génération de la vibration tactile au moyen du vibreur tactile basse fréquence du dispositif faisant casque d'écoute en réponse au signal de retour comprend la génération de la vibration tactile dans un vibreur tactile basse fréquence gauche ou un vibreur tactile basse fréquence droit du dispositif faisant casque d'écoute correspondant à la direction prédéterminée dans laquelle l'utilisateur doit tourner.

8. Système destiné à générer un retour tactile pour un utilisateur au moyen d'un dispositif faisant casque d'écoute, comprenant : un dispositif faisant casque d'écoute et un dispositif informatique, le dispositif faisant casque d'écoute étant fonctionnellement relié à un dispositif informatique, le dispositif faisant casque d'écoute comprenant un vibreur tactile basse fréquence configuré pour générer une vibration tactile en réponse à un signal de retour reçu du dispositif informatique et au moins un capteur choisi dans le groupe constitué par un moniteur de fréquence cardiaque, un GPS et un altimètre ; dans lequel le dispositif informatique est programmé pour envoyer le signal de retour au dispositif faisant casque d'écoute en réponse à un signal représentatif d'une condition du monde réel issu de l'au moins un capteur.

9. Système de la revendication 8, dans lequel le dispositif faisant casque d'écoute comprend un haut-parleur distinct du vibreur tactile basse fréquence et le dispositif informatique est programmé pour envoyer un signal audio du dispositif informatique au dispositif faisant casque d'écoute, amenant le haut-parleur du casque d'écoute à générer un son audible en réponse au signal audio,
dans lequel de préférence le dispositif informatique est programmé pour envoyer le signal de retour simultanément au signal audio, amenant la vibration tactile à être générée simultanément au son audible.

10. Système de l'une quelconque des revendications 8 à 9, dans lequel le dispositif informatique est programmé pour envoyer un signal de retour composé d'ondes à basse fréquence du dispositif informatique au dispositif faisant casque d'écoute.

11. Système de l'une quelconque des revendications 8 à 10, dans lequel le dispositif informatique est programmé pour envoyer le signal de retour pour amener le vibreur tactile basse fréquence du dispositif faisant casque d'écoute à générer la vibration tactile selon un motif de vibration prédéterminé.

12. Système de l'une quelconque des revendications 8 à 11, dans lequel le dispositif informatique est programmé pour envoyer le signal de retour du dispositif informatique au dispositif faisant casque d'écoute comprend l'envoi du signal de retour en réponse à au moins un des éléments suivants:

un signal relatif à une activité physique de l'utilisateur;
un signal relatif à une navigation pour l'utilisateur; et
un signal relatif à un sport d'aventure pratiqué par l'utilisateur.

13. Système de la revendication 12, dans lequel le dispositif faisant casque d'écoute comprend un vibreur tactile basse fréquence gauche et un vibreur tactile basse fréquence droit situés à l'intérieur de boîtiers correspondant à une oreillette gauche et une oreillette droite du dispositif faisant casque d'écoute.

14. Système de la revendication 13, dans lequel le dispositif informatique est programmé pour envoyer le signal de retour du dispositif informatique au dispositif faisant casque d'écoute en réponse à un signal indiquant que l'utilisateur doit tourner dans la direction prédéterminée générée par le dispositif informatique, amenant le vibreur tactile basse fréquence du dispositif faisant casque d'écoute à générer la vibration tactile dans le vibreur tactile basse fréquence gauche ou le vibreur tactile basse fréquence droit du dispositif faisant casque d'écoute correspondant à la direction prédéterminée dans laquelle l'utilisateur doit tourner.

