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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BRAGI GmbH-P0017C2
	Application Number	
Title of Invention	Power Control for Battery Powered Personal Area Network Device System and Method	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

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Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

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All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BRAGI GmbH-P0017C2
	Application Number	
Title of Invention	Power Control for Battery Powered Personal Area Network Device System and Method	

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	133690		
Email Address	docketing@goodhue.com	Add Email	Remove Email

Application Information:

Title of the Invention	Power Control for Battery Powered Personal Area Network Device System and Method		
Attorney Docket Number	BRAGI GmbH-P0017C2	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
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Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	133690		

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BRAGI GmbH-P0017C2
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Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)	
	Continuation of	15837386	2017-12-11	

Prior Application Status	Patented					Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)	
15837386	Continuation of	15245031	2016-08-23	9843853	2017-12-12	

Prior Application Status	Expired			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)	
15245031	Claims benefit of provisional	62211767	2015-08-29	

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Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

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Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BRAGI GmbH-P0017C2
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☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BRAGI GmbH-P0017C2
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Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

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1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

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B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BRAGI GmbH-P0017C2
	Application Number	
Title of Invention	Power Control for Battery Powered Personal Area Network Device System and Method	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 — Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

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Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BRAGI GmbH-P0017C2
	Application Number	
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Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

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Organization Name	BRAGI GmbH

Mailing Address Information For Assignee including Non-Applicant Assignee:

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Address 2			
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Country i	DE	Postal Code	D-80331
Phone Number		Fax Number	
Email Address	pete.boesen@bragi.com		

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See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/JOHN D. GOODHUE/			Date (YYYY-MM-DD)	2018-09-27
First Name	John	Last Name	Goodhue	Registration Number	47603

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BRAGI GmbH-P0017C2
	Application Number	
Title of Invention	Power Control for Battery Powered Personal Area Network Device System and Method	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ABSTRACT OF THE DISCLOSURE

A system and method for managing wireless earpieces. Circuitry of the wireless earpieces are powered utilizing a high-power mode in response to detecting a magnetic field is not applied to one or more of the wireless earpieces. The power sent to the circuitry of the wireless earpieces is altered to a low power mode in response to detecting the magnetic field is applied to one or more of the wireless earpieces.

What is claimed is:

1. A method for power control for a wireless earpiece, comprising:

powering circuitry of the wireless earpiece utilizing a low power mode in response to detecting a magnetic field is applied to the wireless earpiece;

powering circuitry of the wireless earpieces utilizing a high-power mode in response to detecting a magnetic field is not applied to one or more of the wireless earpieces;

altering the power sent to the circuitry of the wireless earpiece to a high-power mode in response to detecting a magnetic field is not applied to one or more of the wireless earpieces;

altering the power sent to the circuitry of the wireless earpieces to a low power mode in response to detecting a magnetic field is applied to one or more of the wireless earpieces; and

charging an onboard battery of the wireless earpiece in response to detecting a magnetic field is applied to the wireless earpiece.

2. The method of claim 1, further comprising:

operating the wireless earpiece utilizing an onboard battery in response to detecting the magnetic field is not applied to the wireless earpiece.

3. The method of claim 1, wherein the magnetic field is applied by a magnet of a smart case configured to receive the wireless earpiece.

4. The method of claim 1, wherein the magnetic field is detected by a reed switch of the wireless earpiece.

5. The method of claim 1, further comprising:

coupling the wireless earpiece to a smart case, wherein the smart case applies a magnetic field to the wireless earpiece.

6. The method of claim 1, wherein the magnetic field is detected by a reed switch integrated in magnetic contacts that interface with a smart case for securing the wireless earpiece.

7. The method of claim 1, further comprising:

synchronizing data between the wireless earpiece and a smart case in response to detecting the magnetic field.

8. The method of claim 1, wherein the low power mode is a power saver mode.

9. A method for power control for a wireless earpiece, comprising:

determining if a magnetic field is present at the wireless earpiece in a powered state;

opening a reed switch located within the wireless earpiece when the magnetic field is detected and placing the wireless earpiece in a low-power mode;

coupling the wireless earpiece to a smart case;

charging a battery located within the wireless earpiece with power supplied by a second battery within the smart case;

remaining in a high-power mode if no magnetic field is detected; and

operating the wireless earpiece with power supplied by the battery within the wireless earpiece.

10. The method of claim 9, wherein the magnetic field is applied by a magnet of the smart case configured to receive the wireless earpiece.

11. The method of claim 10, wherein the magnetic field is detected by the reed switch of the wireless earpiece.

12. The method of claim 11, wherein the magnetic field is detected by the reed switch integrated in magnetic contacts interfacing with a smart case for securing the wireless earpiece.

13. The method of claim 12, further comprising the step of synchronizing data between the wireless earpiece and a smart case in response to detecting the magnetic field.

14. The method of claim 1, wherein the low power mode is a power saver mode.

TITLE: Power Control for Battery Powered Personal Area Network Device System and Method

PRIORITY STATEMENT

This application is a continuation of U.S. Non-Provisional Patent Application No. 15/837,386, filed December 11, 2017 and claims priority to U.S. Patent No. 9,843,853, filed on August 23, 2016 and U.S. Provisional Patent Application No. 62/211,767, filed on August 29, 2015 all of which are titled Power Control Battery Powered Personal Area Network Device System and Method all of which are hereby incorporated by reference in their entireties.

BACKGROUND

I. Field of the Disclosure

The present invention relates to wireless electronics and battery systems. More specifically, but not exclusively, the present invention relates to wireless earpieces managing and extending battery life.

II. Description of the Art

The growth of wearable devices is increasing exponentially. This growth is fostered by the decreasing sizes of microprocessors, circuit boards, chips, and other components. Wearable devices are necessarily dependent upon their batteries to complete their desired function. The overall utility of wearable devices is directly proportional to the battery life of the devices. If the battery life is poor, the user interface and user experiences suffer as too much time and attention are required for retrieving the device, recharging or replacing the battery, and repositioning the wearable device. Operation and conservation of the battery life of the wearable device may be further complicated if the there is no inclusion of an on/off button or switch to conserve precious battery life.

SUMMARY OF THE DISCLOSURE

The illustrative embodiments provide a system and method for managing wireless earpieces. Circuitry of the wireless earpieces are powered utilizing a high-power mode in response to detecting a magnetic field is not applied to one or more of the wireless earpieces. The power sent to the circuitry of the wireless earpieces is altered to a low power mode in response to detecting the magnetic field is applied to one or more of the wireless earpieces.

Another embodiment provides a wireless earpiece. The wireless earpiece includes circuitry for operating the wireless earpiece. The wireless earpiece also includes a battery for powering the circuitry of the wireless earpiece. The wireless earpiece further includes a reed switch connecting the battery to the circuitry. The reed switch connects the circuitry to the battery when a magnetic field is not detected. The reed switch disconnects the circuitry from the battery when a magnetic field is detected.

Yet another embodiment provides a wireless earpiece comprising a processor for executing a set of instructions and a memory for storing the set of instructions. The set of instructions are executed to power circuitry of the wireless earpiece in a high-power mode utilizing an onboard battery in response to a reed switch not detecting a magnetic field and powering the circuitry to a low power mode in response to detecting the magnetic field is applied to the reed switch.

According to another aspect, a smart case including a smart case housing, a first receptacle for receiving a left earpiece disposed within the smart case housing, a second receptacle for receiving a right earpiece disposed within the smart case housing, and a first interface associated with the first receptacle for electrically connecting the smart case to the left earpiece. The smart case further includes a second interface associated with the second receptacle for electrically connecting the smart case to the right earpiece, and an intelligent control disposed within the smart case housing and operatively connected to the first interface and the second interface. The smart case may include at least one manual input operatively connected to the intelligent control. The smart case may include at least one display operatively connected to the intelligent control. The smart case may include a display moveably connected to the smart case housing so the display transitions from a first position to a second position.

BRIEF DESCRIPTION OF THE DRAWINGS

Illustrated embodiments of the present invention are described in detail below with reference to the attached drawing figures, which are incorporated by reference herein, and where:

Fig. 1 is a pictorial representation of a smart case and wireless earpieces in accordance with an illustrative embodiment;

Fig. 2 is a top view of the smart case of FIG. 1 in accordance with an illustrative embodiment;

Fig. 3 is a side view of the smart case of FIG. 1 in accordance with an illustrative embodiment; and

Fig. 4 is a block diagram of a smart case in accordance with an illustrative embodiment; and

Fig. 5 is a flowchart of a process for utilizing wireless earpieces with a smart case in accordance with an illustrative embodiment.

DETAILED DESCRIPTION OF THE DISCLOSURE

The illustrative embodiments provide a system, method, and wireless earpieces for managing and preserving battery life. The wireless earpieces may interact with a smart case to perform various actions. For example, the smart case may be utilized to preserve the battery life of the wireless earpieces by interacting with the wireless earpieces while in a low power mode or state. In addition, the smart cases may ensure the wireless earpieces are charged to a desired level. Charging may be performed utilizing contact or wirelessly (e.g., inductive charging). The smart case may communicate with the wireless earpieces through physical interactions (e.g., magnetic contact points, physical switches, etc.) or through wireless connections, standards, or protocols (e.g., near field communications, Bluetooth, Wi-Fi, etc.). The wireless earpieces may upload, synchronize, or store biometric and performance data associated with the wireless earpieces and/or associated user to the smart case.

In one embodiment, a reed switch may be utilized in the wireless earpieces to activate and deactivate each of the wireless earpieces. The reed switch is an electrical switch operated by an applied magnetic field. The magnetic field may be provided by a magnet of the smart case thereby turning the wireless earpieces on and off. The integration of the reed switches in the wireless earpieces may reduce the need for costly device components or interfaces. As a result, the weight and footprint of the wireless earpieces may be reduced significantly while increasing the ease of use for the users of the wireless earpieces.

Turning now to Figs. 1-3, these figures show a pictorial representation of a smart case 102 and wireless earpieces 142, 144 in accordance with an illustrative embodiment. The smart case 102 may be an open or enclosed case for securing, charging, and managing the wireless earpieces 142, 144. The wireless earpieces 142, 144 may be referred to as a pair (wireless earpieces) or singularly (wireless earpiece). The description may also refer to components and functionality of each of the wireless earpieces 142, 144 collectively or individually. In one embodiment, the wireless earpieces 142, 144 include a set of left and right ear pieces configured to fit into a user's ears. The wireless earpieces 142, 144 may be configured to play music or audio, receive and make phone calls or other communications, read user biometrics and actions (e.g., heart rate, motion, sleeping, etc.).

In another embodiment, the wireless earpieces 142, 144 may represent wireless devices ingested or implanted into a user. For example, the smart case 102 may be configured to work with an endoscopic pill, pacemaker, tracking device, contact lenses, oral implants, bone implants, artificial organs, or so forth. The smart case 102 may act as a logging tool for receiving information, data, or measurements made by the wireless devices. For example, the smart case 102 may be attached to a belt or worn by the user to download data from the wireless device(s) in real-time. As a result, the smart case 102 may be utilized to store, charge, and synchronize data for the wireless earpieces 142, 144 in any number of embodiments.

The smart case 102 encloses a battery, and various another circuitry (not shown). The battery of the smart case 102 may be utilized to charge the wireless earpieces 142, 144 through direct contact or wirelessly. As a result, the smart case 102 may act as a custom charger for ensuring the proper power management and functionality of the wireless earpieces 142, 144. For example, the battery of the smart case 102 may be utilized to charge the wireless earpieces 142,

144 any number of times before the smart case 102 and corresponding battery may require charging. In one embodiment, the smart case 102 may include one or more solar panels, or surfaces configured to charge the smart case 102 utilizing ambient or direct sunlight. The smart case 102 ensures the duty cycle of the wireless earpieces 142, 144 are maximized by properly maintaining power levels. For example, the smart case 102 may keep the wireless earpieces 142, 144 fully charged during a time of inactivity, such as before being purchased (e.g., on a shelf or as part of inventory) or once purchased.

In one embodiment, the smart case 102 include a frame 103. The frame 103 is a support structure for the components of the smart case 102 and may be formed of a rigid plastic, polymer, or other similar material. However, any number of other suitable materials, such as composites, rubber, wood, metal, or so forth, may be utilized. The frame 103 defines receptacles 104, 106 are configured to receive the wireless earpieces 142, 144, respectively. In one embodiment, the receptacles 104, 106 are shaped to fit the external size, shape, and configuration of the wireless earpieces 142, 144.

As a result, an interference fit may secure the wireless earpieces 142, 144 within the frame 103 while the smart case 102 is being moved or otherwise utilized. In one embodiment, the smart case 102 may include a hinged, magnetic, sleeve, or snap on lid to cover the wireless earpieces 142, 144 when positioned within the receptacles 104, 106 of the smart case 102. For example, the cover may make the smart case 102 waterproof and further secure the wireless earpieces 142, 144. In another embodiment, the smart case 102 may also include a removable cover (e.g., neoprene, zip up, snapping, etc.). In yet another embodiment, the cover encases a screen, such as a touch screen. The screen may roll, bend or adapt to the shape and configuration of the smart case 102. The touch screen may also be transparent. The screen may be movably connected to the to the smart case to transition from a first position to a second position by sliding, gliding or through other movement.

The smart case includes interfaces 108, 110 within the receptacles 104, 106. The interfaces 108, 110 are hardware interfaces for electrically connecting the wireless earpieces 142, 144 to the smart case 102. The interfaces 108, 110 may include any number of contact points, busses, wires, or other physical connectors for interfacing the wireless earpieces 142, 144, with the smart case 102. The interfaces 108, 110 may alternatively include inductive chargers for charging the wireless

earpieces 142, 144. In one embodiment, the interfaces 108, 110 are magnetic for automatically coupling with contact points or interfaces of the wireless earpieces 142, 144. In another embodiment, the interfaces 108, 110 may represent male (or alternatively female) connectors for interfacing with the wireless earpieces 142, 144, such as micro-USB, or other developing miniature external connectors. The interfaces 108, 110 may be utilized to charge the wireless earpieces 142, 144. Wireless charging is also contemplated utilizing an inductive charger integrated in the smart case 102 or other charging devices compatible with the wireless earpieces 142, 144. The interfaces 108, 110 may also be utilized to synchronize data between the wireless earpieces 142, 144.

In one embodiment, the interfaces 108, 110 may each include a magnet activating the corresponding reed switch (i.e., reed switch 146 described below) to power off or initiate a low power mode (e.g., lower power state or mode) for one or both of the wireless earpieces 142, 144 when one or more of the wireless earpieces 142, 144 are placed within the receptacles 104, 106. In another embodiment, the wireless earpieces 142, 144 and the smart case 102 may interact to control a device reset function. For example, the wireless earpieces 142, 144 may synchronize captured data with the smart case 102 before moving to a low power mode in anticipation of being charged. A switch may be activated mechanically, magnetically, inductively, electrically, or wirelessly to move the wireless earpieces 142, 144 to a low power mode in anticipation of being charged. Control of the wireless earpieces 142, 144 may be independent for each of the wireless earpieces 142, 144, subject to control one of the wireless earpieces designated as a master device, controlled by the smart case, or may be shared between devices.

The smart case 102 may also include a port 112. The port 112 may be utilized to interface with the smart case 102. For example, the port 112 may be utilized with a connector to charge the battery of the smart case 102. The port 112 may also be utilized to download or upload data stored by the smart case 102 previously stored in the wireless earpieces 142, 144. The port 112 may be a miniaturized port, such as USB Type C, micro-USB, or other miniaturized port suitable for connecting to another electronic device, such as a wall charger, desktop computer, laptop, or wireless device (e.g., smart phone, tablet, etc.). In another embodiment, the smart case 102 may include a dedicated port for charging, such as for receiving a male direct-current (DC) connector.

In one embodiment, the interfaces, 108, 110 or another portion of the smart case 102 as well as the wireless earpieces 142, 144 may include a near field communication (NFC) chip for

communications. For example, NFCs may be utilized to determine the wireless earpieces 142, 144 are proximate the smart case 102 for performing power management as is herein described. NFC may also be utilized to identify the wireless earpieces 142, 144 associated with a smart case 102. In other embodiments, different communications protocols (e.g., Bluetooth, Wi-Fi, etc.), standards, or passive readers (e.g., radio frequency identification tags, etc.) may be utilized for the wireless earpieces 142, 144 to communicate with the smart case 102. For example, the wireless earpieces 142, 144 may initiate a change in a power state in response to being placed in or near the smart case 102. The smart case 102 may be programmed with a threshold distance (e.g., 10 cm, 1 foot, etc.) to determine when the wireless earpieces 142, 144 are proximate the smart case 102 or may rely on the inherent maximum communications distances of the wireless standard or protocol being utilized (e.g., NFC, RFID, etc.). In another embodiment, biometric readings, such as heart beat or temperature may be utilized by the wireless earpieces 142, 144 and smart case 102 to alter the power mode or status of the wireless earpieces 142, 144, as well as the smart case 102 (e.g., may be placed in a low power mode). For example, if the wireless earpieces 142, 144 are near the smart case 102 and no heart beat is detected, the smart case 102 may send a command for the wireless earpieces 142, 144 to shut themselves down or enter a low power mode with minimum functionality. In one embodiment, power to onboard sensory arrays may be terminated and only essential functions remain on. For example, in the low power mode allows charging of the wireless earpieces 142, 144 and/or smart case 102 and uploads/downloads to the wireless earpieces 142, 144 while in the low power mode.

The wireless earpieces 142, 144 may each include a reed switch 146. The reed switch 146 may operate in a closed mode 148 when no magnetic field is present or in an open mode 150 when a magnetic field is present. The magnetic field may be supplied by one or more magnets of the smart case, such as magnet 114. As a result, the reed switch 146 may be in the closed mode 148 when outside the smart case 102 and in the open mode 150 when in the smart case 102.

In one embodiment, the magnet 114 may be integrated in a sidewall of the receptacle 104. Each of the receptacles 104, 106 may include magnets for the wireless earpieces 142, 144. As a result, proximity to the magnet 114 and reed switch 146 may engage the reed switch 146 to the open mode 150. As a result, the wireless earpiece 142 may be charged by the smart case.

Removal of the wireless earpiece 142 disengages the reed switch 146 resulting in the wireless earpiece 142 functioning under its own power.

In another embodiment, the magnet 114 may be integrated in the interface 108. For example, the interface 108 may include magnetic contacts engaging the reed switch 146. The reed switch 146 may be positioned anywhere on or within the wireless earpiece 142. Similarly, the magnet 114 may be positioned anywhere within the smart case 102 (or integrated with any component) allowing the magnet 114 to interact with the reed switch 146 when the wireless earpiece 142 is seated within the receptacle 104. The case may have at least one button 119 or other manual input. The button may be touch sensitive, lighted, or mechanical. There also may be a light such as a LED in the location.

In another embodiment, each of the wireless earpieces 142, 144 may include a magnet so the wireless earpieces 142, 144 may be positioned together to turn off the wireless earpieces 142, 144 when not in use. For example, the magnets and reed switches may be positioned to simultaneously deactivate the wireless earpieces 142, 144. The magnets may also serve another purpose in allowing the wireless earpieces 142, 144 to be stuck to metal objects (e.g., desk, refrigerator, decorations, etc.) when not in use to prevent the wireless earpieces 142, 144 from being dropped or lost.

Fig. 4 is a block diagram of a smart case 402 in accordance with an illustrative embodiment. FIG. 4 shows a wireless environment 400 in which wireless earpieces 401 communicate with and are stored within the smart case 402. The smart case 402 may have any number of configurations and include various circuitry, connections, and other components. The smart case 402 is one potential embodiment of the smart case 102 of FIGs. 1-3.

In one embodiment, the smart case 402 may include a battery 404, a logic engine 406, a memory 408, interfaces 410, 411, a transceiver 412, and a magnet 414. The battery 404 is a power storage device configured to charge the power storage system of the wireless earpieces 401 once or multiple times. In other embodiments, the battery 404 as well as the batteries of the wireless earpieces 401 may represent a fuel cell, thermal electric generator, piezo electric charger, solar charger, ultra-capacitor, or other existing or developing power storage technologies.

In another embodiment, the smart case 402 may include a touch interface or display. The touch interface may indicate the status of the smart case 402. For example, a light may indicate the battery status of the smart case 402 as well as connected wireless earpieces 401, download/synchronization status (e.g., synchronizing, complete, last synchronization, etc.), or other similar information.

The battery 404 may itself be charged through an interface 410. The interface 410 is a hardware interface for connecting the smart case to a power supply or other electronic device. The interfaces 410 may be utilized for charging as well as communications with externally connected devices. For example, the interface 410 may represent a mini-USB, micro-USB or other similar miniature standard connector.

The interface 411 is hardware interface for connecting and communicating with the wireless earpieces 401. The interface 411 may include any number of pins, arms, or connectors for electrically interfacing with the contacts or other interface components of the wireless earpieces 401. In one embodiment, the interface 411 is a magnetic interface automatically coupling to contacts or an interface of the wireless earpieces 401. In another embodiment, the interface 411 may include a wireless inductor for charging the wireless earpieces 401 without a physical connection.

The logic engine 406 is the logic controlling the operation and functionality of the smart case 402. The logic engine 406 may include circuitry, chips, and other digital logic. The logic engine 406 may also include programs, scripts, and instructions implemented to operate the logic engine 406. The logic engine 406 may represent hardware, software, firmware, or any combination thereof. In one embodiment, the logic engine 406 may include one or more processors, such as microprocessors. The logic engine 406 may also represent an application specific integrated circuit (ASIC) or field programmable gate array (FPGA).

For example, a processor included in the logic engine 406 is circuitry or logic enabled to control execution of a set of instructions. The processor may be one or more microprocessors, digital signal processors, application-specific integrated circuits (ASIC), central processing units, or other devices suitable for controlling an electronic device including one or more hardware and software elements, executing software, instructions, programs, and applications, converting and processing signals and information, and performing other related tasks. The processor may also

manage transmission and reception of audio and data, GPS information, wireless LAN, GSM, or LTE, SIM or data cards, or so forth. The processor may be a single chip or integrated with other computing or communications elements of the smart case 402.

The memory 408 is a hardware element, device, or recording media configured to store data for subsequent retrieval or access later. The memory 408 may be static or dynamic memory. The memory 408 may include a hard disk, random access memory, quantum computing drive, cache, removable media drive, mass storage, or configuration suitable as storage for data, instructions, and information. In one embodiment, the memory 408 and the logic engine 406 may be integrated. The memory may use any type of volatile or non-volatile storage techniques and mediums. The memory 408 may store information related to the status of the smart case 402 as well as the wireless earpieces 401.

The transceiver 412 is a component comprising both a transmitter and receiver which may be combined and share common circuitry on a single housing. The transceiver 412 may communicate utilizing Bluetooth, Wi-Fi, ZigBee, ANT+, near field communications, wireless USB, infrared, mobile body area networks, ultra-wideband communications, cellular or other suitable radio frequency standards, networks, protocols, or communications. The transceiver 412 may also be a hybrid transceiver supporting several different communications. For example, the transceiver 412 may communicate with the wireless earpieces 401 utilizing NFC or various Bluetooth communications.

The components of the smart case 402 may be a multi-layer printed circuity board (PCB) electrically connected utilizing any number of wires, contact points, leads, busses, wireless interfaces, or so forth. In addition, the smart case 402 may include any number of computing and communications components, devices or elements which may include busses, motherboards, circuits, ports, interfaces, cards, converters, adapters, connections, transceivers, displays, antennas, and other similar components.

Although not specifically shown, the smart case 402 may communicate with any number of other networks or devices to log information. For example, the smart case 402 may access a portal to store information related to the data acquired by the wireless earpieces 401 and/or smart case 402. The portal may be a web site functioning as a central point of access to information on the Internet or an intranet. The portal may be accessed from any computing or communications

system or device enabled to communicate through a network connection. For example, information accessed by the portal may be stored on a server and an associated database. In another embodiment, the smart case 402 may include a port for receiving a data or communication card (e.g., SIM card, micro SD card, etc.). The data or communications cards may be utilized to store information and may be utilized for data communications.

The wireless earpieces 401 may include components like those shown for the smart case 402 miniaturized and compacted to fit within the three-dimensional footprint of the wireless earpieces 401. Although not shown, the wireless earpieces 401 may include circuitry for operating the device including a logic engine (e.g., microprocessor), memory, and transceiver all of which are powered by an onboard battery.

In one embodiment, the wireless earpieces 401 may each include a reed switch 416. The reed switch 416 may initiate a low power mode of the wireless earpieces 402 when activated (e.g., opened) by the magnet 414 of the smart case 402. As a result, the wireless earpieces 401 may move to a lower power mode when positioned within the smart case 402. Similarly, the reed switch 416 may initiate a self-power (or high power) mode when deactivated (e.g., closed) by the magnet 414 of the smart case 402. During the low power mode, the wireless earpieces 401 may synchronize data with the memory 408 of the smart case 402. In addition, the wireless earpieces may perform maintenance of a real-time clock and maintain other essential onboard software programs. The wireless earpieces 401 may also perform hardware and software verification upon moving to or from a high-power mode to ensure proper operation of the wireless earpieces 401. In another embodiment, activation of the reed switch 416 by the magnet 414 may move the wireless earpieces 401 to their lowest power mode during which minimal required functions may be performed (e.g., software updates, data synchronization, clock updates, etc.). As a result, the wireless earpieces 416 may be fully activated and ready for use when positioned in a user's ears. The reed switch 416 allows precise initiation and deactivation of the onboard battery to maintain optimal levels of onboard power.

Fig. 5 is a flowchart of a process for utilizing a wireless earpiece with a smart case in accordance with an illustrative embodiment. In one embodiment, the processes of FIG. 5 may be implemented by one or more wireless earpieces interfacing or coupling with a smart case. The smart case may interact with the wireless earpieces individually or as a unit. In one example, the

smart case may only interact with a master earpiece with subsequent control signals and commands relayed by the master wireless earpiece to the slave or subservient wireless earpiece.

In one embodiment, the process may begin with the wireless earpiece determining whether a magnetic field is present (step 502). In one embodiment, the determination of step 502 may be made based on the interaction of a magnet (or magnetic field) with a reed switch of the wireless earpiece. In another embodiment, logic or a processor may also be utilized to determine if the magnetic field is present. The magnet may be a permanent magnet, electromagnet, temporary, or hybrid magnet.

If the magnetic field is not present, the wireless earpiece remains powered on as the reed switch remains closed (step 504). When the reed switch is closed the onboard battery of the wireless earpiece powers and operates the wireless earpiece to ensure full functionality. In one embodiment, if the wireless earpieces have gone from detecting the magnetic field to not detecting the magnetic field (e.g., wireless earpieces were removed from the smart case), a startup process for the wireless earpiece may be initiated. For example, the battery may power the circuitry of the wireless earpiece executing a boot up program and preparing the wireless earpiece for operation.

Next, the wireless earpiece operates utilizing the onboard battery (step 506). During step 504, the wireless earpiece operates normally with the onboard battery powering the circuitry and components of the wireless earpiece. For example, the wireless earpiece may communicate with another electronic device, such as a cell phone, laptop, gaming device, music player, or so forth, to make calls, play music or sounds, or otherwise interact. The wireless earpiece may continuously determine whether the magnetic field is present.

If the magnetic field is determined to be present in step 502, the reed switch is opened by the magnetic field (step 508). The reed switch is opened automatically based on its nature and configuration when the magnetic field is present. In one embodiment, the wireless earpiece may move to a low power mode to preserve battery life when in the reed switch is activated potentially indicating the wireless earpiece is within the smart case. The wireless earpiece may alternatively enter a reduced power mode, sleep, or other mode. The wireless earpiece may also send a command or communication to the second wireless earpiece to change power mode or otherwise act in response to the reed switch being opened. In one embodiment, by moving the device to a low power mode, the wireless earpiece, the wireless earpiece is prepared to be charged. In another

embodiment, the wireless earpieces may enter a low power mode in response to detecting proximity to the smart case before entering a low power mode based on activation of the reed switch by a magnet of the smart case.

Next, the wireless earpiece couples to the smart case (step 510). The coupling of the smart case and the wireless earpiece may be based on contact, proximity, or short-range wireless communications. The wireless earpiece may connect to or link with the smart case utilizing points of contact, male and female connectors, or so forth. For example, magnetic contacts may be utilized between the smart case and wireless earpiece to provide a physical interface. The wireless earpieces may utilize contacts to preserve the waterproof nature of the wireless earpieces. During step 510, communications between the wireless earpiece and smart case may also be initiated. For example, data from the wireless earpiece may be synchronized to the smart case.

In another embodiment, the wireless earpiece may be detected wirelessly. For example, the wireless earpiece may be detected by the smart case utilizing an NFC signal, radio frequency identification tag, or other short-range communications signal. In one embodiment, the wireless earpiece may be required to be within a threshold distance (e.g., 10 feet, 10cm, etc.) to be detected by the smart case. Once the wireless earpiece is proximate the smart case, the smart case may begin to implement any number of actions for the wireless earpiece as well as the smart case. For example, the wireless earpiece may begin a move to a low power mode in anticipation of being coupled to the smart case or may enter a low power mode.

Next, the wireless earpiece charges the onboard battery based on power provided by the smart case (step 512). During step 512, the wireless earpiece may determine whether a charge is required for the wireless earpiece. For example, a charge threshold may be utilized by the battery. If a charge is not required, the wireless earpiece does not receive power from the smart case. In one embodiment, the wireless earpiece may automatically charge the onboard battery in response to determining the battery status is anything less than 95%. The wireless earpiece may also charge the onboard battery in response to a designated time elapsing, such as two days, to ensure the batteries are fully functional and kept at full capacity. Maintenance of the batteries may be particularly important when being stored after manufacturing, during a sales period, or during extended periods of non-use. Although referred to as batteries, the batteries for each of the wireless

earpieces may represent ultra-capacitors, fuel cells, heat pump power generators, or other power storage or generation devices.

In another embodiment, during step 510 or 512 the wireless earpiece may download or synchronize data with the smart case. The data may include biometric information (e.g., pulse rate, oxygenation, distance travelled, calories burned, etc.), exercise information, commands received, and other data logged by sensors (e.g., heart rate monitor, pulse oximeter, accelerometers, gyroscopes, etc.) of the wireless earpiece or otherwise determined. The data may represent user data or data about the performance of the wireless earpieces. In one embodiment, only new data gathered by the wireless earpieces may be synchronized to the smart case. The data may also include medical information, such as blood measurements, voice data (e.g., jitter/shimmer rates), temperature, chemical levels (e.g., sodium, glucose, etc.), ambient environment information (e.g., temperature, altitude, barometric readings, speed, etc.) captured audio or video, or so forth.

During any of steps 508-510, the wireless earpiece may enter a power saver or low power mode. During the power saver mode, the wireless earpiece may utilize minimal power to maintain functionality and alert status of the wireless earpiece. For example, the wireless earpiece may be configured to communicate with one or more other external devices, such as the smart case, another pair of wireless earpieces, mobile devices, personal computers, routers, or so forth. Location data of the user may be shared with other external devices and corresponding applications. In the power saver mode, the wireless earpiece minimizes power utilization while still exerting full control over the power utilization, charging, and synchronization of the wireless earpieces. The low power mode maintains the earpieces with minimal functionality to charge and synchronize data as well as other designated functions set by user preferences, default, program updates from a central location, or so forth. As a result, the battery of the wireless earpieces may be maintained in an optimal state. In addition, the transition from the low power mode to a high-power mode may be implemented upon detecting the wireless earpieces have been removed from the smart case.

The illustrative embodiments are not to be limited to the embodiments described herein. The illustrative embodiments contemplate numerous variations in the type of ways in which embodiments may be applied. The foregoing description has been presented for purposes of

illustration and description. It is not intended to be an exhaustive list or limit any of the disclosure to the precise forms disclosed. It is contemplated other alternatives or exemplary aspects are considered included in the disclosure. The description is merely examples of embodiments, processes or methods of the invention. It is understood any other modifications, substitutions, and/or additions may be made, which are within the intended spirit and scope of the disclosure. For the foregoing, it can be seen the disclosure accomplishes at least all the intended objectives.

The previous detailed description is of a small number of embodiments for implementing the invention and is not intended to be limiting in scope. The following claims set forth several the embodiments of the invention disclosed with greater particularity.

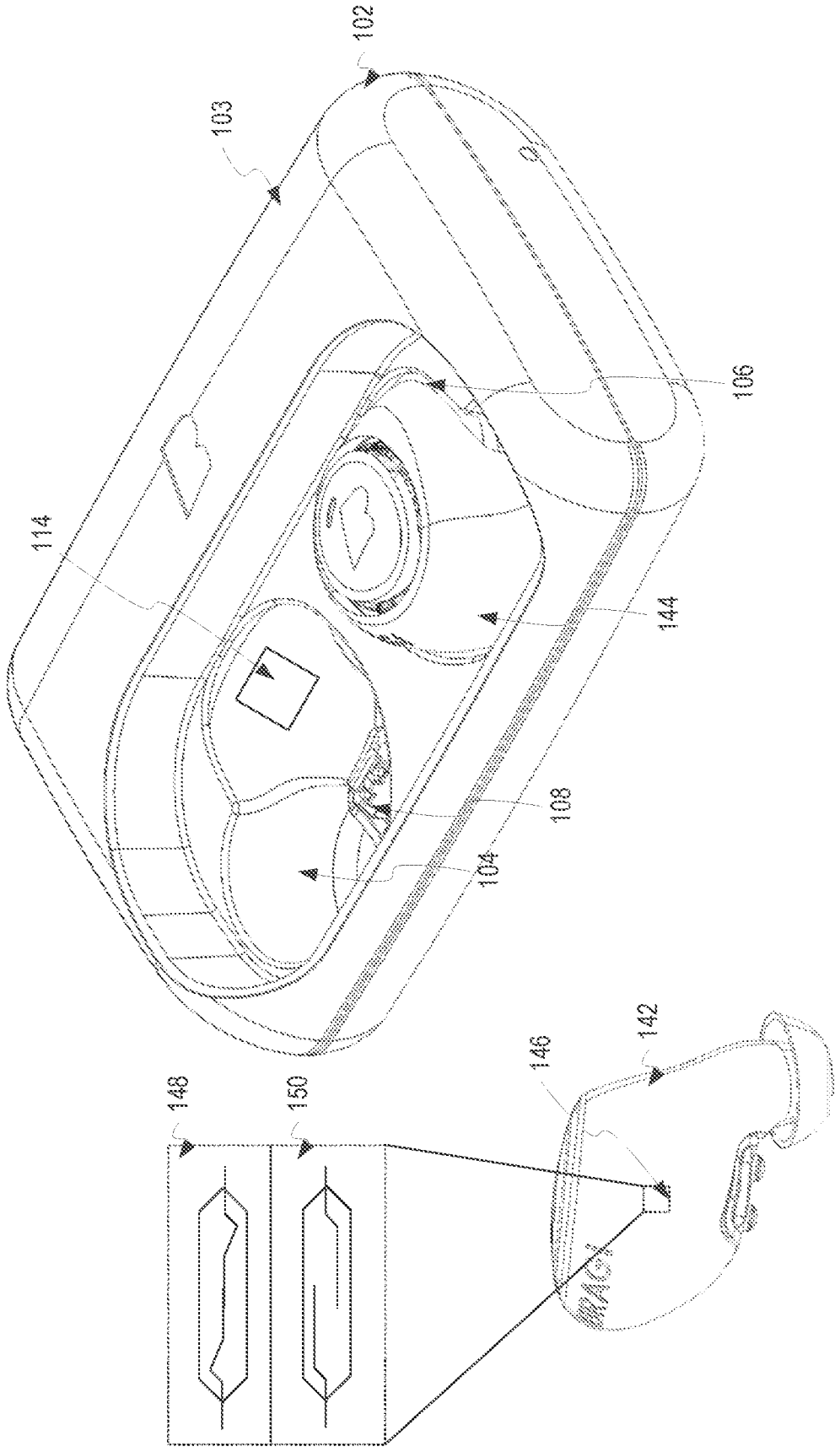


FIG. 1

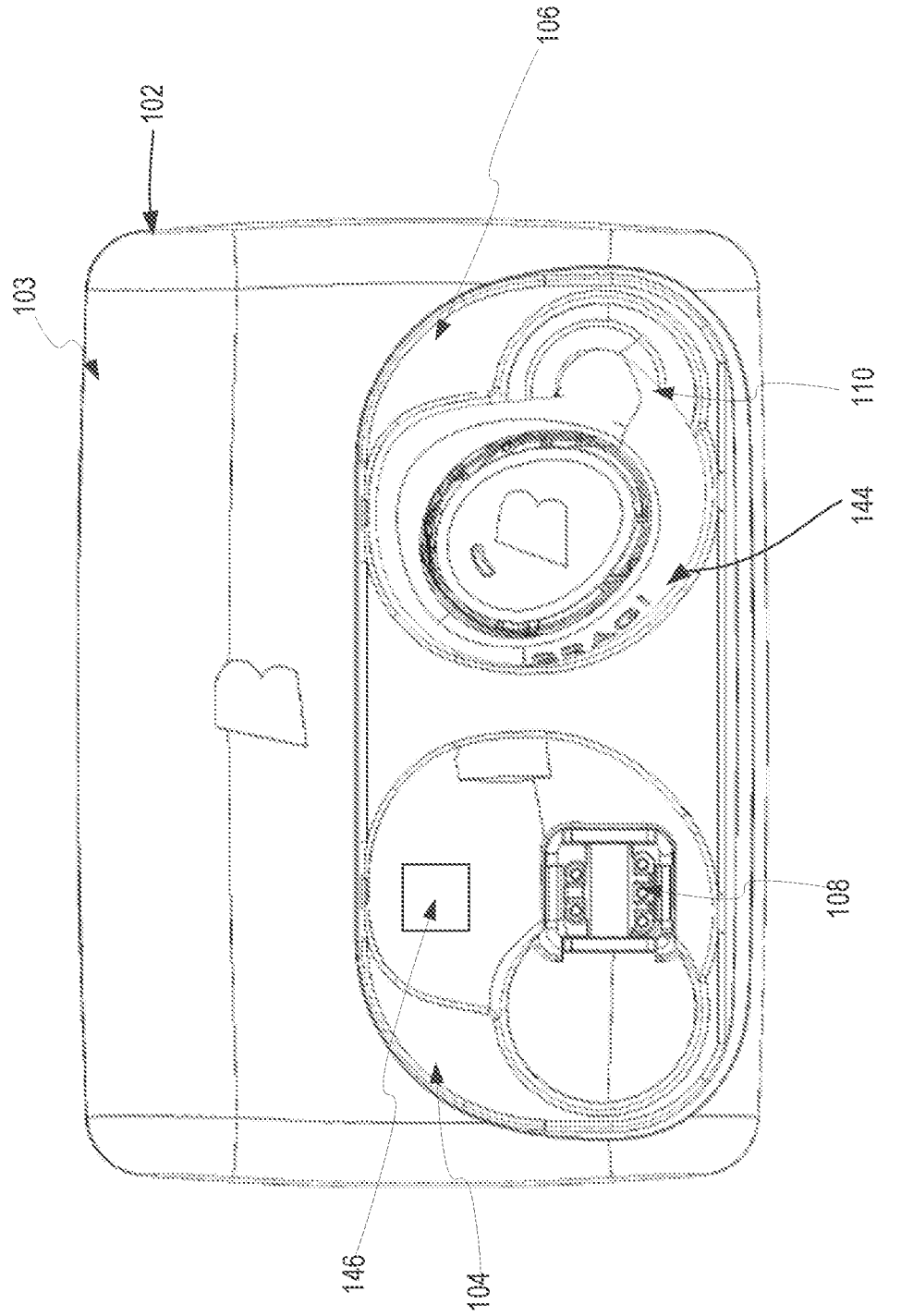


FIG. 2

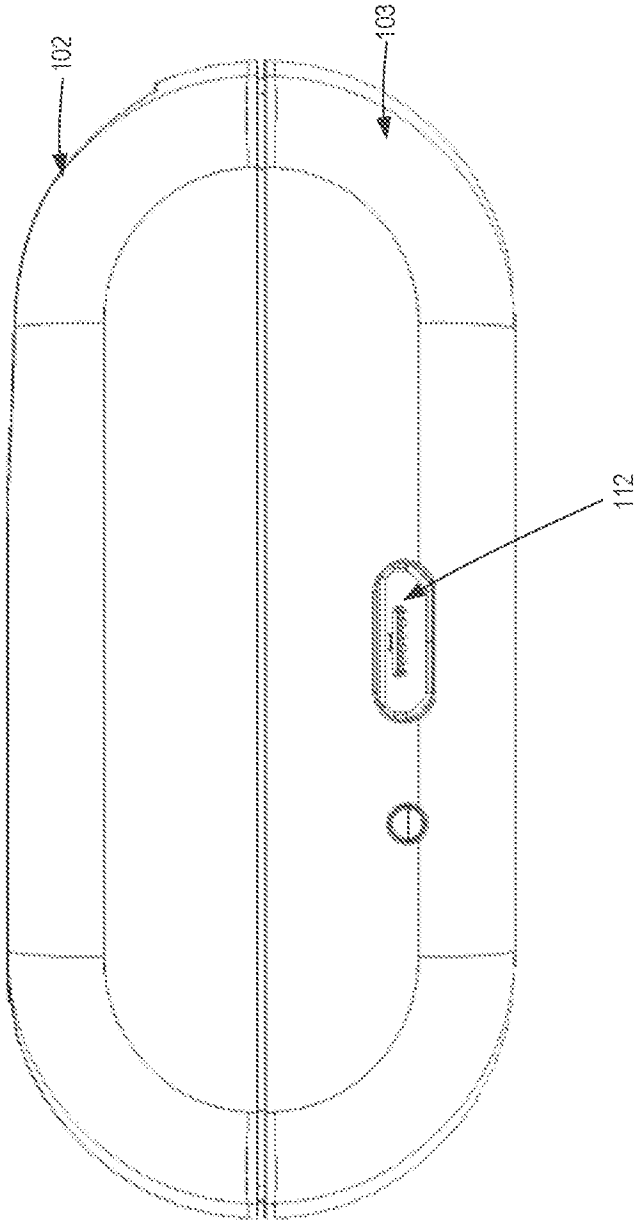


FIG. 3

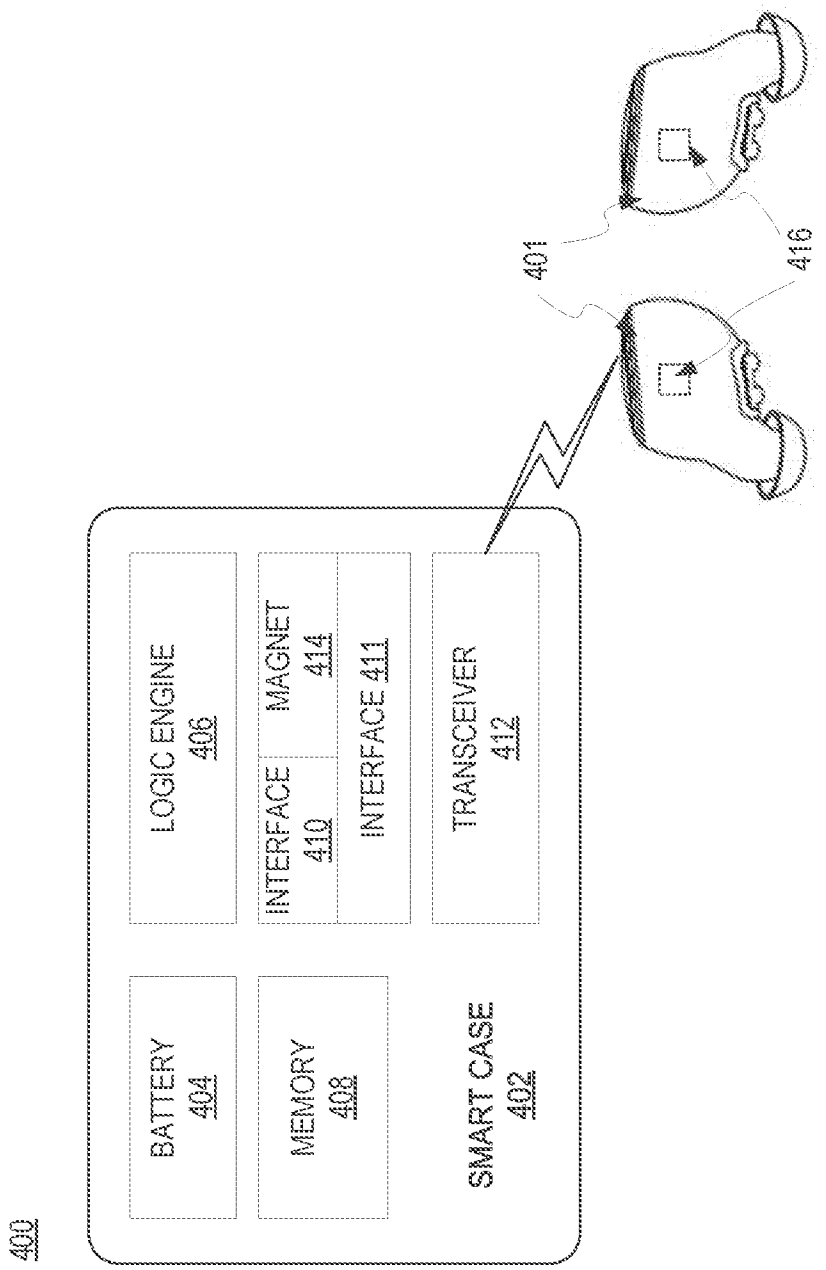

400
SMART CASE 402
BATTERY 404
MEMORY 408
LOGIC ENGINE 406
INTERFACE 410
MAGNET 414
INTERFACE 411
TRANSCEIVER 412
401
416