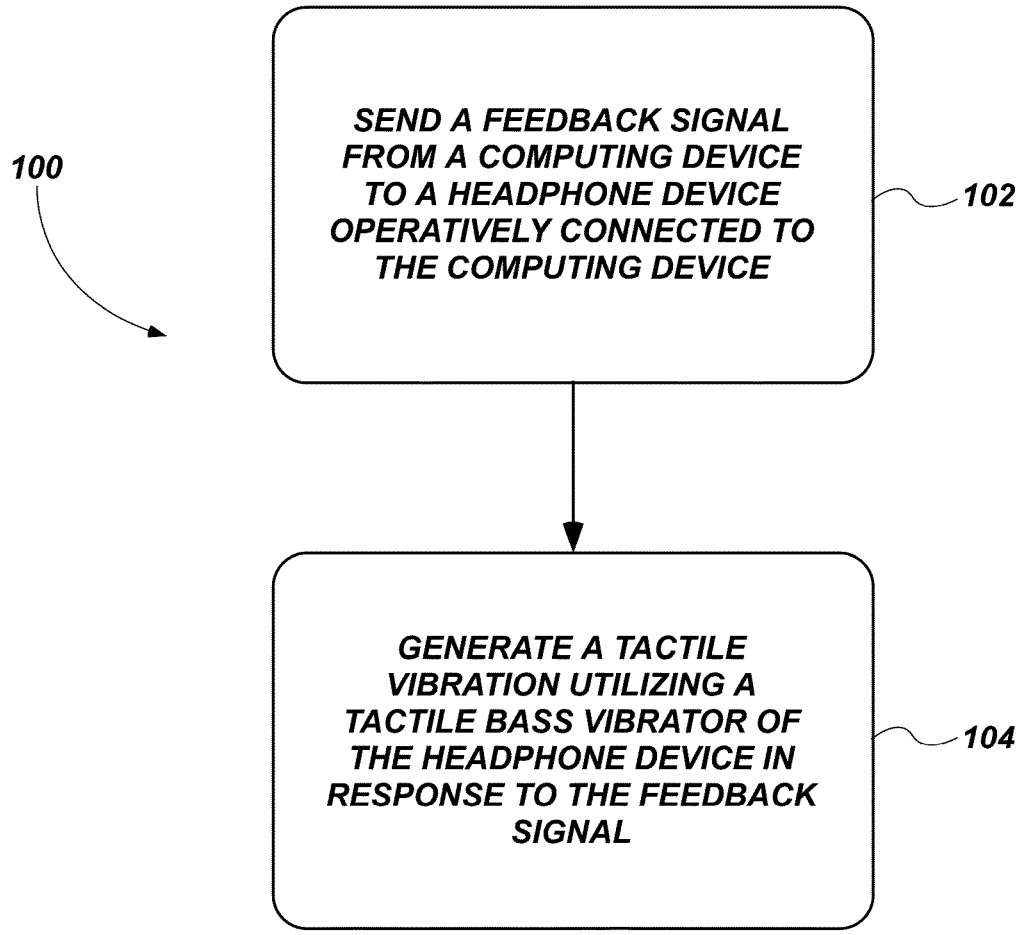
100
SEND A FEEDBACK SIGNAL FROM A COMPUTING DEVICE TO A HEADPHONE DEVICE OPERATIVELY CONNECTED TO THE COMPUTING DEVICE
102
GENERATE A TACTILE VIBRATION UTILIZING A TACTILE BASS VIBRATOR OF THE HEADPHONE DEVICE IN RESPONSE TO THE FEEDBACK SIGNAL
104

FIG. 1

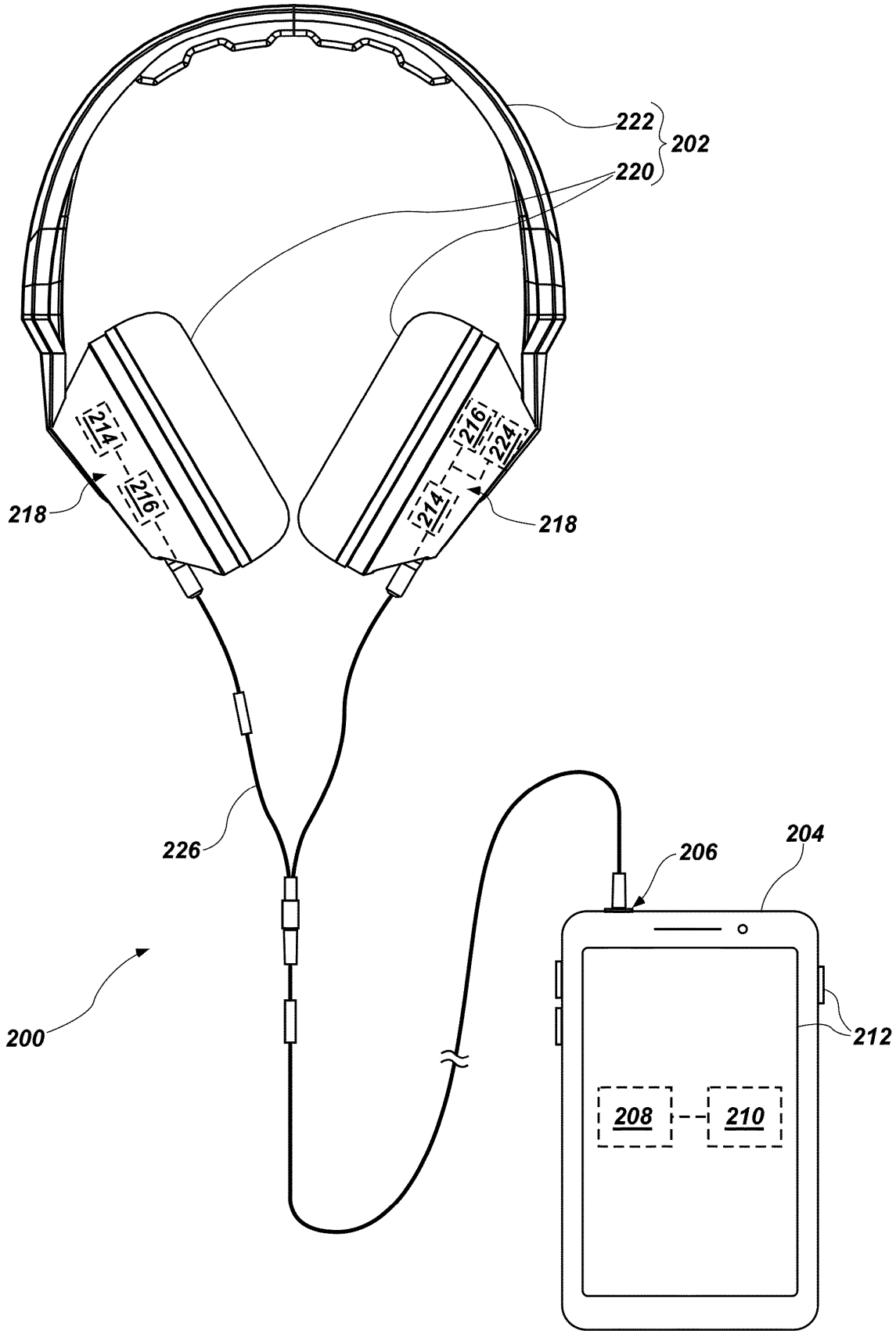

FIG. 2

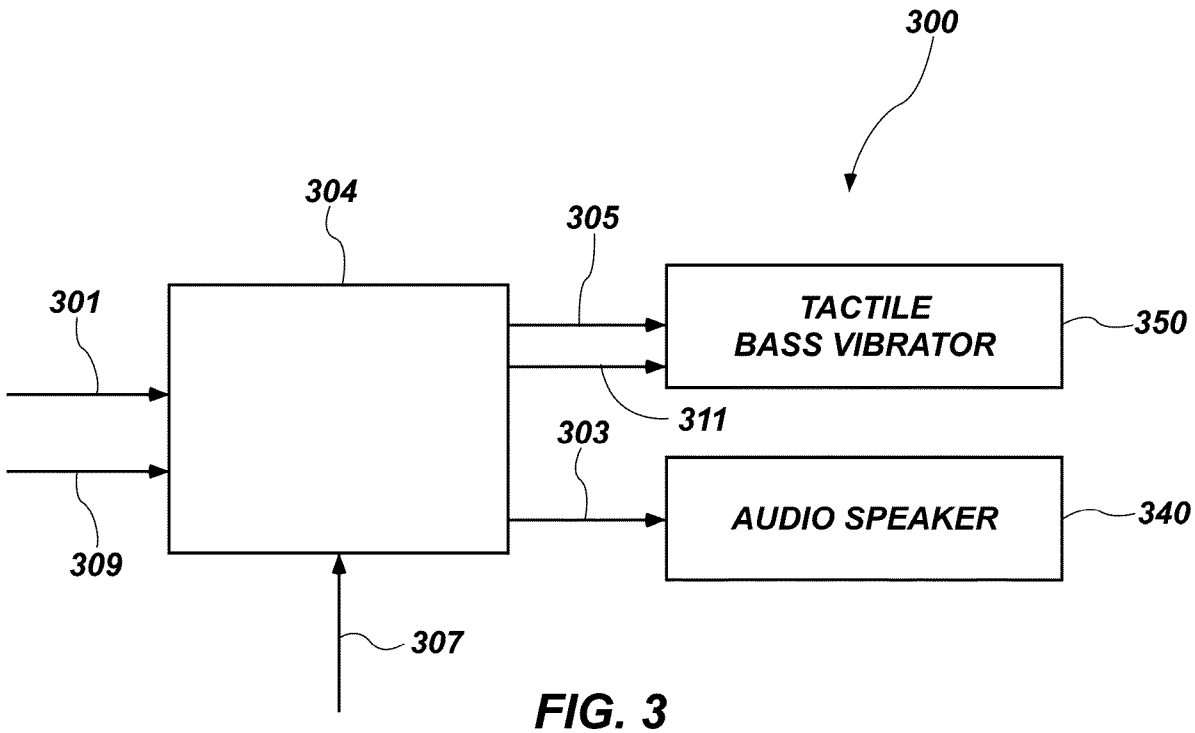
300
304
305
301
TACTILE
BASS VIBRATOR
350
311
303
AUDIO SPEAKER
340
309
307

FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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- US 20140056459 A **[0001] [0037]**
- US 20100239115 A **[0003]**
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专利名称(译)	利用耳机设备和相关系统产生触觉用户反馈的方法		
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[标]申请(专利权)人(译)	骷髅头有限公司		
申请(专利权)人(译)	SKULLCANDY INC.		
当前申请(专利权)人(译)	SKULLCANDY INC.		