FIG. 4

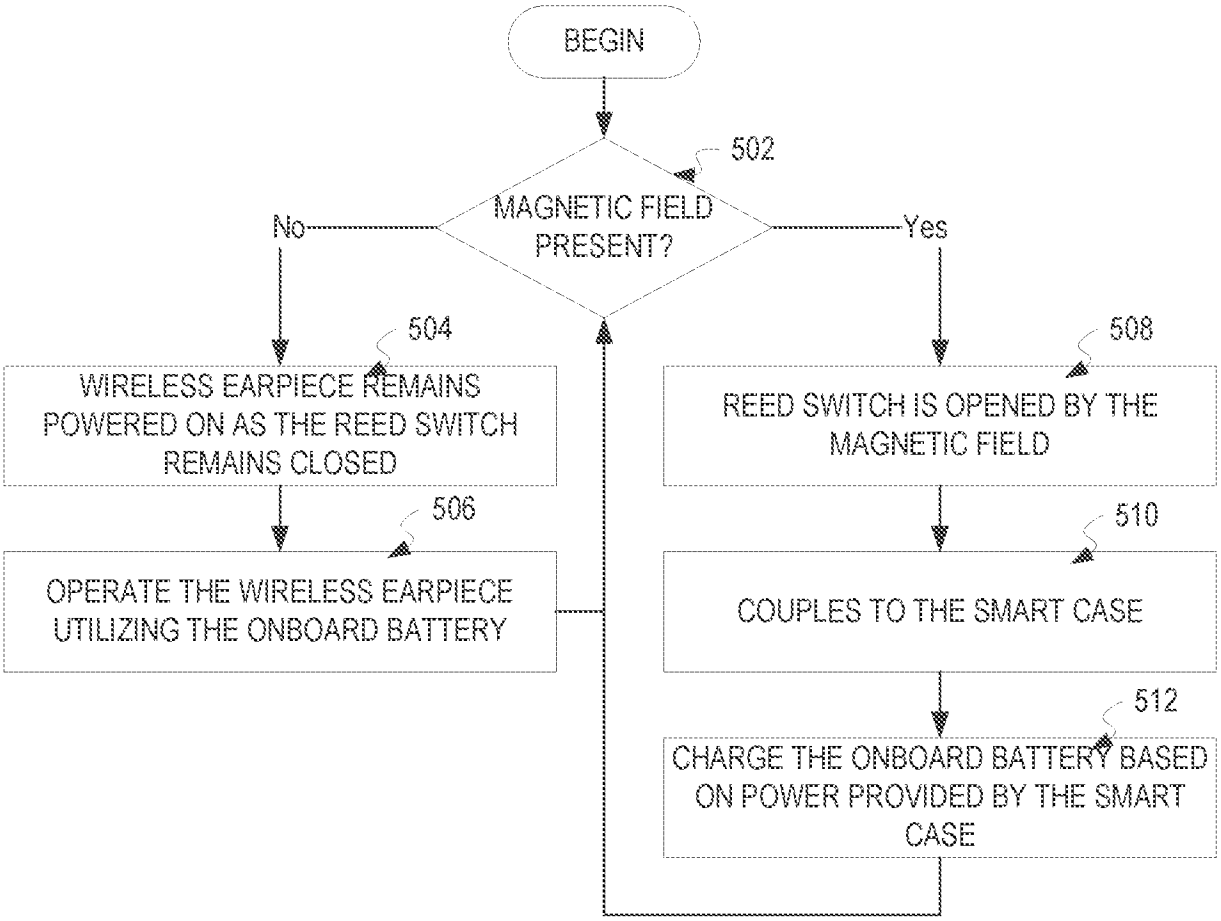

BEGIN
502
MAGNETIC FIELD PRESENT?
No
Yes
504
WIRELESS EARPIECE REMAINS POWERED ON AS THE REED SWITCH REMAINS CLOSED
506
OPERATE THE WIRELESS EARPIECE UTILIZING THE ONBOARD BATTERY
508
REED SWITCH IS OPENED BY THE MAGNETIC FIELD
510
COUPLES TO THE SMART CASE
512
CHARGE THE ONBOARD BATTERY BASED ON POWER PROVIDED BY THE SMART CASE

FIG. 5

PTO/AIA/01 (08-12)
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	Power Control for Battery Powered Personal Area Network Device System and Method

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 15/245,031

filed on 2016-08-23

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

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LEGAL NAME OF INVENTOR

Inventor: Eric Christian Hirsch Date (Optional):

Signature: Eric Christian Hirsch

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/01 (06-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	Power Control for Battery Powered Personal Area Network Device System and Method

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

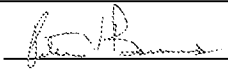
I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Peter Vincent Boesen Date (Optional) :_____

Signature: 

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	Power Control for Battery Powered Personal Area Network Device System and Method
First Named Inventor/Applicant Name:	Eric Christian Hirsch
Filer:	John Darrell Goodhue/Ashlyn Nguyen
Attorney Docket Number:	BRAGI GmbH-P0017C2

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	75	75
UTILITY SEARCH FEE	2111	1	330	330
UTILITY EXAMINATION FEE	2311	1	380	380
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**785**

Electronic Acknowledgement Receipt

EFS ID:	33851097
Application Number:	16144338
International Application Number:	
Confirmation Number:	3503
Title of Invention:	Power Control for Battery Powered Personal Area Network Device System and Method
First Named Inventor/Applicant Name:	Eric Christian Hirsch
Customer Number:	133690
Filer:	John Darrell Goodhue/Ashlyn Nguyen
Filer Authorized By:	John Darrell Goodhue
Attorney Docket Number:	BRAGI GmbH-P0017C2
Receipt Date:	27-SEP-2018
Filing Date:	
Time Stamp:	15:43:47
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$785
RAM confirmation Number	092818INTEFSW00002695506801
Deposit Account	506801
Authorized User	Ashlyn Nguyen

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.17 (Patent application and reexamination processing fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	BRAGIGmbH-P0017C2_USPTO_AIA14.pdf	1874235 f8810e6f0350d3862caedd47b7099e9d20c1ae70	no	9
Warnings:					
Information:					
2		BRAGIGmbH-P0017C2_NON_PROVISIONAL_PATENT_APPLICATION.pdf	186208 7edd1e8cb79102f6f4390df0c7320a0935e6834c	yes	19

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Abstract	19	19
	Claims	16	18
	Specification	1	15

Warnings:					
Information:					
3	Drawings-only black and white line drawings	Visio-BRAGIGmbH-P0017C2_FIGS_efs.pdf	435229 49d2239e6cf7c48d023153b5c5a34dbee7639039	no	5
Warnings:					
Information:					
4	Oath or Declaration filed	Eric_BRAGIGmbH-P0017_15245031_DEC_SIGNED_EFS.pdf	1526883 ca076bfb77c2fe985436fd41a75a1284b6a5be66	no	2
Warnings:					
Information:					
5	Oath or Declaration filed	Boesen_BRAGIGmbH-P0017_15245031_DEC_Signed.pdf	209856 5e3b999b5de89c4020e1d86af2fb67f618824042	no	2

Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	35446 214ced0fa528be45cb98d1bcd81110e84fc1c464	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	4267857	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/144,338	09/27/2018	2656	785	BRAGI GmbH-P0017C2	14	2

CONFIRMATION NO. 3503

133690
Goodhue, Coleman & Owens, P.C.
12951 University Ave
Suite 201
Clive, IA 50325

FILING RECEIPT

OC000000103172017

Date Mailed: 10/19/2018

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Eric Christian Hirsch, München, GERMANY;
Peter Vincent Boesen, München, GERMANY;

Applicant(s)

BRAGI GmbH, Munchen, GERMANY;

Assignment For Published Patent Application

BRAGI GmbH, München, GERMANY

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 15/837,386 12/11/2017 PAT 10117014
which is a CON of 15/245,031 08/23/2016 PAT 9843853
which claims benefit of 62/211,767 08/29/2015

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 10/18/2018

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/144,338**

Projected Publication Date: 01/24/2019

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

Power Control for Battery Powered Personal Area Network Device System and Method

Preliminary Class

381

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/144,338

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	75		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	330		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	380		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	14 minus 20 =	*	x 50 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*	x 230 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	785		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/144,338	09/27/2018	Eric Christian Hirsch	BRAGI GmbH-P0017C2	3503

133690 7590 10/29/2018

Goodhue, Coleman & Owens, P.C.
12951 University Ave
Suite 201
Clive, IA 50325

EXAMINER	
BERNARDI, BRENDA C	

ART UNIT	PAPER NUMBER
2667	

NOTIFICATION DATE	DELIVERY MODE
10/29/2018	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTO@dockettrak.com
docketing@goodhue.com
eofficeaction@appcoll.com

Office Action Summary	Application No. 16/144,338	Applicant(s) Hirsch et al.	
	Examiner BRENDA C BERNARDI	Art Unit 2667	AIA Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 9/27/2018.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-14 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-14 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on See Continuation Sheet is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Continuation of Application Papers 11): 9/27/2018

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

2. **Claims 1-14** are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 3, 2, 4, 5, 6, 7, 8, 9, 3, 4, 5, 7, 8 and 9, respectively, of **US Patent No. 10,117,014**. Although the conflicting claims are not identical, they are not patentably distinct based on the rationale provided below. Limitations of the present invention and US Patent No. 10,117,014 are listed in the following table for claim 1.

Claim 1 of Present Invention	Claim 3 of US Patent No. 10,117,014
a method for power control for a wireless earpiece, comprising	a method for managing a wireless earpiece, comprising
powering circuitry of the wireless earpiece utilizing a low power mode in response to detecting a magnetic field is applied to the wireless earpiece; and	powering circuitry of the wireless earpiece utilizing a low power mode in response to detecting a magnetic field is applied to the wireless earpiece; and
powering circuitry of the wireless earpieces utilizing a high power mode in response to detecting a magnetic field is not applied to one or more of the wireless earpieces	
altering the power sent to the circuitry of the wireless earpiece to a high power mode in response to detecting a magnetic field is not applied to one or more of the wireless earpieces	altering the power sent to the circuitry of the wireless earpiece to a high power mode in response to detecting a magnetic field is not applied to one or more of the wireless earpieces
altering the power sent to the circuitry of the wireless earpieces to a low power mode in response to detecting a magnetic field is applied to one or more of the wireless earpieces; and	
charging an onboard battery of the wireless earpiece in response to detecting a magnetic field is applied to the wireless earpiece	charging an onboard battery of the wireless earpiece in response to detecting a magnetic field is applied to the wireless earpiece

US Patent No. 10,117,014 claim 3 fails to disclose powering circuitry of the wireless earpieces utilizing a high power mode in response to detecting a magnetic field is not applied to one or more of the wireless earpieces. However, US Patent No. 10,117,014 does disclose altering the power sent to the circuitry of the wireless earpiece to a high power mode in response to detecting a magnetic field is not applied to one or more of the wireless earpieces, and it would be obvious to power circuitry in order to alter the power. US Patent No. 10,117,014 claim 3 also fails to disclose altering the power sent to the circuitry of the wireless earpieces to a low power mode in response to detecting

a magnetic field is applied to one or more of the wireless earpieces. However, US Patent No. 10,117,014 does disclose powering circuitry of the wireless earpiece utilizing a low power mode in response to detecting a magnetic field is applied to the wireless earpiece and, similarly, it would have been obvious to power circuitry in order to alter the power.

Allowable Subject Matter

3. **Claims 1-14** are allowable over the prior art and are allowed if the nonstatutory obviousness-type double patenting rejection above is overcome. Nothing in the prior art showed or suggested the specific limitations of these claims.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to BRENDA C BERNARDI whose telephone number is (571)270-7125. The examiner can normally be reached on M-F 8am-5pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, MATTHEW BELLA can be reached on (571) 272-7778. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/BRENDA C BERNARDI/
Primary Examiner, Art Unit 2667

Notice of References Cited	Application/Control No. 16/144,338	Applicant(s)/Patent Under Reexamination	
	Examiner BRENDA C BERNARDI	Art Unit 2667	Page 1 of 1

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*	B	US-20140270227-A1	09-2014	Swanson; Eric J.	H04R1/1016	381/74
*	C	US-9013145-B2	04-2015	Castillo; Armando	H02J7/0044	320/103
*	D	US-20060258412-A1	11-2006	Liu; Serina	H02J7/0044	455/575.2
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Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/144,338	Hirsch et al.
	Examiner	Art Unit
	BRENDA C BERNARDI	2667

CPC - Searched*		
Symbol	**Date**	**Examiner**
H04R1/1041	10/24/2018	/bb/
H04W52/0225	10/24/2018	/bb/
H02J7/025	10/24/2018	/bb/
H02J7/007	10/24/2018	/bb/
H02J50/10	10/24/2018	/bb/
H04R1/1025	10/24/2018	/bb/
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H04R2420/07	10/24/2018	/bb/
H04M1/6066	10/24/2018	/bb/

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

/BRENDA C BERNARDI/ Primary Examiner, Art Unit 2667	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/144,338	Hirsch et al.
	Examiner	Art Unit
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Search Notes		
Search Notes	**Date**	**Examiner**
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H02J7/025 (text search only - see attached search history printout)	10/24/2018	/bb/
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H02J50/10 (text search only - see attached search history printout)	10/24/2018	/bb/
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Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**

/BRENDA C BERNARDI/
Primary Examiner, Art Unit 2667

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
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S3	79	(("BOESEN") near3 ("Peter")).INV.	US-PGPUB; USPAT; USOCR	OR	OFF	2017/03/30 17:02
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S14	5997	H04M1/6066.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/03/30 17:43
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S22	1	(12/459466).APP.	USPAT; USOCR	OR	OFF	2017/03/31 09:41
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S33	1	(14/604082).APP.	USPAT; USOCR	OR	OFF	2017/03/31 12:09
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S36	0	(12/131603).APP.	USPAT; USOCR	OR	OFF	2017/03/31 12:34
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S38	1	("2006/0258412").URPN.	USPAT	OR	OFF	2017/03/31 12:36
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S63	6357	H04M1/6066.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/01/20 13:29
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S67	1102877	(low or high) near power	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/01/20 13:31
S68	1035394	magnetic near field	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/01/20 13:31
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S73	142	(("BOESEN") near3 ("Peter")).INV.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/01/20 13:54
S74	8	(("BRAGI") near3 ("GMBH")).AS,AANM.	USPAT	ADJ	ON	2018/01/20 14:11
S75	7022	H04R1/1041.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S76	6363	H04W52/0225.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S77	37581	H02J7/025.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S78	10848	H02J7/007.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S79	18242	H02J50/10.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S80	1680	H04R1/1025.cpc.	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2018/06/18 12:01

			EPO; JPO; DERWENT; IBM_TDB			
S81	6500	H04R1/028.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S82	10907	H04R2420/07.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S83	6524	H04M1/6066.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S84	85686	S75 or S76 or S77 or S78 or S79 or S80 or S81 or S82 or S83	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S85	3121	(wireless$3 or wire-less$3) near3 (earpiece or ear-piece or earbud or ear-bud)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S86	1005	S84 and S85	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S87	1143734	(low or high) near power	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S88	1067843	magnetic near field	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/18 12:01
S89	12	S86 and (S87 same S88)	US-PGPUB; USPAT;	OR	ON	2018/06/18 12:01

			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S90	22	S85 and (S87 same S88)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/18 12:04
S91	102	("20010005197" | "20010027121" | "20010056350" | "20020002413" | "20020007510" | "20020010590" | "20020030637" | "20020046035" | "20020057810" | "20020076073" | "20020118852" | "20030065504" | "20030100331" | "20030104806" | "20030115068" | "20030125096" | "20030218064" | "20040070564" | "20040160511" | "20050043056" | "20050125320" | "20050148883" | "20050165663" | "20050196009" | "20050251455" | "20050266876" | "20060029246" | "20060074671" | "20060074808" | "20080254780" | "20120309453" | "20140004912" | "3934100" | "4150262" | "4334315" | "4375016" | "4588867" | "4654883" | "4682180" | "4791673" | "4865044" | "5191602" | "5201007" | "5280524" | "5295193" | "5298692" | "5343532" | "5363444" | "5497339" | "5606621" | "5613222" | "5692059" | "5721783" | "5749072" | "5771438" | "5802167" | "5929774" | "5933506" | "5949896" | "5987146" | "6021207" | "6054989" | "6081724" | "6094492" | "6111569" | "6112103" | "6157727" | "6167039" | "6181801" | "6208372" | "6275789" | "6339754" | "6408081" | "6470893" | "6542721" | "6560468" | "6654721" | "6664713" | "6694180" | "6718043" | "6738485" | "6748095" | "6754358" | "6784873" | "6823195" | "6852084" | "6879698" | "6892082" | "6920229" | "6952483" | "6987986" | "7136282" | "7203331" | "7209569" | "7215790" | "7463902" | "7508411" | "7983628" | "8140357" | "D464039" | "D468299" | "D468300").PN.	US-PGPUB; USPAT	ADJ	ON	2018/06/18 12:07
S93	0	"16144338"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2018/10/23 09:08
S94	3	"15245031"	US-PGPUB; USPAT; USOCR; FPRS;	OR	OFF	2018/10/23 09:10

			EPO; JPO; DERWENT; IBM_TDB			
S95	44	((("BRAGI") near3 ("GMBH"))).AS,AANM.	USPAT	ADJ	ON	2018/10/23 20:25
S96	34	(("HIRSCH") near3 ("Eric")).INV.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/10/23 20:30
S97	223	(("BOESEN") near3 ("Peter")).INV.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/10/23 20:33
S98	512	((wireless$3 or wire-less$3) near3 (earpiece or ear-piece or earbud or ear-bud)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:37
S99	93	S97 and S98	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:37
S100	7915	H04R1/1041.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:44
S101	6920	H04W52/0225.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:44
S102	42828	H02J7/025.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:44
S103	12423	H02J7/007.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:44
S104	21615	H02J50/10.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:44

S105	1936	H04R1/1025.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:44
S106	7513	H04R1/028.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:44
S107	12426	H04R2420/07.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:44
S108	6815	H04M1/6066.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:44
S109	96689	S100 or S101 or S102 or S103 or S104 or S105 or S106 or S107 or S108	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:44
S110	2689	(wireless$3 or wire-less$3) near3 (earpiece or ear-piece or earbud or ear-bud)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:44
S111	926	S109 and S110	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:44
S112	561107	charg$4 near3 battery	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:45
S113	1037387	magnetic near3 field	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2018/10/23 20:46

			DERWENT; IBM_TDB			
S114	86	S111 and S112 and S113	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:46
S115	3345	(wireless$3 or wire-less$3) near3 (earpiece or ear-piece or earbud or ear-bud)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/10/23 20:55
S116	1175290	(low or high) near power	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/10/23 20:55
S117	1092869	magnetic near field	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/10/23 20:55
S118	27	S115 and (S116 same S117)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/10/23 20:55

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S52	0	(((wireless$3 or wire-less$3) near3 (earpiece or ear-piece)) and (high$3 near power near mode) and (detect$4 near3 magnetic near field) and ((chang$4 or alter$4) near power) and (low$3 near power near mode)).clm.	USPAT	OR	OFF	2017/08/04 11:21
S71	0	(((wireless$3 or wire-less$3) near3 (earpiece or ear-piece)) and (high$3 near power near mode) and (detect$4 near3 magnetic near field) and ((chang$4 or alter$4) near power) and (low$3 near power near mode)).clm.	USPAT	OR	OFF	2018/01/20 13:38
S92	0	(((wireless$3 or wire-less$3) near3 (earpiece or ear-piece)) and (high$3 near power near mode) and (detect$4 near3 magnetic near field) and ((chang$4 or alter$4) near power) and (low$3 near power near mode)).clm.	USPAT	OR	OFF	2018/06/18 12:06

10/ 23/ 2018 9:01:12 PM
C:\ Users\ bbernardi\ Documents\ EAST\ Workspaces\ 16144338.wsp

Bibliographic Data

Application No: 16/144,338

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /BRENDA C BERNARDI/ Examiner's Signature | Initials

Title: Power Control for Battery Powered Personal Area Network Device System and Method

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FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
09/27/2018	381	2667	BRAGI GmbH-P0017C2
RULE			

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Peter Vincent Boesen München, GERMANY

CONTINUING DATA

This application is a CON of 15837386 12/11/2017 PAT 10117014

15837386 is a CON of 15245031 08/23/2016 PAT 9843853

15245031 has PRO of 62211767 08/29/2015

FOREIGN APPLICATIONS

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16144338
Filing Date	2018-09-27
First Named Inventor	Eric Christian Hirsch
Art Unit	
Examiner Name	
Attorney Docket Number	BRAGI GmbH-P0017C2

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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	3	3047089	A	1962-07-31	Zwislocki; Jozef J.	Entire Document
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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	3	20010043707	A1	2001-11-22	Leedom; Marvin A.	Entire Document
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16144338
	Filing Date	2018-09-27
	First Named Inventor	Eric Christian Hirsch
	Art Unit	
	Examiner Name	
	Attorney Docket Number	BRAGI GmbH-P0017C2

	108	9037125	B1	2015-05-19	Kadous	Entire Document
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	Attorney Docket Number	BRAGI GmbH-P0017C2

	119	9767709	B2	2017-09-19	Ellis	Entire Document
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	Examiner Name	
	Attorney Docket Number	BRAGI GmbH-P0017C2

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16144338
	Filing Date	2018-09-27
	First Named Inventor	Eric Christian Hirsch
	Art Unit	
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	Attorney Docket Number	BRAGI GmbH-P0017C2

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	1	Stretchgoal - It's Your Dash (02/14/2014), 14 pages.	
	2	Stretchgoal - The Carrying Case for The Dash (02/12/2014), 9 pages.	
	3	Stretchgoal - Windows Phone Support (02/17/2014), 17 pages.	
	4	The Dash + The Charging Case & The BRAGI News (2/21/14), 12 pages.	
	5	The Dash-A Word From Our Software, Mechanical and Acoustics Team + An Update (3/11/2014), 7 pages.	
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	First Named Inventor	Eric Christian Hirsch
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	Attorney Docket Number	BRAGI GmbH-P0017C2

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	Filing Date	2018-09-27
	First Named Inventor	Eric Christian Hirsch
	Art Unit	
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	Attorney Docket Number	BRAGI GmbH-P0017C2

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

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A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/JOHN D. GOODHUE/	Date (YYYY-MM-DD)	2018-10-29
Name/Print	John D. Goodhue	Registration Number	47603

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Electronic Patent Application Fee Transmittal

Application Number:	16144338
Filing Date:	27-Sep-2018
Title of Invention:	Power Control for Battery Powered Personal Area Network Device System and Method
First Named Inventor/Applicant Name:	Eric Christian Hirsch
Filer:	Kyle S. Coleman/Ashlyn Nguyen
Attorney Docket Number:	BRAGI GmbH-P0017C2

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
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		Total in USD ($)		**120**

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EFS ID:	34146971
Application Number:	16144338
International Application Number:	
Confirmation Number:	3503
Title of Invention:	Power Control for Battery Powered Personal Area Network Device System and Method
First Named Inventor/Applicant Name:	Eric Christian Hirsch
Customer Number:	133690
Filer:	Kyle S. Coleman/Ashlyn Nguyen
Filer Authorized By:	Kyle S. Coleman
Attorney Docket Number:	BRAGI GmbH-P0017C2
Receipt Date:	29-OCT-2018
Filing Date:	27-SEP-2018
Time Stamp:	15:57:08
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$120
RAM confirmation Number	103018INTEFSW00002923506801
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3	Non Patent Literature	AkkermanS_Acoustic-Ear-Recognition-for-Person-Identification.pdf	2495266 b1b31c9249354adbd434d81f7b936b6bd295f024	no	5
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4	Non Patent Literature	Abdullah_A-Multi-Channel-Opto-Electronics-Sensor.pdf	10771536 4dbb8038b3dee9d2ea34b0b8ef870ae0c4e30e90	no	22
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5	Non Patent Literature	Update5February242014.pdf	4011009 f70a0f42f18b57902831c24c966424f2d08051f5	no	14
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6	Non Patent Literature	Ben_Coxworth_Graphene-based_ink_could_enable_low-cost_foldable_electronics.pdf	1375973 e500b2779b21db37fdbfa365f5c1f0ec6a3ba8de	no	7
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9	Non Patent Literature	FacebookReferences.pdf	10610745 a4aa525b8f44d530668b63fc73c123b6bb8e4408	no	51
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10	Non Patent Literature	Update12May132014.pdf	1528236 4a32e20e070a8ff7135d23e93dffed754fa71ae9	no	8
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11	Non Patent Literature	Update26March62015.pdf	4942028 5c11f95c389b82da464e2011620cbee14bc71230	no	18
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Electronic Acknowledgement Receipt

EFS ID:	34147233
Application Number:	16144338
International Application Number:	
Confirmation Number:	3503
Title of Invention:	Power Control for Battery Powered Personal Area Network Device System and Method
First Named Inventor/Applicant Name:	Eric Christian Hirsch
Customer Number:	133690
Filer:	Kyle S. Coleman/Ashlyn Nguyen
Filer Authorized By:	Kyle S. Coleman
Attorney Docket Number:	BRAGI GmbH-P0017C2
Receipt Date:	29-OCT-2018
Filing Date:	27-SEP-2018
Time Stamp:	16:05:30
Application Type:	Utility under 35 USC 111(a)

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15	Non Patent Literature	Update36September102015.pdf	3386456 3e0a29d906413acbbac020e9cfe22e544076136e	no	15
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17	Non Patent Literature	Nuance_updates_computer-assisted_physician_documentation-10-20-2015.pdf	581699 42f793fd5bdb76c9ca673c1df879a44a8da1ac04	no	2
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18	Non Patent Literature	Hoffman_how-to-use-Android-Beam_2-22-13.pdf	1017058 bcf18b479e95cedde6342d98cd5472860f8f0992	no	4
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19	Non Patent Literature	Hoyt_Lessons-leared-from-Implementation-of-Voice-Recognition_2017.pdf	4657786 13d5944d41e1d9e1cff629180660091bd9d0c411	no	8
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20	Non Patent Literature	47091_HYUNDAI_MOTOR_COMPANY_INTRODUCES_A_HEALTH_MOBILITY_CONCEPT_FOR_WELLNESS_IN.pdf	1053414 f4e456f45b4fdc3261c82bac2ac75b35e7c15759	no	3
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Information:					
		Total Files Size (in bytes):	79894023		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
Nilsson, Peter
Dilg, Haeusler, Schindelmann
Patentanwaltsgesellschaft mbH
Leonrodstrasse 58
80636 München
ALLEMAGNE

DILG · HAEUSLER · SCHINDELMANN
Patentanwalts GmbH
17. Nov. 2016
FRIST AE 04.2017 WEX | AE

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference H1199 WO	Date of mailing *(day/month/year)* 16 November 2016 (16-11-2016) **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/EP2016/070245	International filing date *(day/month/year)* 26 August 2016 (26-08-2016)
Applicant BRAGI GMBH	

1. [X] The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46).

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the International Search Report.

   How? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338 82 70

   For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 - 9.011.

2. [ ] The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. [ ] **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   [ ] the protest together with the decision thereon has been transmitted to the International Bureau together with any applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   [ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **19 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the International Searching Authority European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040 Fax: (+31-70) 340-3016	Authorized officer KOEGTEL, Gilbert Tel. +31 (0)70 340-3544

Form PCT/ISA/220 (July 2014)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
H 1159 WO		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP2016/070245	26 August 2016 (26-08-2016)	29 August 2015 (29-08-2015)
Applicant		
SRAGI GMBH		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

[X] the international application in the language in which it was filed

[ ] a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. [ ] **Certain claims were found unsearchable** (See Box No. II)

3. [ ] **Unity of invention is lacking** (see Box No III)

4. With regard to the **title**,

[X] the text is approved as submitted by the applicant

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

[X] the text is approved as submitted by the applicant

[ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 1

[X] as suggested by the applicant

[ ] as selected by this Authority, because the applicant failed to suggest a figure

[ ] as selected by this Authority, because this figure better characterizes the invention

b. [ ] none of the figures is to be published with the abstract

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/070245

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W52/02 H02J50/10
ADD. H04M1/60

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W H04M H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2014/004912 A1 (RAJAKARUNANAYAKE YASANTHA [US]) 2 January 2014 (2014-01-02) paragraphs [0017], [0018], [0021] - [0025]	1-20
A	US 2012/309453 A1 (MAGUIRE YAEL [US]) 6 December 2012 (2012-12-06) paragraphs [0020], [0051] - [0054], [0060]	1-20

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

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 November 2016	16/11/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Amorotti, M

1

Form PCT/ISA/210 (second sheet) (April 2005)

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014004912 A1	02-01-2014	US 2014004912 A1	02-01-2014
		US 2016029319 A1	28-01-2016
US 2012309453 A1	06-12-2012	US 2012309453 A1	06-12-2012
		US 2013303225 A1	14-11-2013

Information on Search Strategy - Pilot phase (see OJ 2015, A86)
This type of information contained in this sheet may change during the pilot for improving the usefulness of this new service.

Application Number
PCT/EP2016/070245

TITLE: POWER CONTROL FOR BATTERY POWERED PERSONAL AREA NETWORK DEVICE SYSTEM AND METHOD

APPLICANT: BRAGI GMBH

IPC CLASSIFICATION: H04W52/02, H02J50/10, H04M1/60

EXAMINER: Amorotti, M

CONSULTED DATABASES: WPI

CLASSIFICATION SYMBOLS DEFINING EXTENT OF THE SEARCH:

IPC:

CPC: H04W52/0225, H04M1/6066, H02J50/10, H02J7/025, H02J5/005

FI/F-TERMS:

KEYWORDS OR OTHER ELEMENTS FEATURING THE INVENTION:
magnetic, inductive, contactless, earpiece, headset, power charge recharge

EPO FORM P904A3

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

DILG · HAEUSLER · SCHINDELMANN
Patentanwälte GmbH

17. Nov. 2016

FRIST 3 Mon CC & Q Mail AM

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2016/070245	26.08.2016	29.08.2015

International Patent Classification (IPC) or both national classification and IPC
INV. H04W52/02 H02J50/10 ADD. H04M1/60

Applicant
BRAGI GMBH

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Fax: +31 70 340 - 3016	see form PCT/ISA/210	Amorotti, M Telephone No. +31 70 340-0

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-20
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-20
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-20
	No:	Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following document:

D1 US 2014/004912 A1 (RAJAKARUNANAYAKE YASANTHA [US]) 2 January 2014 (2014-01-02)

2 D1 is regarded as being the prior art closest to the subject-matter of claim 1, and discloses a method for managing wireless ~~earpieces~~ headphone, comprising:
powering circuitry of the wireless earpieces utilizing a ~~high power~~ communication mode ~~in response to detecting~~ when a magnetic field is not applied to one or more of the wireless device; and
altering the power sent to the circuitry of the wireless earpieces to a ~~low power~~ power transfer mode mode ~~in response to detecting~~ when said magnetic field is applied to one or more of the wireless earpieces.

The subject-matter of claim 1 therefore differs from D1 in that the two operating modes are related to the drained powers (i.e. high and low power) and in the step of detecting the magnetic field; it is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as how to automatically save energy when the wireless device are not in use.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: the step of detecting an (electro)magnetic field is disclosed by D2 cited in the search report; however D2 does not discloses the power related mode of operation (i.e. high power and low power modes); moreover the device of D2 detects an RF field in place of a magnetic field. The skilled person would not combine D1 and D2 to produce the difference without the exercise of inventive activity.

3 In the same way claim 10 is new and inventive w.r.t. the cited prior art.

4 Claims 2-9, 11-20 are dependent on one or more independent claims whose subject-matter is considered as being new and inventive, as discussed above, and as such said dependent claims also meet the requirements of the PCT with respect to novelty and inventive step.

5 **Further Remarks**

5.1 Independent claims 1 and 10 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art above cited being placed in the preamble (Rule 6.3(b)(i) PCT) and the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

5.2 The features of the claims should be provided with reference signs placed in parentheses to increase the intelligibility of the claims(Rule 6.2(b) PCT).

5.3 To meet the requirements of Rule 5.1(a)(ii) PCT, D1 should be identified in the description and the relevant background art disclosed therein should be briefly discussed.

5.4 The attention of the applicant is drawn to the fact that the application may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Article 34(2)(b) PCT).

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
Nilsson, Peter
Dilg, Haeusler, Schindelmann
Patentanwaltsgesellschaft mbH
Leonrodstrasse 58
80636 München
ALLEMAGNE

DILG · HAEUSLER · SCHINDELMANN
Patentanwalts GmbH
18. Nov. 2016
FRIST 18.11.2016 Tag 10 AP

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference H 1198 WO	Date of mailing *(day/month/year)* 16 November 2016 (16-11-2016) **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/EP2016/070231	International filing date *(day/month/year)* 26 August 2016 (26-08-2016)
Applicant BRAGI GMBH	

1. [X] The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46).

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the International Search Report.

   How? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70

   For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 - 9.011

2. [ ] The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. [ ] **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   [ ] the protest together with the decision thereon has been transmitted to the International Bureau together with any applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   [ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **19 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the International Searching Authority	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040 Fax: (+31-70) 340-3016	LANG, Ulrich Tel: +49 (0)89 2399-2534

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
H 1196 WO		
International application No	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP2016/070231	26 August 2016 (26-08-2016)	29 August 2015 (29-08-2015)
Applicant		
BRAGI GMBH		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

[X] the international application in the language in which it was filed

[ ] a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a))

c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. [ ] **Certain claims were found unsearchable** (See Box No. II)

3. [ ] **Unity of invention is lacking** (see Box No III)

4. With regard to the **title,**

[X] the text is approved as submitted by the applicant

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

[X] the text is approved as submitted by the applicant

[ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings,**

a. the figure of the **drawings** to be published with the abstract is Figure No. 1

[X] as suggested by the applicant

[ ] as selected by this Authority, because the applicant failed to suggest a figure

[ ] as selected by this Authority, because this figure better characterizes the invention

b. [ ] none of the figures is to be published with the abstract

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/070231

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65D5/42 G08B7/06
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65D G08B G09F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/239497 A1 (MCGUIRE KENNETH STEPHEN [US] ET AL) 6 October 2011 (2011-10-06)	15,18
Y	paragraph [0020] - paragraph [0043]	16,19,20
A	figures 1-4	1-14,17

X	US 2011/140844 A1 (MCGUIRE KENNETH STEPHEN [US] ET AL) 16 June 2011 (2011-06-16)	15,18,20
Y	paragraph [0014] - paragraph [0050]	16,19
A	figures 1-2	1-14,17

X	US 6 084 526 A (BLOTKY RANDOLPH M [US] ET AL) 4 July 2000 (2000-07-04)	15,18
Y	column 2, line 23 - column 4, line 44;	16,19,20
A	figures 1-5	1-14,17

	-/--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 November 2016	18/11/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Fitterer, Johann

2

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/008275 A1 (FERRARI MICHAEL G [US] ET AL) 8 January 2009 (2009-01-08)	15,18
Y	paragraph [0002] - paragraph [0017]	16,19,20
A	figures 1,2	1-14,17
X	US 2009/261114 A1 (MCGUIRE KENNETH STEPHEN [US] ET AL) 22 October 2009 (2009-10-22)	15,18
Y	paragraph [0002] - paragraph [0067]	16,19,20
A	figures 1-9	1-14,17
Y	US 2005/094839 A1 (GWEE LIN K [US]) 5 May 2005 (2005-05-05)	16,19,20
A	paragraph [0012] - paragraph [0014] figures 1-2	1-15,17, 18

2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2016/070231

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011239497 A1	06-10-2011	CN 102812505 A	05-12-2012
		EP 2553673 A2	06-02-2013
		US 2011239497 A1	06-10-2011
		WO 2011123316 A2	06-10-2011
US 2011140844 A1	16-06-2011	AR 079464 A1	25-01-2012
		BR 112012014301 A2	05-07-2016
		CN 102652329 A	29-08-2012
		EP 2513886 A1	24-10-2012
		JP 2013513433 A	22-04-2013
		TW 201140526 A	16-11-2011
		US 2011140844 A1	16-06-2011
		WO 2011081780 A1	07-07-2011
US 6084526 A	04-07-2000	JP 2000344244 A	12-12-2000
		US 6084526 A	04-07-2000
US 2009008275 A1	08-01-2009	AT 512088 T	15-06-2011
		CA 2690046 A1	08-01-2009
		EP 2170729 A1	07-04-2010
		ES 2367830 T3	08-11-2011
		JP 5140725 B2	13-02-2013
		JP 2010531789 A	30-09-2010
		US 2009008275 A1	08-01-2009
		WO 2009004591 A1	08-01-2009
US 2009261114 A1	22-10-2009	NONE	
US 2005094839 A1	05-05-2005	NONE	

Information on Search Strategy - Pilot phase (see OJ 2015, A86)
The type of information contained in this sheet may change during the pilot for improving the usefulness of this new service.

Application Number
PCT/EP2016/070231

TITLE: RESPONSIVE PACKAGING SYSTEN FOR MANAGING DISPLAY ACTIONS

APPLICANT: BRAGI GMBH

IPC CLASSIFICATION: B65D5/42, G08B7/06

EXAMINER: Fitterer, Johann

CONSULTED DATABASES:

CLASSIFICATION SYMBOLS DEFINING EXTENT OF THE SEARCH:

IPC:

CPC: B65D5/4212, B65D5/4204, B65D2203/00, B65D2203/12, G08B5/36, G08B7/06, G08B, G09F2027/001, G09F, TXTE

FI/F-TERMS:

KEYWORDS OR OTHER ELEMENTS FEATURING THE INVENTION:
Packaging system; wireless earpieces; sensors; near field communication chip; packaging defining a window for displaying the wireless earpieces; display action in response to a display criteria being met.

EPO FORM 1504

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43*bis*.1)

DIEHL HABUSLER SCHINDELMANN
Patentanwälte GmbH
18. Nov. 2016
FRIST

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2016/070231	26.08.2016	29.08.2015

International Patent Classification (IPC) or both national classification and IPC
INV. B65D5/42 G08B7/06

Applicant
BRAGI GMBH

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465	see form PCT/ISA/210	Fitterer, Johann Telephone No. +49 89 2399-0

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☑ the international application in the language in which it was filed.

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-14, 16, 17, 19
	No:	Claims	15, 18, 20
Inventive step (IS)	Yes:	Claims	1-14, 17
	No:	Claims	15, 16, 18-20
Industrial applicability (IA)	Yes:	Claims	1-20
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Reference is made to the following documents:

D1 US 2011/239497 A1 (MCGUIRE KENNETH STEPHEN [US] ET AL) 6 Oct 2011 (2011-10-06)

D2 US 2011/140844 A1 (MCGUIRE KENNETH STEPHEN [US] ET AL) 16 Jun 2011 (2011-06-16)

D3 US 6 084 526 A (BLOTKY RANDOLPH M [US] ET AL) 4 Jul 2000 (2000-07-04)

D4 US 2009/008275 A1 (FERRARI MICHAEL G [US] ET AL) 8 Jan 2009 (2009-01-08)

D5 US 2009/261114 A1 (MCGUIRE KENNETH STEPHEN [US] ET AL) 22 Oct 2009 (2009-10-22)

D6 US 2005/094839 A1 (GWEE LIN K [US]) 5 May 2005 (2005-05-05)

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Independent claims

1.1 Claim 1

1.1.1 Reference is made to Re Item VIII below. Accordingly, the present statement with regard to novelty and inventive step is based on the assumption that wireless earpieces are an essential part of the claimed packaging system, wherein the one or more sensors and the near field communication chip of the pair of wireless earpieces are utilized to determine whether certain display criteria are met (see also claim 17).

1.1.2 D1 discloses (see paragraphs [0020] to [0043]; figures 1-4) a packaging system from which the subject-matter of claim 1 differs in that it comprises wireless earpieces including one or more sensors and a near field communication chip, the packaging defining a window for displaying the wireless earpieces.

The subject-matter of claim 1 solves the problem of providing a packaging system which on the one hand attracts potential buyer's attention by performing a display action and on the other hand preserves resources like for example electronic components.

Even though packaging systems comprising one or more sensors and a near field communication chip communicating with a plurality of other adjacent packaging systems, wherein the packaging performs a display action in response to a display criteria being met, are well known in the art, see for ex-

ample D1, the cited prior art does not teach or suggest a packaging system comprising wireless earpieces, wherein a display action of the packaging system is controlled by one or more sensors and a near field communication chip included in said wireless earpieces.

Since this concept defining the wireless earpieces as part of the display management system (see claim 17) is neither known from nor rendered obvious by the available prior art, the packaging system of claim 1 incorporating said concept is considered to be new and inventive (Article 33(2) / (3) PCT).