[标]发明人	NOERTKER SAM TIMOTHY JOHN WINDT MATTHEW		
发明人	NOERTKER, SAM TIMOTHY, JOHN WINDT, MATTHEW		
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CPC分类号	H04R1/1008 H04R2201/10 A61B5/02438 A61B5/1118 A61B5/486 A61B5/7455 G06F3/016 H04R2400/03 H04R1/1075 H04R29/001		
优先权	62/098936 2014-12-31 US		
其他公开文献	EP3041258A1		
外部链接	Espacenet		

摘要(译)

利用耳机设备产生触觉用户反馈的方法可以包括从计算设备向可操作地连接到计算设备的耳机设备发送反馈信号。响应于反馈信号，可以利用耳机设备的触觉低音振动器产生触觉振动。利用耳机设备产生触觉用户反馈的系统可以包括可操作地连接到计算设备的耳机设备，该耳机设备包括触觉低音振动器，其被配置为响应于从计算设备接收的反馈信号而产生触觉振动。计算设备可以被编程为响应于预定事件向耳机设备发送反馈信号

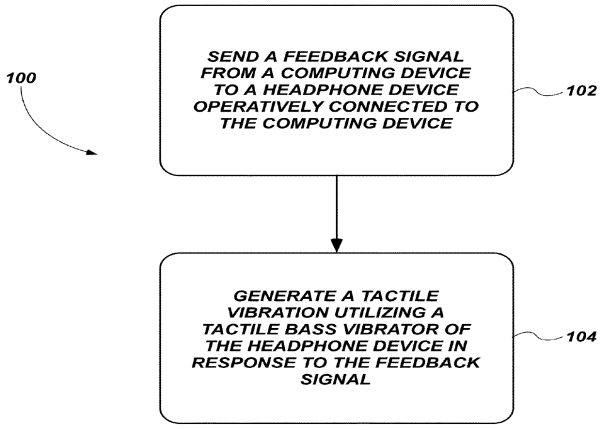

FIG. 1