1.2 Claim 15 does not meet the requirement of Article 33(2) PCT, because its subject-matter is not novel.

D1 discloses (see paragraphs [0020] to [0043]; figures 1-4) a method of managing display actions performed by a packaging system, comprising: determining a location and an orientation of the packaging system; determining whether display criteria are met; and performing a display action utilizing an interface of the packaging system to attract attention of a user in response to the display criteria being met (see particularly paragraphs [0039] to [0042]).

All features of claim 15 are therefore disclosed in combination in D1.

It is noted that all features of claim 15 are also taught or at least suggested by each of the documents D2 to D5, see the corresponding passages and figures cited in the search report.

2 Dependent claims

2.1 Claims 2-14 are dependent on claim 1. Taking account of the above comments, see items 1.1.1 and 1.1.2, claims 2-14 thus also meet the requirements of the PCT with respect to novelty and inventive step.

2.2 Claims 16, 18-20 do not contain any features which, in combination with the features of any claim to which they refer (except claim 17 depending on claim 16), meet the requirements of the PCT in respect of novelty and/or inventive step, since the additional features are known from the prior art (see documents D1 to D6 and the corresponding passages and figures cited in the search report) and/or the additional features come within the scope of the customary practice followed by persons skilled in the art.

2.3 The above discussed inventive concept of claim 1 (see item 1.1.2) is included in claim 17 depending on claim 16. Accordingly, the packaging system includes at least a pair of wireless earpieces and a smart case for the pair of wireless earpieces, wherein the location and the orientation of the packaging

system is determined utilizing one or more sensors of the pair of wireless earpieces. The method of claim 17 depending on claim 16 is therefore considered to be new and inventive (Article 33(2) / (3) PCT).

Re Item VII

Certain defects in the international application

The independent claims are not in the two-part form, Rule 6.3(b) PCT.

The features of the claims are not provided with reference signs, Rule 6.2(b) PCT.

The dependencies of claims 17 and 19 are not correct, because these claims depend i.a. on claim 15 wherein, however, the wireless earpieces and the smart case mentioned in claims 17 and 19 are introduced in claim 16.

There are no documents indicated in the description reflecting relevant background art, Rule 5.1(a)(ii) PCT.

Re Item VIII

Certain observations on the international application

1 Claim 1 is directed to a packaging system comprising wireless earpieces. In contrast, the description implies that the invention relates to a packaging system for any product to be packaged, see for example page 1, lines 10-11. This inconsistency leads to doubt concerning the matter for which protection is sought, thereby rendering the claims unclear, Article 6 PCT.

2 Moreover, claim 1 defines wireless earpieces including one or more sensors and a near field communication chip, and a packaging performing a display action in response to a display criteria being met. However, claim 1 fails to define any interaction between these features, as specified for example in claim 17: The location and the orientation of the packaging system (which are used to determine whether certain display criteria are met) are determined utilizing one or more sensors of the pair of wireless earpieces. Since this interaction between the wireless earpieces and the display of the packaging appears to be an essential part of the present invention, claim 1 does not meet the requirements of Article 6 PCT in that it does not contain all the technical features essential to the definition of the invention.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
Nilsson, Peter
Dilg, Haeusler, Schindelmann
Patentanwaltsgesellschaft mbH
Leonrodstrasse 58
80636 München
ALLEMAGNE

DILG · HAEUSLER · SCHINDELMANN
Patentanwalts GmbH
23. Nov. 2016
FRIST

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference H 1193 WO	Date of mailing *(day/month/year)* 16 November 2016 (16-11-2016) **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/EP2016/070247	International filing date *(day/month/year)* 26 August 2016 (26-08-2016)
Applicant BRAGI GMBH	

1. [X] The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the International Search Report.

   How? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70

   For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 - 9.011.

2. [ ] The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. [ ] **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   [ ] the protest together with the decision thereon has been transmitted to the International Bureau together with any applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   [ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **19 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.005-8.032.

Name and mailing address of the International Searching Authority	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040 Fax: (+31-70) 340-3016	IPRAZAR, Paula Tel: +49 (0)89 2399-8131

Form PCT/ISA/220 (July 2014)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
H 1193 WO		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP2016/070247	26 August 2016 (26-08-2016)	29 August 2015 (29-08-2015)
Applicant		
BRAGI GMBH		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

[X] the international application in the language in which it was filed

[ ] a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. [ ] **Certain claims were found unsearchable** (See Box No. II)

3. [ ] **Unity of invention is lacking** (see Box No III)

4. With regard to the **title**,

[X] the text is approved as submitted by the applicant

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

[X] the text is approved as submitted by the applicant

[ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 1

[X] as suggested by the applicant

[ ] as selected by this Authority, because the applicant failed to suggest a figure

[ ] as selected by this Authority, because this figure better characterizes the invention

b. [ ] none of the figures is to be published with the abstract

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/070247

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04R1/10 H04R29/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04R G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 563 301 B2 (GVENTER BRIAN [US]) 13 May 2003 (2003-05-13) column 2, line 53 - column 3, line 31; claim 6; figures 1a-2b,5,7 column 4, line 45 - column 5, line 12 column 6, line 51 - column 7, line 10 column 7, lines 36-40 -----	1-19
A	NEMANJA PAUNOVIC ET AL: "A methodology for testing complex professional electronic systems", SERBIAN JOURNALOF ELECTRICAL ENGINEERING, vol. 9, no. 1, 1 February 2012 (2012-02-01), pages 71-80, XP055317584, YU ISSN: 1451-4869, DOI: 10.2298/SJEE1201071P page 71 - page 75 -----	1-19

-/--

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 November 2016	18/11/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Righetti, Marco

1

Form PCT/ISA/210 (second sheet) (April 2005)

International application No
PCT/EP2016/070247

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2008/113053 A1 (QUALCOMM INC [US]; RUTSCHMAN PHILLIP [US]) 18 September 2008 (2008-09-18) abstract; figure 2	4,11

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2016/070247

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6563301	B2 13-05-2003	NONE	
WO 2008113053	A1 18-09-2008	EP 2119200 A1	18-11-2009
		JP 2010523018 A	08-07-2010
		KR 20100015531 A	12-02-2010
		TW 200901744 A	01-01-2009
		US 2008226094 A1	18-09-2008
		US 2012155670 A1	21-06-2012
		WO 2008113053 A1	18-09-2008

Information on Search Strategy - Pilot phase (see OJ 2015, A86)
The type of information contained in this sheet may change during the pilot for improving the usefulness of this new service.

Application Number
PCT/EP2016/070247

TITLE: PRODUCTION LINE PCB SERIAL PROGRAMMING AND TESTING METHOD AND SYSTEM

APPLICANT: BRAGI GMBH

IPC CLASSIFICATION: H04R1/10, H04R29/00

EXAMINER: Righetti, Marco

CONSULTED DATABASES: NPL, EPODOC, INET, WPI

CLASSIFICATION SYMBOLS DEFINING EXTENT OF THE SEARCH:

IPC:

CPC: H04R1/10, H04R5/033, H04R29/00, H04R25/30, G01R31

FI/F-TERMS:

KEYWORDS OR OTHER ELEMENTS FEATURING THE INVENTION:
earpiece, test, jig, pcb

EPO FORM P0448

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

MÜLLER · SCHINDELMANN
Patentanwälte GmbH
23. Nov. 2016
FRIST

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2016/070247	26.08.2016	29.08.2015

International Patent Classification (IPC) or both national classification and IPC
INV. H04R1/10 H04R29/00

Applicant
BRAGI GMBH

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA	Date of completion of this opinion	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465	see form PCT/ISA/210	Righetti, Marco Telephone No. +49 89 2399-0

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-19
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-19
Industrial applicability (IA)	Yes:	Claims	1-19
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 6 563 301 B2 (GVENTER BRIAN [US]) 13 May 2003 (2003-05-13)

D2 NEMANJA PAUNOVIC ET AL: "A methodology for testing complex professional electronic systems",
SERBIAN JOURNALOF ELECTRICAL ENGINEERING,
vol. 9, no. 1, 1 February 2012 (2012-02-01), pages 71-80, XP055317584, YU
ISSN: 1451-4869, DOI: 10.2298/SJEE1201071P

D3 WO 2008/113053 A1 (QUALCOMM INC [US]; RUTSCHMAN PHILLIP [US]) 18 September 2008 (2008-09-18)

2 Regarding the subject matter of **claim 1**, the following is noted:

i) It is common practice to use PCBs in a wireless earpieces.

ii) The production of the PCBs is usually removed from the firm which produces the earpieces, and said PCBs go through an automated testing process, before being delivered to the customer.

iii) It is also common practice to perform intermediate tests of any electronic products comprising a PCB (and thus, also of wireless earpieces) during the production phase, in a semi-assembled configuration (for example, preliminary control functionality tests).

iv) End-of-line functional testing and acoustic testing of the final product is also common practice; moreover, any certification procedures require the product to pass specific functional and operational tests.

Thus, it seems that the subject matter of claim 1 is not new (Article 33(2) PCT), as it does not comprise any technical features, which differentiate it from common methods used for testing wireless earpieces during the production phase.

3 Anyway, the present application does not meet the criteria of Article 33(3) PCT, because the subject-matter of **claims 1, 11, 15** does not involve an inventive step, for the following reasons:

3.1 Document D1 is regarded as being the prior art closest to the subject-matter of **claim 1**, and discloses

A method for testing a wireless electronic device (Col. 2, lines 53-55; Fig. 7; col. 6, lines 51-53), the method comprising:
initiating automated testing of one or more printed circuit boards (PCBs) of the electronic device (Fig. 7, ref. 710; col. 2, lines 56-61; col. 4, line 65 - col. 5, line 5; col. 6, line 53-54);
testing the semi-assembled electronic device (Fig. 7, ref. 720, 730, 740, 743, 745; col. 2, lines 62-65; col. 6, lines 54-62);
performing end-of-line functional testing (Fig. 7,ref. 750, 760, 765, 770; col. 6, line 63 - col. 7, line 10);
performing final acoustic testing of the electronic device (col. 7, line 7-8).

3.2 The subject-matter of claim 1 therefore differs from this known method in that the wireless electronic device is a wireless earpiece.

3.3 However, the testing method described in D1 is presented as suited for performing the testing during the production phase of any wireless electronic devices (see claim 6); it would thus come within the scopes of a skilled person to adapt it for performing the testing during the production phase of a wireless earpiece, according to circumstances and testing requirements, without the involvement of any inventive activities.

The subject matter of claim 1 is therefore not inventive (Article 33(3) PCT).

3.4 The further independent **claim 15** corresponds closely in its scope to the scope of claim 1, and is thus not allowable for lack of inventive step of its subject matter, for the same reasons given above for claim 1.

3.5 Regarding **claim 11**, stereo earpieces communicating with each other using near field magnetic induction are well known (see, for example, D3, Fig. 2 and abstract); adapting the testing method shown in D1 for also performing testing during the production phase of such stereo earpieces would not involve the exercise of any inventive activity.

4 Dependent **claims 2-10, 12-14, 16-19** do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step, for the following reasons:

Document D1 further discloses the additional subject matter of **claim 2** (testing jigs: Fig. 1A, 1B; col. 4, lines 45-55), **claims 3, 18** (panels: col. 2, lines 58-61), **claim 5** (col. 5, lines 10-12), **claim 6** (audio testing: col. 7, line 7-8), **claim 7** (shielding during testing: Fig. 5; col. 6, lines 15-26), **claim 12** (computing device: see col. 7, lines 37-41; Fig. 5, ATE 520a, 520b).

Regarding **claim 4**, see arguments put forward against claim 11, under point 3.5 above.

Regarding **claims 8, 9, 13, 14, 16, 19** the test to be performed on the PCBs depend just on circumstances and project requirements, and their choice does not involve the exercise of any inventive activities (see col. 2, lines 56-60).

In **claims 10, 17** the expressions "lateral segment" and "medial segment" are not technically well recognized, and leave the reader in doubt about the technical features to which they refer, thereby rendering the subject matter of said claims unclear (Art. 6 PCT). Moreover, it is not clear in the expressions "copy(ing) all files onto the wireless earpiece" to which files it is referred to.

Re Item VIII

5 The application does not meet the requirements of Article 6 PCT, because **claims 1, 11, 15** are not clear, for the following reasons:

5.1 In claims 1, 11 reference is made to "the semi-assembled wireless earpiece", for which however there is no antecedent, thus rendering the subject matter of said claims unclear.

5.2 In claim 15, the expression "perform semi-assembly testing of the wireless earpiece" is not technically well recognized, and leaves the reader in doubt about the technical features to which it refers, thereby rendering the subject matter of said claim unclear.

Bitte beachten Sie, dass angeführte Nichtpatentliteratur (wie z. B. wissenschaftliche oder technische Dokumente) je nach geltendem Recht dem Urheberrechtsschutz und/oder anderen Schutzarten für schriftliche Werke unterliegen könnte. Die Vervielfältigung urheberrechtlich geschützter Texte, ihre Verwendung in anderen elektronischen oder gedruckten Publikationen und ihre Weitergabe an Dritte ist ohne ausdrückliche Zustimmung des Rechtsinhabers nicht gestattet.

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XS CPETENFRDE

[illegible]

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
Nilsson, Peter
Dilg, Haeusler, Schindelmann
Patentanwaltsgesellschaft mbH
Leonrodstrasse 58
80636 München
ALLEMAGNE

DILG · HAEUSLER · SCHINDELMANN
Patentanwalts GmbH
17. Okt. 2016
FRIST 24 0 2016

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference H 1194 WO	Date of mailing *(day/month/year)* 18 October 2016 (18-10-2016) **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/EP2016/070216	International filing date *(day/month/year)* 26 August 2016 (26-08-2016)
Applicant BRAGI GMBH	

1. [X] The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46).

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the International Search Report.

   How? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70

   For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 - 9.011.

2. [ ] The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. [ ] **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   [ ] the protest together with the decision thereon has been transmitted to the International Bureau together with any applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   [ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **19 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the International Searching Authority European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040 Fax: (+31-70) 340-3016	Authorized officer BAUMANN, Harald Tel: +49 (0)89 2399-2131

Form PCT/ISA/220 (July 2014)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
H 1194 WO		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP2016/070216	26 August 2016 (26-08-2016)	29 August 2015 (29-08-2015)
Applicant		
BRAGI GMBH		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

[X] the international application in the language in which it was filed

[ ] a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. [ ] **Certain claims were found unsearchable** (See Box No. II)

3. [ ] **Unity of invention is lacking** (see Box No III)

4. With regard to the **title,**

[X] the text is approved as submitted by the applicant

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

[X] the text is approved as submitted by the applicant

[ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings,**

a. the figure of the **drawings** to be published with the abstract is Figure No. 1

[X] as suggested by the applicant

[ ] as selected by this Authority, because the applicant failed to suggest a figure

[ ] as selected by this Authority, because this figure better characterizes the invention

b. [ ] none of the figures is to be published with the abstract

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/070216

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04B5/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04B H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/073070 A1 (ROFOUGARAN AHMADREZA REZA [US]) 19 March 2009 (2009-03-19) paragraphs [0009], [0059] figure 8	1-8
Y	US 8 436 780 B2 (SCHANTZ HANS GEGORY [US] ET AL) 7 May 2013 (2013-05-07) figures 4a,4b	1-7,17
X	US 2010/203831 A1 (MUTH JAMES MICHAEL [US]) 12 August 2010 (2010-08-12)	9,11-16
Y	figures 1-4 paragraphs [0018], [0024], [0025]	3,8,10, 17,18
X	US 8 300 864 B2 (MULLENBORN MATTHIAS [DK] ET AL) 30 October 2012 (2012-10-30)	19
Y	column 6, line 34 - line 52 figure 1b	10,18

-/--

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 October 2016	18/10/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax (+31-70) 340-3016	Avilés Martínez, L

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 424 820 B1 (BURDICK WAYNE A [US] ET AL) 23 July 2002 (2002-07-23) paragraph [0059] figures 1-6 figures 11(A), 11(B)	1-19

1

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009073070 A1	19-03-2009	US 2009073070 A1	19-03-2009
		US 2012034869 A1	09-02-2012
		US 2013052953 A1	28-02-2013
US 8436780 B2	07-05-2013	NONE	
US 2010203831 A1	12-08-2010	US 2010203831 A1	12-08-2010
		US 2012242294 A1	27-09-2012
US 8300864 B2	30-10-2012	CN 101605293 A	16-12-2009
		EP 2129088 A1	02-12-2009
		US 2009296967 A1	03-12-2009
US 6424820 B1	23-07-2002	NONE	

Information on Search Strategy - Pilot phase (see OJ 2015, A66)
The type of information contained in this sheet may change during the pilot for improving the usefulness of this new service.

Application Number
PCT/EP2016/070216

TITLE: ANTENNA FOR USE IN A WEARABLE DEVICE

APPLICANT: BRAGI GMBH

IPC CLASSIFICATION: H04B5/00

EXAMINER: Avilés Martínez, L

CONSULTED DATABASES: WPI

CLASSIFICATION SYMBOLS DEFINING EXTENT OF THE SEARCH:

IPC:

CPC: H04B5, H01Q1, H04B5/0006

FI/F-TERMS:

KEYWORDS OR OTHER ELEMENTS FEATURING THE INVENTION:

EPO FORM P0A32

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

DR. [illegible] HELMANN
[illegible]
12 DEC. 2016

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2016/070216	26.08.2016	29.08.2015

International Patent Classification (IPC) or both national classification and IPC
INV. H04B5/00

Applicant
BRAGI GMBH

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465	see form PCT/ISA/210	Avilés Martínez, I. Telephone No. +49 89 2399-0

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-8, 10-19
	No:	Claims	9
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-19
Industrial applicability (IA)	Yes:	Claims	1-19
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: US2009073070

D2: US8436780

D3: US2010203831

D4: US8300864

2. Article 33(3) PCT

The present application does not meet the criteria of Article 33(3) PCT, because the subject-matter of claim 1 does not involve an inventive step.

Document D1 is regarded as being the prior art closest to the subject-matter of claim 1, and discloses :

A wearable device (paragraph 9), comprising:
a housing (implicit);
a first short range transceiver for far field communication (fig. 8 (42'-46') and paragraph 69) disposed within the housing;
a second short range transceiver for near field communication (fig. 8 (42-46) and paragraph 69) disposed within the housing;

wherein the second short range transceiver for near field communications comprises

a core and a plurality of coil turns wrapped around the core (paragraph 59 : "*the coil antenna 96 is a round or u-shaped ferrite core with windings, a magnetic coupling with a tag occurs in near field mode*");

a generally planar printed circuit board disposed within the housing and having a plurality of components mounted thereto (implicit in RFID circuits);

Claim 1 differs from D1 it that it further discloses that:

(i) the core is mounted perpendicularly to the plurality of components mounted on the generally planar printed circuit board to thereby reduce electromagnetic interference.

This Authority is of the opinion that the position of the core respective the PCB represent one of the possible alternatives that a skilled person would choose, without involving an inventive exercise, see D2 (fig. 4a , 4b), and therefore claim 1 is not inventive.

3. Article 33(2) PCT

The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 9 is not new in the sense of Article 33(2) PCT.

Document D3 discloses:

A system (fig. 4) comprising:
a first wearable device (fig. 4 (402));
a second wearable device (fig. 4 (404));
wherein each of the first wearable device and the second wearable device comprises a housing, a first short range transceiver for far field communication (fig. 4 (Bluetooth transceiver 408, 412)) disposed within the housing, and a second short range transceiver for near field communication (fig. 4 (414, 410)) disposed within the housing.

The subject-matter of claim 9 is thus not new, Article 33(2) PCT.

4. Dependent claims 2-8, 9-18 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step for the following reasons:

claim 2: see D4 (fig. 1b)

claims 3, 13: design option

claims 4, 14: see D1 (paragraph 59)

claims 5, 6, 15, 16: The features of these claims are merely one of several straightforward possibilities from which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill, in order to solve the problem posed.

claims 7, 17: normal design option, see D2 (fig. 4a, 4b and column 6, 36-54)

claims 8, 18: see D3 (fig. 4)

claim 10: see D4 (fig. 1b and column 6, lines 34-51)

claim 11 : see D1

claim 12: see D2

claim 19: see D4 (fig. 1b and column 6, lines 34-52)

Re Item VII

Certain defects in the international application

1. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

2. A document reflecting the prior art described on page 1, is not identified in the description (Rule 5.1(a)(ii) PCT).

Re Item VIII

Certain observations on the international application

1. Claims 1, 9 and 19 have been drafted as separate independent claims.

However, according to the description page 1 the problem to be solved is to reduce the interferences between a near field antenna and the different components of a wireless wearable device, which is solved by the feature :

(i) the core is mounted perpendicularly to the plurality of components mounted on the generally planar printed circuit board to thereby reduce electromagnetic interference.

It is therefore clear from the description that the above feature is essential to the definition of the invention.

Since independent claims 9 and 19 do not contain this feature it does not meet the requirement following from Article 6 PCT taken in combination with Rule 6.3(b) PCT that any independent claim must contain all the technical features essential to the definition of the invention.

2. In the present case, it would be appropriate to formulate one single independent claim containing all the features which are essential for the definition of the invention

3. Claim 1 does not meet the requirements of Article 6 PCT because the matter for which protection is sought is not clearly defined. It is not explicitly disclosed, and not clear to the skilled person how the position of the core reduces the interference. The claim attempts to define the subject-matter in terms of the result to be achieved, which merely amounts to a statement of the underlying problem, without providing the technical features necessary for achieving this result.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:
Nilsson, Peter
Dilg, Haeusler, Schindelmann
Patentanwaltsgesellschaft mbH
Leonrodstrasse 58
80636 München
ALLEMAGNE

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference H 1195 WO	Date of mailing *(day/month/year)* 9 January 2017 (09-01-2017) **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/EP2016/070228	International filing date *(day/month/year)* 26 August 2016 (26-08-2016)
Applicant BRAGI GMBH	

1. [X] The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46).

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the International Search Report.

   How? Directly to the International Bureau of WIPO, 34 chemin des Colombettes, 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70

   For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 - 9.011.

2. [ ] The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. [ ] **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   [ ] the protest together with the decision thereon has been transmitted to the International Bureau together with any applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   [ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **19 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the International Searching Authority European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040 Fax: (+31-70) 340-3016	Authorized officer TOUYSSERKANI, Tanja Tel: +49 (0)89 2399-2161

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
H1195 WO		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP2016/070228	26 August 2016 (26-08-2016)	29 August 2015 (29-08-2015)
Applicant		
BRAGI GMBH		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language,** the international search was carried out on the basis of:
      [X] the international application in the language in which it was filed
      [ ] a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.
2. [ ] **Certain claims were found unsearchable** (See Box No. II)
3. [ ] **Unity of invention is lacking** (see Box No III)
4. With regard to the **title,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established by this Authority to read as follows:
5. With regard to the **abstract,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority
6. With regard to the **drawings,**
   a. the figure of the **drawings** to be published with the abstract is Figure No. 1
      [X] as suggested by the applicant
      [ ] as selected by this Authority, because the applicant failed to suggest a figure
      [ ] as selected by this Authority, because this figure better characterizes the invention
   b. [ ] none of the figures is to be published with the abstract

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/070228

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04M1/05
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04M G06F H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2005/212911 A1 (MARVIT DAVID L [US] ET AL) 29 September 2005 (2005-09-29) paragraph [0034] - paragraph [0035] paragraph [0103] - paragraph [0109] paragraph [0166] figures 1,2 paragraph [0052] -----	1-8, 11-15 9,10
X Y	US 2013/154826 A1 (RATAJCZYK CHRIS [US]) 20 June 2013 (2013-06-20) paragraph [0014] paragraph [0034] paragraph [0038] - paragraph [0042] paragraph [0049] - paragraph [0050] ----- -/--	1,3,11, 14 9,10

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 December 2016	09/01/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax. (+31-70) 340-3016	Maciejewski, Robert

2

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	US 2013/293494 A1 (RESHEF GILAD [HK]) 7 November 2013 (2013-11-07) paragraph [0062] abstract figure 3	1-15
X	US 2011/018731 A1 (LINSKY JOEL BENJAMIN [US] ET AL) 27 January 2011 (2011-01-27) paragraphs [0006] - [0011] paragraph [0064] - paragraph [0066] paragraph [0071] - paragraph [0080] paragraph [0088] - paragraph [0093] claims 1,8,	1-8,14, 15
X	US 2009/303073 A1 (GILLING ERIK [US] ET AL) 10 December 2009 (2009-12-10) paragraph [0023] - paragraph [0026] claims 1-10	1-8,11, 12,14,15

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005212911 A1	29-09-2005	CN 101329600 A	24-12-2008
		US 2005212911 A1	29-09-2005
US 2013154826 A1	20-06-2013	NONE	
US 2013293494 A1	07-11-2013	US 2013293494 A1	07-11-2013
		US 2015378438 A1	31-12-2015
		WO 2013163943 A1	07-11-2013
US 2011018731 A1	27-01-2011	CN 102473024 A	23-05-2012
		CN 102473025 A	23-05-2012
		CN 102483640 A	30-05-2012
		CN 105183155 A	23-12-2015
		EP 2457136 A1	30-05-2012
		EP 2457137 A1	30-05-2012
		EP 2457138 A1	30-05-2012
		JP 5670452 B2	18-02-2015
		JP 5694318 B2	01-04-2015
		JP 6009515 B2	19-10-2016
		JP 2013500521 A	07-01-2013
		JP 2013500522 A	07-01-2013
		JP 2013500523 A	07-01-2013
		JP 2014222524 A	27-11-2014
		JP 2015046173 A	12-03-2015
		KR 20120047970 A	14-05-2012
		KR 20120056832 A	04-06-2012
		KR 20140119786 A	10-10-2014
		US 2011018731 A1	27-01-2011
		US 2011018794 A1	27-01-2011
		US 2011022196 A1	27-01-2011
		WO 2011011746 A1	27-01-2011
		WO 2011011750 A1	27-01-2011
		WO 2011011751 A1	27-01-2011
US 2009303073 A1	10-12-2009	NONE	

Information on Search Strategy - Pilot phase (see OJ 2015, A96)
The type of information contained in this sheet may change during the pilot for improving the usefulness of this new service.

Application Number
PCT/EP2016/070228

TITLE: RESPONSIVE VISUAL COMMUNICATION SYSTEM AND METHOD

APPLICANT: BRAGI GMBH

IPC CLASSIFICATION: H04M1/05

EXAMINER: Maciejewski, Robert

CONSULTED DATABASES: EPODOC, WPI

CLASSIFICATION SYMBOLS DEFINING EXTENT OF THE SEARCH:

IPC:

CPC: H04M1/05, H04M1/6066, H04M1/7253, G06F3/017, H04B1/385, G06F1/163, G06F3/016

FI/F-TERMS:

KEYWORDS OR OTHER ELEMENTS FEATURING THE INVENTION:
A wearable device providing responsive visual feedback based on a mode of operation determined by the processor.

EPO FORM P04A42

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

SEER - SCHNUCKENMANN
Patentanwälte GmbH
09. Jan. 2017
FRIST 26.02.2017

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2016/070228	26.08.2016	29.08.2015

International Patent Classification (IPC) or both national classification and IPC
INV. H04M1/05

Applicant
BRAGI GMBH

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465	see form PCT/ISA/210	Maciejewski, Robert Telephone No. +49 89 2399-0

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	2, 7-10, 12, 13, 15
	No:	Claims	1, 3-6, 11, 14
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-15
Industrial applicability (IA)	Yes:	Claims	1-15
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1 US 2005/212911 A1 (MARVIT DAVID L [US] ET AL) 29 September 2005 (2005-09-29)

D2 US 2013/154826 A1 (RATAJCZYK CHRIS [US]) 20 June 2013 (2013-06-20)

D3 US 2013/293494 A1 (RESHEF GILAD [HK]) 7 November 2013 (2013-11-07)

D4 US 2011/018731 A1 (LINSKY JOEL BENJAMIN [US] ET AL) 27 January 2011 (2011-01-27)

D5 US 2009/303073 A1 (GILLING ERIK [US] ET AL) 10 December 2009 (2009-12-10)

1 Document D1, discloses (see the paragraphs cited in Search Report), according to the features of independent claim 1:

a wearable device providing responsive visual feedback, the wearable device ("a handheld device 10:...a watch or any other device capable of being held or worn by a user" - paragraph [0034]) comprising:
a wearable device housing (implicit the watch or any other device capable of being held or worn by a user);
at least one lighting element (display -12) associated with the housing for providing visual feedback ("Display 12 presents visual output of the device and may comprise a liquid crystal display (LCD), a light emitting diode (LED) or any other type of display for communicating output to a user" - paragraph [0035]);
a processor (processor - 16) disposed within the wearable device housing, the processor operatively connected to the at least one lighting element (figure 1);
a plurality of sensors operatively connected to the processor ("Processor 32 processes data from accelerometers 24, cameras 26, gyros 28 and rangefinders 30 to produce an output indicative of the motion of device 10" -

paragraph [0052]);
wherein the processor is programmed to determine a mode of operation using sensed data from the plurality of sensors ("Motion detector 22 tracks movement of handheld device 10 which may be used as a form of input to perform certain functions. Such input movement may result from a user moving the device in a desired fashion to perform desired tasks" - paragraph [0038]);
wherein the processor is programmed to control the at least one lighting element ("This feedback may comprise ... a visual format" - paragraph [0103]) to convey visual feedback based on the mode of operation determined by the processor ("Different types of feedback may also be context or application specific in some embodiments. Different contexts might include device state, such as what application is in focus or use, battery level, and available memory, as well as states defined by the user, such as quiet or silent mode.").

Hence, claim 1 at least do not satisfy the criterion set forth in Article 33(1) and (2) PCT.

A similar novelty objection could also have been raised based on the disclosure of documents D2 (see the paragraphs cited in Search Report), D3 (see the paragraphs cited in Search Report), D4 (see the paragraphs cited in Search Report) and D5 (see the paragraphs cited in Search Report).

2 The additional features of the dependent claims 2-10 do not add anything new or inventive to the subject-matter of the claims on which they depend, for the following reason:

- The additional feature of claim 2 which defines an earpiece as a wearable device, cannot be seen as involving an inventive step.

- The additional features of claim 3, specifying a LED, are known from D1 (a light emitting diode (LED) - paragraph [0035]).

- The additional features of claim 4, which specify an inertial sensor are also known from D1 ("motion detector 22 includes accelerometers 24a, 24b and 24c; cameras 26a, 26b and 26c; gyros 28a, 28b and 28c;" - paragarph [0042]).

- The additional features of claim 5, which define the mode associated with gestural movements, are known from document D1 ("one or more recognized gestures have their own respective feedback" - paragraph [0103]).

- The additional features of claim 7, which specify that the mode is associated with battery level access, are known from D1 ("battery level" - paragraph [0103]).

- The additional features of claims 7 and 8 specifying that the modes are associated with charging and diagnostic belong to the state of the art.

- The additional features of claim 9 and 10, which define a computing device which can be programmed for feedback indicators of associated wearable, device are at least not inventive at least in the light of disclosure of document D2. D2 mentions a computing device which can be programmed for notification indicators of associated wearable device connected over the short range communication. Thus, combination of documents D1 and D2 is justified.

As a consequence, dependent claims 2 to 10 do not meet the requirements of Article 33(1) PCT.

3 Notwithstanding the clarity objection of claim 11 (see section VIII) and as far as its wording can be understood the subject-matter of independent claim 11 corresponds in terms of system features to that of claim 1. Additionally, claim 11 specifies a second wearable device comprising the same features as the first wearable device. No clear collaboration of the two devices could be determined. As a consequence, the objection raised in respect of claim 1 applies also to independent claim 11. Thus, the criteria of Article 33(1) and (2) PCT are not met.

4 The subject-matter of claims 12,13 corresponds to that of claim 2 and also does not meet the requirements of Article 33(1) PCT.

5 The subject-matter of independent claim 14 corresponds in terms of method features to that of claim 1. The objection raised in respect of claim 1 therefore also applies mutatis mutandis to independent claim 14.

As a consequence, the criteria of Article 33(1) and (2) PCT are not met.

6 The subject-matter of claim 15 corresponds in terms of method features to that of claim 2. Therefore, the objections raised in paragraph 2 above apply equally to claim 15 which does consequently not meet the requirements of Article 33(1) PCT.

Re Item VII

Certain defects in the international application

The independent claims are not in the two-part form in accordance with Rule 6.3(b) PCT, with those features known from the prior art being placed in the preamble (Rule 6.3(b)(I) PCT) and with remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

The requirements of Rule 5.1(a)(ii) PCT are not fulfiled, as the relevant prior art of documents D1-D3 are not identified in the description and the relevant background art disclosed therein briefly discussed.

The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Re Item VIII

Certain observations on the international application

Claim 11 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The functional statement "the first device wearable device and the second wearable device are configured to work in concert to convey visual feedback" does not enable the skilled person to determine which technical features are necessary to perform the stated function.

The same applies to "recover the data" of claim 9, which is also vague (Article 6 PCT).

Claim 15 does not meet the requirements of Article 6 PCT because its category is not clear. In contrast to the wording of the preamble which suggests the definition of a method, the features describe a device (earpiece).

The expression "herein incorporated by reference" (see page 1, line 8) should be deleted (see the PCT-Guidelines 4.26 and 4.27)

Electronic Acknowledgement Receipt

EFS ID:	34147414
Application Number:	16144338
International Application Number:	
Confirmation Number:	3503
Title of Invention:	Power Control for Battery Powered Personal Area Network Device System and Method
First Named Inventor/Applicant Name:	Eric Christian Hirsch
Customer Number:	133690
Filer:	Kyle S. Coleman/Ashlyn Nguyen
Filer Authorized By:	Kyle S. Coleman
Attorney Docket Number:	BRAGI GmbH-P0017C2
Receipt Date:	29-OCT-2018
Filing Date:	27-SEP-2018
Time Stamp:	16:11:54
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Non Patent Literature	BRAGIGmbH-P0017PCT_PCTEP1670245_ISR-WRITTEN-OPINION_11-16-16.pdf	3456152 cf79838fc1686da3d8982d5a03b9f01741cc15ee	no	10

Warnings:

Information:					
2	Non Patent Literature	BRAGIGmbH-P0009PCT_PCTEP1670231_ISR-WRITTEN-OPINION_EFS_11-18-16.pdf	4549449 7951ac08c80fbfb0f4ca9e1715ac74061d422bb1	no	12
Warnings:					
Information:					
3	Non Patent Literature	BRAGIGmbH-P0002PCT_PCTEP1670247_ISR-WRITTEN-OPINION_11-18-16.pdf	4622845 7650f0fbde40bfbe39263e3b19516343e00e3d17	no	13
Warnings:					
Information:					
4	Non Patent Literature	BRAGIGmbH-P0003PCT_PCTEP1670216_ISR-WRITTEN-OPINION_10-18-16.pdf	4311349 88e3335118cfac698bc51557c0aedb224fe8eac2	no	13
Warnings:					
Information:					
5	Non Patent Literature	BRAGIGmbH-P0004PCT_PCTEP1670228_ISR-WRITTEN-OPINION_3-8-17.pdf	2631128 55470576b10cfcb4e51864078809a02e2b0a62a5	no	13
Warnings:					
Information:					
6	Non Patent Literature	Jain_Score-normalization-in-multimodal-biometric-systems.pdf	9358382 58dc0f8bacaa564af3946b42c4709ae6c9e8aebc	no	16
Warnings:					
Information:					
7	Non Patent Literature	Update9Mar282014.pdf	1423870 4cf7ae68f6250a2a037af887eccd7f689b264bbe	no	7
Warnings:					
Information:					
8	Non Patent Literature	Touch-ID-built-into-iPhone-display-one-step-closer_efs.pdf	3273054 1bddf6d58803b237b53154c96d70d9ddabccae42	no	14
Warnings:					
Information:					

9	Non Patent Literature	Nemanja_Paunovice_A-methodology-for-testing-complex_2-1-2012.pdf	5078357 27fe5fc1e24de26801ce930f471dab027e9a056b	no	10
Warnings:					
Information:					
10	Non Patent Literature	NIGEL_WHITFIELD_FAKE_TAPE_DETECTORS_REF.pdf	2111942 b4cbd4c416c1b2447b1cab0825e1e0987585dd26	no	6
Warnings:					
Information:					
11	Non Patent Literature	Nuance_ING-Netherlands-Launches-Voice-Biometrics-Payment-System_efs.pdf	944498 d3f623d6095b3a6d3d1b03e6ae533e49bb5a26f0	no	4
Warnings:					
Information:					
12	Non Patent Literature	A_one_size_disposable_hearing_aid_is_introduced.pdf	123404 59f9e5ef510a9f3c2fe9d2eb3cbb2ddbd5dfcb8f	no	4
Warnings:					
Information:					
13	Non Patent Literature	Update2February142014.pdf	3598244 2ca6f0a27927283cdc7c272e84a37656d5daeac2	no	14
Warnings:					
Information:					
14	Non Patent Literature	Update1February122014.pdf	1583282 a74d728f7a8f6c4c51cc1c50f8083f1f58fa37d2	no	9
Warnings:					
Information:					
15	Non Patent Literature	Update3February172014.pdf	5792675 0611de3026e03cbe58328b344f52cbcd9e1a7454	no	17
Warnings:					
Information:					

16	Non Patent Literature	Update4February212014.pdf	3421673 08e02601621bf68704a9300b182ddc292a1339e6	no	12
Warnings:					
Information:					
17	Non Patent Literature	Update6March112014.pdf	1657923 6a289bf052152e8c3d94a7ee3334135d87dc28b5	no	7
Warnings:					
Information:					
18	Non Patent Literature	update7March222014.pdf	2478404 34a502168e354a432fdd977e1c7f01318aeb41ab	no	11
Warnings:					
Information:					
19	Non Patent Literature	Weisiger_Conjugated_Hyperbilirubinemia_1-5-16.pdf	603771 ea8a93149324b88025dbc8db4222011e649ce10f	no	2
Warnings:					
Information:					
20	Non Patent Literature	Wertzner_Analysis-of-fundamental-frequency_2005.pdf	3874338 c18e26a6d78c10f1115d623a04633685286118c88	no	7
Warnings:					
Information:					
		Total Files Size (in bytes):	64894740		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

(19)中华人民共和国国家知识产权局

(12)发明专利申请

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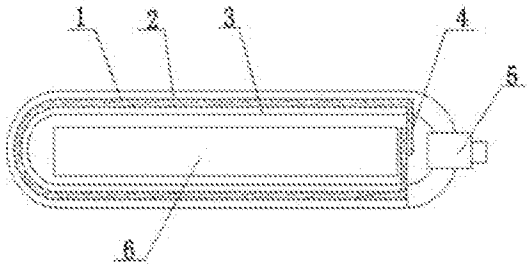
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(54)发明名称

一种具有屏蔽信号功能的手机套

(57)摘要

一种具有屏蔽信号功能的手机套，由皮质外壳(1)、石墨烯膜层(2)、棉质内衬(3)、拉链(4)、石墨烯膜搭边(5)组成，其特征在于：所述的石墨烯膜层(2)被缝制在皮质外壳(1)和棉质内衬(3)所形成的夹层内，拉链(4)将皮质外壳(1)的二端缝制在一起，再用石墨烯膜搭边(5)缝制在拉链(4)的内侧。本发明，可以有效的屏蔽所有来自于外界来到手机信号，使得用户在使用时，不会因为是否关机而纠结。



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1. 一种具有屏蔽信号功能的手机套，由皮质外壳(1)、石墨烯膜层(2)、棉质内衬(3)、拉链(4)、石墨烯膜搭边(5)组成，其特征在于：所述的石墨烯膜层(2)被缝制在皮质外壳(1)和棉质内衬(3)所形成的夹层内，拉链(4)将皮质外壳(1)的二端缝制在一起，再用石墨烯膜搭边(5)缝制在拉链(4)的内侧。

2. 根据权利要求 1 所述的一种具有屏蔽信号功能的手机套，其特征在于：所述的石墨烯膜搭边(5)为两片，将拉链(4)的开口处封上，石墨烯膜搭边(5)和石墨烯膜层(2)使得手机套内形成了一个密不透风的屏蔽层，手机(6)放入手机套内，并将拉链(4)拉上，屏蔽了手机套内外的信号。

一种具有屏蔽信号功能的手机套

技术领域

[0001] 本发明涉及一种具有屏蔽信号功能的手机套，尤其适合于需要在一段时间内让手机无法正常通行时使用。

背景技术

[0002] 在参加一些重要会议和接待客人时，手机响是一个非常不礼貌的行为，会直接影响谈判事务的成败。但是如果在处理事情时将手机关闭，有时又会影响到其他客户，因为在工作时间关机，是对打电话进来的人的蔑视。所以最好的办法是让手机在这段时间内没有信号。对方打电话进来时会被告知“对方不在服务区”。而不是“对方已关机”。对方不在服务区有时会经常出现，比如在高铁上，隧道内等。所以不会因为你不接电话而影响你在客户那里的影响。

发明内容

[0003] 针对以上不足，本发明的目的在于提供了一种具有屏蔽信号功能的手机套，是采用石墨烯膜缝制成的口袋，将其和真皮缝合在一起，将手机放入里面信号会被石墨烯材料屏蔽，从而达到手机在放入手机套后没有信号的功能。

[0004] 本发明的技术方案是通过以下方式实现的：一种具有屏蔽信号功能的手机套，由皮质外壳、石墨烯膜层、棉质内衬、拉链、石墨烯膜搭边组成，其特征在于：所述的石墨烯膜层被缝制在皮质外壳(1)和棉质内衬所形成的夹层内，拉链将皮质外壳的二端缝制在一起，再用石墨烯膜搭边缝制在拉链的内侧。

[0005] 所述的石墨烯膜搭边为两片，将拉链的开口处封上，石墨烯膜搭边和石墨烯膜层使得手机套内形成了一个密不透风的屏蔽层，手机放入手机套内，并将拉链拉上，屏蔽了手机套内外的信号。

[0006] 本发明，可以有效的屏蔽所有来自于外界来到手机信号，使得用户在使用时，不会因为是否关机而纠结。

附图说明

[0007] 图 1 是本发明示意图。

[0008] 图 2 是本发明打开示意图。

具体实施方式

[0009] 由图 1、图 2 知，一种具有屏蔽信号功能的手机套，由皮质外壳 1、石墨烯膜层 2、棉质内衬 3、拉链 4、石墨烯膜搭边 5 组成，所述的石墨烯膜层 2 被缝制在皮质外壳 1 和棉质内衬 3 所形成的的夹层内，拉链 4 缝制在手机套的开口处，石墨烯膜搭边 5 缝制在拉链 4 内侧。所述的皮质外壳 1 和棉质内衬 3 组成一个手机套的外体。石墨烯膜层 2 被缝制在皮质外壳 1 和棉质内衬 3 所形成的的夹层内，保证手机套的外体在手机 6 放入后，信号不会通过手机

套的外体传输到手机 6 上，所述的拉链 4 缝制在手机套的开口处，石墨烯膜搭边 5 缝制在拉链 4 内侧，将手机 6 放入手机套后，将拉链 4 拉上，将手机套关上，两片石墨烯膜搭边 5 将拉链 4 的开口处封上，石墨烯膜搭边 5 和石墨烯膜层 2 使得手机套内形成了一个密不透风的屏蔽层，完全屏蔽从手机套外进入封信号。

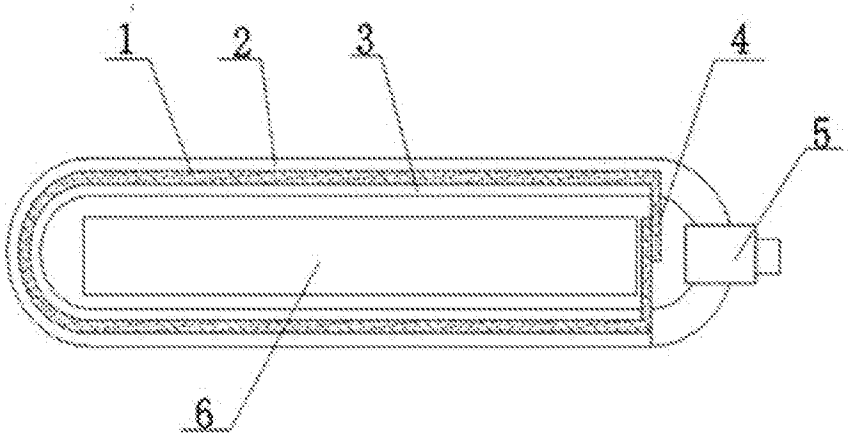


图 1

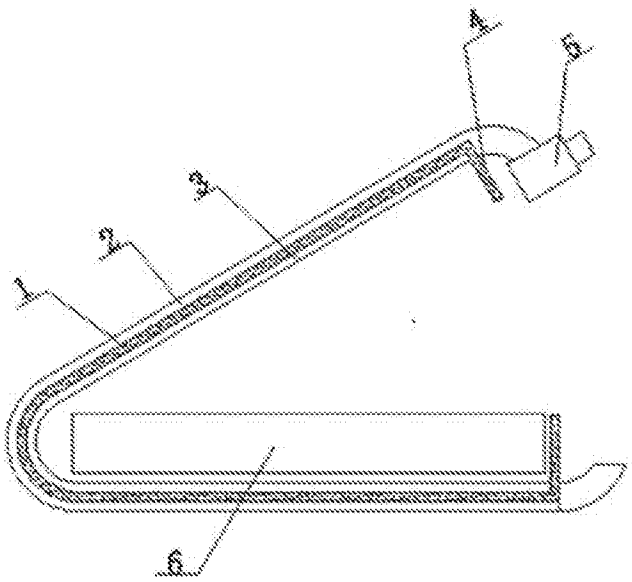


图 2

Espacenet

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Mobile phone case with signal shielding function

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Abstract of CN104683519 (A)

The invention relates to a mobile phone case with a signal shielding function. The mobile phone case consists of a leather housing (1), a graphene film layer (2), a cotton liner (3), a zipper (4), and a graphene film overlapped edge (5), and is characterized in that the graphene film layer (2) is sewn in an interlayer formed by the leather housing (1) and the cotton liner (3); both ends of the leather housing (1) are sewn together by the zipper (4) and then are sewn inside the zipper (4) by the graphene film overlapped edge (5). According to the mobile phone case, all mobile phone signals from the outsides can be effectively shielded, so that a user cannot be entangled due to shutdown when using a mobile phone.

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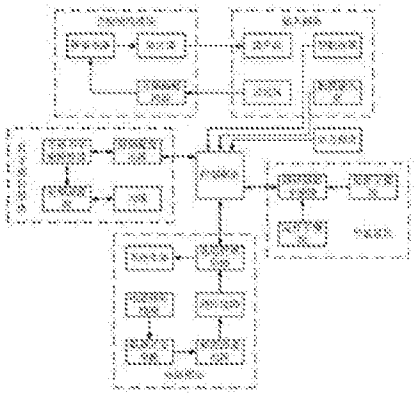
权利要求书1页 说明书3页 附图1页

(54)发明名称

一种集成导航功能的蓝牙耳机

(57)摘要

本发明公开了一种集成导航功能的蓝牙耳机，它包括控制模块、导航模块、音频处理模块、用于语音播报导航路径的语音模块、输入模块、电源模块和蓝牙通信模块，所述导航模块、音频处理模块、语音模块、输入模块、电源模块和蓝牙通信模块均与控制模块连接，控制模块、导航模块、音频处理模块、语音模块、输入模块和蓝牙通信模块均与电源模块连接。本发明采用无线充电技术，消除了因电源线与电源插口之间因接触不良而产生的充电问题，可以通过语音为用户进行导航，并且通过语音模块为用户播报导航路径，方便用户使用。



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1. 一种集成导航功能的蓝牙耳机，其特征在于：它包括控制模块、导航模块、音频处理模块、用于语音播报导航路径的语音模块、输入模块、电源模块和蓝牙通信模块，所述导航模块、音频处理模块、语音模块、输入模块、电源模块和蓝牙通信模块均与控制模块连接，控制模块、导航模块、音频处理模块、语音模块、输入模块和蓝牙通信模块均与电源模块连接。

2. 根据权利要求 1 所述的一种集成导航功能的蓝牙耳机，其特征在于：所述导航模块包括用于获取用户当前位置信息的定位子模块、用于存储电子地图数据的地图子模块和用于进行路径规划的路径规划子模块，路径规划子模块分别与定位子模块、地图子模块和控制模块连接。

3. 根据权利要求 1 所述的一种集成导航功能的蓝牙耳机，其特征在于：所述电源模块包括充电电池、用于接收电能的电能接收线圈、整流滤波电路、调压电路和充电管理电路，电能接收线圈的电流输出端与整流滤波电路的电流输入端连接，整流滤波电路的电流输出端与调压电路的电流输入端连接，调压电路的电流输出端与充电管理电路的电流输入端连接，充电管理电路的电流输出端与充电电池的电流输入端连接，充电管理电路与控制模块连接进行数据交换。

4. 根据权利要求 3 所述的一种集成导航功能的蓝牙耳机，其特征在于：所述电能接收线圈和整流滤波电路之间设置有隔离式安全栅。

5. 根据权利要求 1 所述的一种集成导航功能的蓝牙耳机，其特征在于：所述输入模块包括用于启动 / 关闭导航功能的导航按键、用于输入导航目的地的触摸输入屏、扬声器和麦克风，导航按键和触摸输入屏均与控制模块连接，所述扬声器和麦克风均与音频处理模块连接。

6. 根据权利要求 5 所述的一种集成导航功能的蓝牙耳机，其特征在于：所述音频处理模块包括音频编解码器、降噪电路和放大器，所述音频编解码器通过降噪电路与放大器连接，放大器与扬声器连接，音频编解码器还与麦克风连接，放大器还与控制电路模块连接。

7. 根据权利要求 1 所述的一种集成导航功能的蓝牙耳机，其特征在于：所述蓝牙通信模块包括射频收发电路、平衡不平衡转换器、射频滤波器和天线，天线通过射频滤波器与平衡不平衡转换器连接，平衡不平衡转换器与射频收发电路连接，射频收发电路与控制模块连接。

一种集成导航功能的蓝牙耳机

技术领域

[0001] 本发明涉及耳机技术领域，特别是涉及一种集成导航功能的蓝牙耳机。

背景技术

[0002] 目前常用的是汽车导航仪，该导航仪一般体积较大，不便于携带，耳机是一种可以随身携带的小型电子设备。目前市场上的耳机一般是用来实现对电子产品如收音机、MP3、MP4、移动电话或个人数位助理（PDA）等中音频内容的播放。目前的耳机并不具有导航的功能，因此也无法通过语音方式的实现对出行者的指导。

发明内容

[0003] 本发明的目的在于克服现有技术的不足，提供一种集成导航功能的蓝牙耳机，采用无线充电技术，可以通过语音为用户进行导航。

[0004] 本发明的目的是通过以下技术方案来实现的：一种集成导航功能的蓝牙耳机，它包括控制模块、导航模块、音频处理模块、用于语音播报导航路径的语音模块、输入模块、电源模块和蓝牙通信模块，所述导航模块、音频处理模块、语音模块、输入模块、电源模块和蓝牙通信模块均与控制模块连接，控制模块、导航模块、音频处理模块、语音模块、输入模块和蓝牙通信模块均与电源模块连接。

[0005] 所述导航模块包括用于获取用户当前位置信息的定位子模块、用于存储电子地图数据的地图子模块和用于进行路径规划的路径规划子模块，路径规划子模块分别与定位子模块、地图子模块和控制模块连接。

[0006] 所述电源模块包括充电电池、用于接收电能的电能接收线圈、整流滤波电路、调压电路和充电管理电路，电能接收线圈的电流输出端与整流滤波电路的电流输入端连接，整流滤波电路的电流输出端与调压电路的电流输入端连接，调压电路的电流输出端与充电管理电路的电流输入端连接，充电管理电路的电流输出端与充电电池的电流输入端连接，充电管理电路与控制模块连接进行数据交换。

[0007] 所述电能接收线圈和整流滤波电路之间设置有隔离式安全栅。

[0008] 所述输入模块包括用于启动 / 关闭导航功能的导航按键、用于输入导航目的地的触摸输入屏、扬声器和麦克风，导航按键和触摸输入屏均与控制模块连接，所述扬声器和麦克风均与音频处理模块连接。

[0009] 所述音频处理模块包括音频编解码器、降噪电路和放大器，所述音频编解码器通过降噪电路与放大器连接，放大器与扬声器连接，音频编解码器还与麦克风连接，放大器还与控制电路模块连接。

[0010] 所述蓝牙通信模块包括射频收发电路、平衡不平衡转换器、射频滤波器和天线，天线通过射频滤波器与平衡不平衡转换器连接，平衡不平衡转换器与射频收发电路连接，射频收发电路与控制模块连接。

[0011] 本发明的有益效果是：

（1）本发明设置有导航模块，为用户提供导航功能，并且通过语音模块为用户播报导航路径，方便用户使用；

（2）本发明采用无线充电技术，消除了因电源线与电源插口之间因接触不良而产生的充电问题。

附图说明

[0012] 图 1 为本发明一种集成导航功能的蓝牙耳机的结构框图。

具体实施方式

[0013] 下面结合附图进一步详细描述本发明的技术方案，但本发明的保护范围不局限于以下所述。

[0014] 如图 1 所示，一种集成导航功能的蓝牙耳机，它包括控制模块、导航模块、音频处理模块、用于语音播报导航路径的语音模块、输入模块、电源模块和蓝牙通信模块，所述导航模块、音频处理模块、语音模块、输入模块、电源模块和蓝牙通信模块均与控制模块连接，控制模块、导航模块、音频处理模块、语音模块、输入模块和蓝牙通信模块均与电源模块连接。

[0015] 所述导航模块包括用于获取用户当前位置信息的定位子模块，用于存储电子地图数据的地图子模块和用于进行路径规划的路径规划子模块，路径规划子模块分别与定位子模块、地图子模块和控制模块连接。

[0016] 所述输入模块包括用于启动 / 关闭导航功能的导航按键、用于输入导航目的地的触摸输入屏、扬声器和麦克风，导航按键和触摸输入屏均与控制模块连接，扬声器和麦克风均与音频处理模块连接。

[0017] 用户通过导航按键启动导航功能，并通过触摸输入屏输入目的地，控制模块接收到目的地信息后，将目的地信息传输至路径规划子模块，路径规划子模块通过定位子模块获取用户当前位置信息，并调取通过地图子模块调取电子地图数据，为用户规划路径，完成路径规划得到导航路径后，将导航路径传输至控制模块，控制模块控制语音模块为用户进行语音导航。

[0018] 所所述电源模块包括充电电池、用于接收电能的电能接收线圈、整流滤波电路、调压电路和充电管理电路，所述电能接收线圈的电流输出端与整流滤波电路的电流输入端连接，整流滤波电路的电流输出端与调压电路的电流输入端连接，调压电路的电流输出端与充电管理电路的电流输入端连接，充电管理电路的电流输出端与充电电池的电流输入端连接，所述充电管理电路与控制模块连接进行数据交换。

[0019] 所述电能接收线圈和整流滤波电路之间设置有隔离式安全栅，使得蓝牙信号与无线充电信号之间不会相互干扰，提高了蓝牙通信的质量。

[0020] 所述音频处理模块包括音频编解码器、降噪电路和放大器，所述音频编解码器通过降噪电路与放大器连接，所述放大器与扬声器连接，所述音频编解码器还与麦克风连接，所述放大器还与控制电路模块连接。

[0021] 所述蓝牙通信模块包括射频收发电路、平衡不平衡转换器、射频滤波器和天线，所述天线通过射频滤波器与平衡不平衡转换器连接，所述平衡不平衡转换器与射频收发电路

连接，所述射频收发电路与控制模块连接。

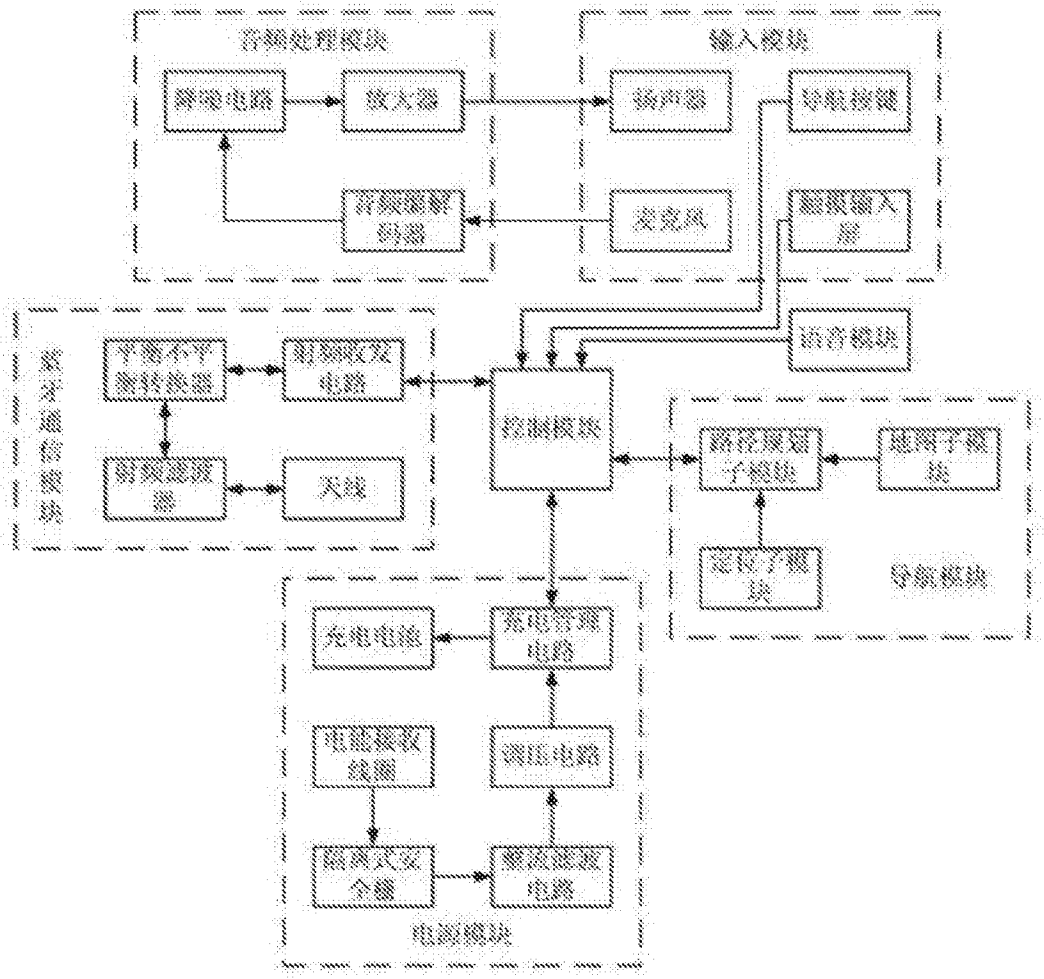

音频处理模块
降噪电路
放大器
扬声器
存储器
麦克风
输入模块
导航按键
数据输入接口
语音模块
短距离通信模块
射频收发电路
天线
控制模块
存储器
导航模块
充电电池
充电管理电路
电能接收线圈
调压电路
整流滤波电路
电源模块

图 1

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DESCRIPTION CN104837094

The invention discloses a Bluetooth headset with integrated navigation function, which comprises a control module, a navigation module, an audio processing module, a voice module for a voice broadcast navigation route, an input module, a power supply module and a Bluetooth communication module, the navigation module, The audio processing module, the voice module, the input module, the power supply module and the Bluetooth communication module are connected with the control module. The control module, the navigation module, the audio processing module, the voice module, the input module and the Bluetooth communication module are connected with the power supply module. The invention adopts the wireless charging technology to eliminate the charging problem caused by the poor contact between the power supply line and the power outlet, and can navigate the user through the voice, and broadcast the navigation route for the user through the voice module, and is convenient for the user to use.

An integrated navigation function for Bluetooth headsets

Technical field

The present invention relates to the field of headphone technology, and more particularly to a Bluetooth headset incorporating an integrated navigation function.

Background technique

At present, the commonly used car navigator, the navigator is generally larger, not easy to carry, headphones is a small electronic equipment can carry. Currently on the market headphones are generally used to achieve the electronic products such as radio, MP3, MP4, mobile phones or personal digital assistants (PDA) and other audio content playback. The current headset does not have the function of navigation, and therefore can not achieve through the voice of the guide to the traveler.

The contents of the invention

It is an object of the present invention to overcome the deficiencies of the prior art and to provide a Bluetooth headset with integrated navigation function, which can be navigated by voice for the user using voice charging technology.

The object of the present invention is achieved by the following technical scheme: a Bluetooth headset incorporating an navigation function comprising a control module, a navigation module, an audio processing module, a voice module for a voice broadcast navigation path, an input module, a power supply module, and The Bluetooth communication module, the navigation module, the audio processing module, the voice module, the input module, the power supply module and the Bluetooth communication module are connected with the control module, the control module, the navigation module, the audio processing module, the voice module, the input module and the Bluetooth communication module Are connected to the power supply module.

The navigation module includes a positioning sub-module for acquiring the current location information of the user, a map sub-module for storing the electronic map data and a path planning sub-module for carrying out the path planning, the path planning sub-module and the positioning sub- The submodule is connected to the control module.

The power supply module comprises a rechargeable battery, a power receiving coil for receiving electric energy, a rectifying filter circuit, a voltage regulating circuit and a charging management circuit. The current output end of the electric energy receiving coil is connected with the current input terminal of the rectifying filter circuit, and the rectifying filter circuit The current output end is connected with the current input terminal of the voltage regulating circuit, the current output end of the voltage regulating circuit is connected with the current input terminal of the charge management circuit, the current output end of the charge management circuit is connected with the current input terminal of the charging battery, Control module connection for data exchange.

And an isolation type safety barrier is arranged between the electric energy receiving coil and the rectifying filter circuit.

The input module includes a navigation button for starting / closing the navigation function, a touch input screen for inputting a navigation destination, a speaker and a microphone, a navigation key and a touch input screen are connected to the control module, both of which are connected to The audio processing module is connected.

The audio processing module comprises an audio codec, a noise reduction circuit and an amplifier, the audio codec is connected with the amplifier through a noise reduction circuit, the amplifier is connected with the loudspeaker, the audio codec is also connected with the microphone, and the amplifier is connected with the control circuit Module connection.

The wireless communication module comprises a radio frequency transmitting and receiving circuit, a balun, an radio frequency filter and an antenna, the antenna is connected with a balun through a radio frequency filter, the balun is connected with the radio frequency transmitting and receiving circuit, the radio frequency transmitting and receiving circuit Control module connection.

The beneficial effects of the present invention are:

（1）

The invention provides a navigation module, provides the navigation function for the user, and broadcasts the navigation route to the user through the voice module, is convenient for the user to use;

（2）

The present invention adopts the wireless charging technology to eliminate the charging problem caused by the poor contact between the power supply line and the power supply socket.

Description of the drawings

1 is a block diagram showing the structure of a Bluetooth headset having an integrated navigation function according to the present invention.

detailed description

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS The present invention will now be described in more detail with reference to the accompanying drawings, but the scope of the present invention is not limited to the following.

As shown in Fig. 1, a Bluetooth headset incorporating an integrated navigation function includes a control module, a navigation module, an audio processing module, a voice module for a voice broadcast navigation path, an input module, a power supply module and a Bluetooth communication module, The module, the audio processing module, the voice module, the input module, the power supply module and the Bluetooth communication module are connected with the control module. The control module, the navigation module, the audio processing module, the voice module, the input module and the Bluetooth communication module are connected with the power module.

The navigation module includes a positioning sub-module for acquiring the current location information of the user, a map sub-module for storing the electronic map data and a path planning sub-module for carrying out the path planning, the path planning sub-module and the positioning sub- The submodule is connected to the control module.

The input module includes a navigation button for starting / closing the navigation function, a touch input screen for inputting a navigation destination, a speaker and a microphone, a navigation key and a touch input screen are connected to the control module, both the speaker and the microphone are processed with the audio Module connection.

The user initiates the navigation function through the navigation key and enters the destination through the touch input screen. After receiving the destination information, the control module transmits the destination information to the path planning sub-module. The path planning sub-module obtains the user's current location information through the positioning sub-module And picks up the electronic map data through the map sub-module, planning the path for the user, completes the path planning to obtain the navigation route, transmits the navigation route to the control module, and controls the control module to control the voice module for the user.

The power supply module comprises a rechargeable battery, an electric energy receiving coil for receiving electric energy, a rectifying filter circuit, a voltage regulating circuit and a charging management circuit, the current output end of the electric energy receiving coil is connected with the current input end of the rectifying filter circuit, The current output end of the filter circuit is connected with the current input end of the voltage regulating circuit, the current output end of the voltage regulating circuit is connected with the current input end of the charge management circuit, the current output end of the charge management circuit is connected with the current input terminal of the rechargeable battery, The charge management circuit is connected with the control module for data exchange.

An isolation barrier is arranged between the electric energy receiving coil and the rectifying filter circuit so that the Bluetooth signal and the wireless charging signal do not interfere with each other and improve the quality of the Bluetooth communication.

The audio processing module comprises an audio codec, a noise reduction circuit and an amplifier, the audio codec is connected with an amplifier through a noise reduction circuit, the amplifier is connected with a speaker, and the audio codec is also connected with the microphone, The amplifier is also connected to the control circuit module.

The Bluetooth communication module comprises a radio frequency transmitting and receiving circuit, an imbalance unbalanced converter, an antenna and an antenna, the antenna is connected with a balun through a radio frequency filter, the balun is connected with a radio frequency transceiver circuit, The RF transceiver circuit is connected to the control module.

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CLAIMS CN104837094

[1]

1The A Bluetooth headset with integrated navigation function is characterized in that it comprises a control module, a navigation module, an audio processing module, a voice module for a voice broadcast navigation route, an input module, a power supply module and a Bluetooth communication module, the navigation module, The audio processing module, the voice module, the input module, the power supply module and the Bluetooth communication module are connected with the control module. The control module, the navigation module, the audio processing module, the voice module, the input module and the Bluetooth communication module are connected with the power module.

[2]

2The An integrated navigation function Bluetooth headset according to claim 1, wherein said navigation module includes a positioning sub-module for acquiring user's current location information, a map sub-module for storing electronic map data, and a map sub-module for storing The path planning sub-module and the path planning sub-module are connected with the positioning sub-module, the map sub-module and the control module respectively.

[3]

3The An integrated navigation function of a Bluetooth headset according to claim 1, wherein said power supply module comprises a rechargeable battery, a power receiving coil for receiving electric energy, a rectifying filter circuit, a voltage regulating circuit and a charge management circuit, The current output end of the receiving coil is connected with the current input terminal of the rectifying filter circuit, the current output end of the rectifying filter circuit is connected with the current input terminal of the voltage regulating circuit, the current output end of the voltage regulating circuit is connected with the current input end of the charging management circuit, The current output terminal of the charge management circuit is connected with the current input terminal of the rechargeable battery, and the charge management circuit is connected with the control module for data exchange.

[4]

4The An integrated navigation function Bluetooth headset according to claim 3, wherein an isolated barrier is provided between said power receiving coil and said rectifying filter circuit.

[5]

5The An integrated navigation function of a Bluetooth headset according to claim 1, wherein said input module includes a navigation key for starting / closing the navigation function, a touch input screen for inputting a navigation destination, a speaker and a microphone , The navigation key and the touch input screen are connected with the control module, and the speaker and the microphone are connected with the audio processing module.

[6]

6The An integrated navigation function of a Bluetooth headset according to claim 5, wherein said audio processing module comprises an audio codec, a noise reduction circuit and an amplifier, said audio codec being connected to the amplifier via a noise reduction circuit , The amplifier is connected to the loudspeaker, the audio codec is also connected to the microphone, and the amplifier is also connected to the control circuit module.

[7]

7The An integrated navigation function of a Bluetooth headset according to claim 1, wherein said Bluetooth communication module comprises a radio frequency transceiver circuit, a balanced unbalanced converter, an RF filter and an antenna, the antenna is passed through a radio frequency filter and the balanced Balanced converter connection, balanced unbalanced converter and RF transceiver circuit connection, RF transceiver circuit and control module connection.

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(12)实用新型专利

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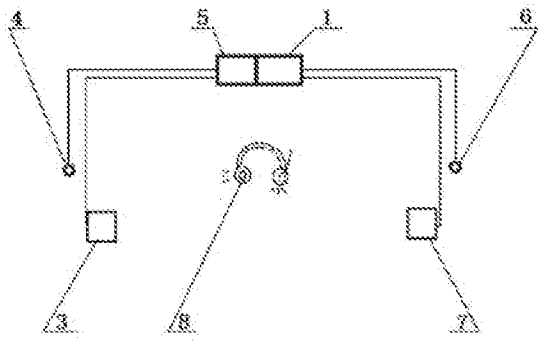
权利要求书1页 说明书2页 附图1页

(54)实用新型名称

一种车载式道路背景音采播安全装置

(57)摘要

一种车载式道路背景音采播安全装置，包括安装在车身上的声音采集器，声音采集器用于采集道路背景音信号，所述声音采集器连接信号处理模块，信号处理模块设有无线发射模块，控制按钮，所述信号处理模块与设置有无线接收模块的无线耳机无线通讯连接，或者信号处理模块通过线路与车载音响系统连接。本实用新型一种车载式道路背景音采播安全装置，能采集道路背景声音，通过无线耳机或车载音响系统扬声器播放，传达给驾驶人员知悉车况路况和预判风险，提高交通安全性。



CN 204244472 U

1. 一种车载式道路背景音采播安全装置，包括安装在车身上的声音采集器，声音采集器用于采集道路背景音信号，其特征在于，所述声音采集器连接信号处理模块(5)，信号处理模块(5)设有无线发射模块、控制按钮，所述信号处理模块(5)与设置有无线接收模块的无线耳机(8)无线通讯连接；或者信号处理模块(5)通过线路与车载音响系统连接。

2. 根据权利要求 1 所述一种车载式道路背景音采播安全装置，其特征在于，所述声音采集器至少包括位于车身左、右侧的第一声音采集器(4)、第二声音采集器(6)。

3. 根据权利要求 1 或 2 所述一种车载式道路背景音采播安全装置，其特征在于，所述声音采集器安装在车门把手的凹槽内。

4. 根据权利要求 1 所述一种车载式道路背景音采播安全装置，其特征在于，所述车载音响系统包括车载音响主机(1)、以及连接车载音响主机(1)的第一车载音响扬声器(3)、第二车载音响扬声器(7)，车载音响主机(1)连接信号处理模块(5)。

一种车载式道路背景音采播安全装置

技术领域

[0001] 本实用新型一种车载式道路背景音采播安全装置，涉及汽车交通安全领域。

背景技术

[0002] 目前，随着汽车制造技术和工艺进步，汽车车厢密封、隔音性能得到较大提升，尤其小型乘用汽车的密封、隔音性能优越，确保了驾乘人员的舒适性。据测定，小型乘用汽车在车窗密闭的静止状态时，车内噪音分贝值约为车外的 40%，降噪效果明显。

[0003] 车辆良好隔音效果带来驾乘舒适性的同时，却存在一定的交通安全隐患：车辆在行驶过程中，因使用空调、隔离灰尘、降低噪声等需要，车辆通常处于车窗密闭状态下，驾驶人员很难听清道路背景音，诸如道路上人、车、物及自然环境声音，这些声音例如相邻车辆的鸣笛声、车辆状态声音等，对于驾驶人员掌握瞬息变化的车况路况，提前预判行车风险，管控交通安全有重要的意义。

发明内容

[0004] 汽车密封隔音性能提升后，为了克服驾驶人员不能闻听瞬息变化的道路背景音所带来的行车安全隐患，确保交通安全，本实用新型提供一种车载式道路背景音采播安全装置，能采集道路背景声音，通过无线耳机或车载音响系统扬声器播放，传达给驾驶人员知悉车况路况和预判风险，提高交通安全性。

[0005] 本实用新型采取的技术方案为：

[0006] 一种车载式道路背景音采播安全装置，包括安装在车身上的声音采集器，声音采集器用于采集道路背景音信号，所述声音采集器连接信号处理模块，信号处理模块设有无线发射模块、控制按钮，所述信号处理模块与设置有无线接收模块的无线耳机无线通讯连接；

[0007] 或者信号处理模块通过线路与车载音响系统连接。

[0008] 所述声音采集器至少包括位于车身左、右侧的第一声音采集器、第二声音采集器。

[0009] 所述声音采集器安装在车门把手的凹槽内。

[0010] 所述车载音响系统包括车载音响主机、以及连接车载音响主机的第一车载音响扬声器、第二车载音响扬声器，车载音响主机连接信号处理模块。

[0011] 本实用新型一种车载式道路背景音采播安全装置，技术效果如下：

[0012] 1)、车身左、右两侧的声音采集器适时采集道路背景音，为减少行驶风噪，声音采集器通常安装在车门把手的凹槽内。

[0013] 2)、车身安装的声音采集器应有二个或二个以上，并与车内播放器声道匹配，产生立体声效果，使驾驶人员能够准确判别不同声音的方位。

[0014] 3)、驾驶人员可通过信号处理模块上设置的控制按钮，选择两种方式收听道路背景音：1：采用无线发射模块发送信号，驾驶人员配戴无线立体声耳机收听道路背景音，车内其他乘员不受道路背景音干扰；车载音响系统可播放其它音源如音乐供其他乘员欣赏，

互不干扰。2：通过车载音响系统播放道路背景音。

附图说明

[0015] 图 1 为本实用新型装置连接示意图。

具体实施方式

[0016] 如图 1 所示，一种车载式道路背景音采播安全装置，包括安装在车身上的声音采集器，声音采集器用于采集道路背景音信号，所述声音采集器连接信号处理模块 5，信号处理模块 5 设有无线发射模块、控制按钮，所述信号处理模块 5 与设置有无线接收模块的无线耳机 8 无线通讯连接；或者信号处理模块 5 通过线路与车载音响系统连接。所述车载音响系统包括车载音响主机 1、以及连接车载音响主机 1 的第一车载音响扬声器 3、第二车载音响扬声器 7，车载音响主机 1 连接信号处理模块 5。

[0017] 所述声音采集器至少包括位于车身左、右侧的第一声音采集器 4、第二声音采集器 6。所述声音采集器安装在车门把手的凹槽内。

[0018] 声音采集器选用具有远距离、全指向特性的原音微型拾音器，如思正 COTT-C6 微型拾音器、快鱼 X. TRADIO 系列微型拾音器等。

[0019] 位于车身左、右侧的第一声音采集器 4、第二声音采集器 6 适时采集道路背景音，声音信号进入信号处理模块 5 进行处理，驾驶员可通过信号处理模块上设置的控制按钮，选择两种方式收听道路背景音：当选择无线收听方式时，信号处理模块 5 的无线发射模块发射信号，设置有无线接收模块的无线耳机 8 接收信号后，传递给驾驶人员收听。当选择车载音响收听方式时，信号处理模块 5 将有线信号传送到车载音响系统，经放大后通过位于车内左、右侧的第一车载音响扬声器 3、第二车载音响扬声器 7 播放给驾驶人员收听。

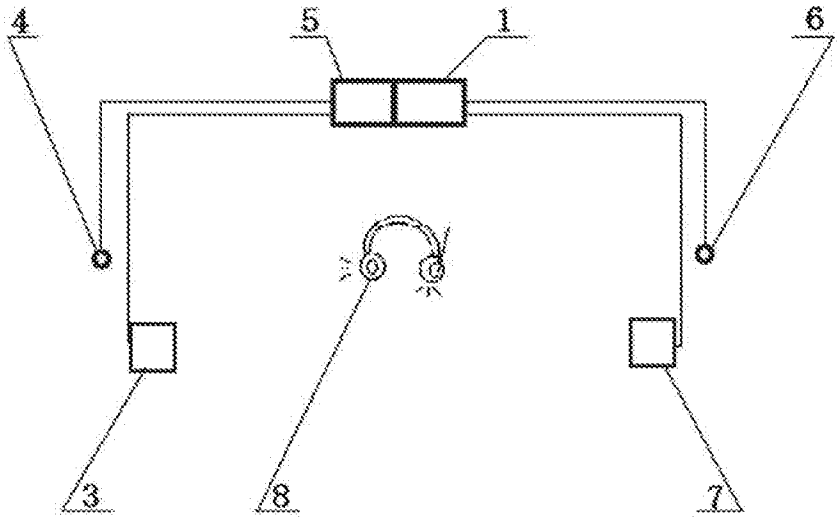


图 1

Espacenet

Bibliographic data: CN204244472 (U) — 2015-04-01

Vehicle-mounted road background sound collecting and broadcasting safety device

Inventor(s): WU TIANMING; WU BIANYAO ± (WU TIANMING, ; WU BIANYAO)

Applicant(s): CHINA THREE GORGES CORP ± (CHINA THREE GORGES CORPORATION)

Classification: **- international:** ***H04R27/00***
- cooperative:

Application number: CN20142807078U 20141219

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Abstract of CN204244472 (U)

A vehicle-mounted road background sound collecting and broadcasting safety device comprises a sound collector mounted on a vehicle body and sound collectors used for collecting road background sound signals. The sound collectors are connected with a signal processing module. The signal processing module is provided with a wireless transmission module and a control button. The signal processing module is in wireless communication with a wireless earphone provided with a wireless reception module. Or the signal processing module is connected with a vehicle-mounted sound equipment system via a line. The vehicle-mounted road background sound collecting and broadcasting safety device can collect road background sound and broadcast the sound via the wireless earphone or loudspeakers of the vehicle-mounted sound equipment system, so that a driver can be informed of vehicle and road conditions and then anticipate risks, thereby improving traffic safety.

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DESCRIPTION CN204244472

The present invention relates to a sound collecting device for collecting a road background sound signal, the sound collecting device is connected with a signal processing module, and the signal processing module is provided with a wireless transmitting module And a control button connected to the wireless headset wireless communication connection provided with the wireless receiving module; or the signal processing module is connected with the car audio system through the line. The utility model adopts a car-based road background sound sowing security device, which can collect the background sound of the road, and broadcast through the wireless headset or the car audio system loudspeaker to convey to the driver know the traffic condition and the pre-judgment risk and improve the traffic safety.

A kind of car - based road background sound sowing security device

Technical field

The utility model is a car-type road background sound sowing security device, which involves the field of automobile traffic safety.

Background technique

At present, with the automobile manufacturing technology and technological progress, car compartment sealed, sound insulation performance has been greatly improved, especially small passenger car seal, soundproof performance, to ensure the occupants of the comfort. According to the determination of small passenger cars in the window closed static state, the car noise decibel value of about 40% of the car, noise reduction effect is obvious.

The vehicle has a good sound insulation effect to bring comfort at the same time, but there is a certain traffic safety hazards: the vehicle in the process of driving, due to the use of air conditioning, dust isolation, reduce noise and other needs, the vehicle is usually in a window closed state, the driver It is difficult to hear the road background sound, such as road people, cars, objects and the natural environment of the sound, such as the sound of neighboring vehicles such as the whistle, the state of the vehicle sound, for the driver to grasp the rapid changes in traffic conditions, Risk, control traffic safety has important significance.

The contents of the invention

In order to overcome the traffic safety hazard caused by the changing background of the road, the utility model provides a vehicle-based road background sound and sowing security device, which can collect Road background sound, through the wireless headset or car audio system speakers to play, to convey to the driver aware of traffic conditions and pre-risk assessment, improve traffic safety.

The technical scheme adopted by the utility model is:

The present invention relates to a sound collecting device for collecting a road background sound signal, the sound collecting device is connected with a signal processing module, and the signal processing module is provided with a wireless transmitting module A control button connected to a wireless headset wireless communication connection provided with a wireless receiving module;

Or the signal processing module is connected to the car audio system via a line.

The sound collector includes at least a first sound collector located on the left and right sides of the vehicle body and a second sound collector.

The sound collector is mounted in the recess of the door handle.

The car audio system includes a car audio main unit, and a first car audio speaker connected to a car audio host, a second car audio speaker, and a car audio host connection signal processing module.

The utility model is a kind of car-type road background sound sowing security device, the technical effect is as follows:

1)

, The left and right sides of the body of the sound collection device timely collection of road background sound, in order to reduce the driving wind noise, the sound collector is usually installed in the door handle groove.

2)

, The body of the installation of the sound collector should have two or more, and with the car player channel match, resulting in stereo effects, so that drivers can accurately determine the direction of different sounds.

[2]

, The driver can be set by the signal processing module on the control button, choose two ways to listen to the road background sound: 1: the use of wireless transmission module to send the signal, the driver wearing a wireless stereo headphones to listen to the road background sound, the car other passengers from the Road background sound interference; car audio system can play other audio sources such as music for the other crew to enjoy, do not interfere with each other. 2: Play the road background sound through the car audio system.

Description of the drawings

Fig. 1 is a schematic view of the connection of the utility model.

detailed description

As shown in Fig. 1, a vehicle-mounted road background sound collecting security device includes a sound collector mounted on a vehicle body for collecting a road background sound signal, the sound collector being connected to a signal processing module 5, The processing module 5 is provided with a wireless transmission module, a control button 5 which is wirelessly connected to a wireless headset 8 provided with a wireless receiving module; or the signal processing module 5 is connected to a car audio system via a line. The vehicle-mounted sound system includes a vehicle-mounted audio main unit 1, a first vehicle-mounted sound speaker 3 connected to the in-vehicle audio host 1, a second vehicle-mounted sound speaker 7, and a car-mounted audio host 1 to connect the signal processing module 5.

The sound collector includes at least a first sound collector 4 and a second sound collector 6 located on the left and right sides of the vehicle body. The sound collector is mounted in the recess of the door handle.

Sound collector selection with long-range, full-point characteristics of the original micro-pickup, such as thinking COTT-C8 miniature pickup, fast fish X.TRADIO series of miniature pickup.

The first sound collector 4 and the second sound collector 6 are located on the left and right sides of the vehicle body to collect the road background sound and the sound signal enters the signal processing module 5 for processing. The driver can select the control signal by setting the control button on the signal processing module When the wireless listening mode is selected, the radio transmission module of the signal processing module 5 transmits a signal, and the wireless headset 8 provided with the radio receiving module receives the signal and transmits it to the driver for listening. When the car audio listening mode is selected, the signal processing module 5 transmits the cable signal to the in-vehicle sound system and is amplified by the first car audio player 3 and the second car audio speaker 7 located on the left and right sides of the vehicle to the driver Listen.

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CLAIMS CN204244472

[1]

1The A sound collecting device for collecting a road background sound signal, characterized in that the sound collecting device is connected with a signal processing module (5), a signal The processing module (5) is provided with a wireless transmission module and a control signal, the signal processing module (5) is wirelessly connected with the wireless headset (8) provided with the wireless receiving module; or the signal processing module (5) System connection.

[2]

2The A vehicle-mounted road background sound-broadcasting security apparatus according to claim 1, characterized in that said sound collector includes at least a first sound collector (4) located on the left and right sides of the vehicle body, a second sound collector (6).

[3]

3The A vehicle-mounted road background sound-broadcasting safety apparatus according to claim 1 or 2, wherein said sound collector is installed in a groove of a door handle.

[4]

4The The vehicle-mounted sound system comprises a vehicle-mounted sound main unit (1) and a first vehicle-mounted audio speaker (1) connected to a car-mounted audio main unit (1), wherein the vehicle-mounted sound system (1) 3), the second car audio speaker (7), the car audio host (1) to connect the signal processing module (5).

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(54) Hearing aid system

(57) A hearing aid system includes an earpiece for producing sound representative of a listening environment. A module worn by the hearing aid user is in wireless communication with the earpiece. A plurality of microphones are located in the module to receive incoming sound signals from the listening environment. Processing circuitry in the module analyzes the incoming sound signals received by the plurality of microphones and generates control signals to govern the production of sound by the earpiece.



Fig. 1

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a hearing aid system, and more particularly to a personal hearing aid and information system that employs beamforming and other processing techniques to optimize the performance of the hearing aid system in a variety of sound environments.

[0002] Hearing aids have become a popular and effective tool for enabling a person with a hearing deficiency to detect and recognize audible sounds by filtering and amplifying the sounds and reproducing them in a microphone worn in the ear of the user. Hearing aid devices have become more and more sophisticated, and binaural hearing aid systems have been developed so that a user wearing a hearing aid in each ear may identify the direction from which a sound originated based on differences in the time of arrival of a sound at each ear and differences in loudness level between the ears.

[0003] Despite the improvements in hearing aid technology and hearing aid system processing, existing hearing aid systems are still unable to approximate the selective listening patterns that are generated by the human brain in response to particular sound environments. Specifically, hearing aid systems are typically unable to effectively "focus" the attention of the listener onto a particular sound source where other sounds are also present. There is a continuing need in the art for a complete hearing aid system providing improved ability to discriminate among sound levels and sources.

BRIEF SUMMARY OF THE INVENTION

[0004] The present invention is a hearing aid system that includes at least one earpiece and a module in wireless communication with the earpiece. A plurality of microphones are located in the module to receive incoming sound signals from a listening environment. Processing circuitry in the module analyzes the incoming sounds signals received by the microphones and generates control signals that direct the earpiece to produce sounds representative of the listening environment. The processing and analysis amplify sound signals originating from desired directions and attenuate sound signals originating from undesired directions, resulting in superior listening performance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005]

FIG. 1 is a diagram illustrating a human outfitted with a hearing aid system according to the present invention

FIG. 2 is a diagram illustrating the components of a hearing aid system according to a first embodiment of the present invention.

FIG. 3 is a diagram illustrating the components of a hearing aid system according to a second embodiment of the present invention.

FIG. 4 is a block diagram illustrating the functional components of a medallion utilized in the hearing aid system of the present invention.

FIG. 5 is a block diagram illustrating the functional components of an earpiece utilized in the hearing aid system of the present invention.

FIG. 6 is a diagram illustrating a simplistic example of a multi-element sensor array for receiving incoming sound signals.

FIG. 7 is a stacked graph illustrating a beamforming example where the left and right sensor signals are in phase.

FIG. 8 is a stacked graph illustrating a beamforming example where the left and right sensor signals are 180 degrees out of phase.

FIG. 9 is a stacked graph illustrating a beamforming example where the left and right sensor signals are less than 180 degrees out of phase.

FIG. 10 is a graph illustrating the response of a hearing aid system employing two omni-directional microphones 5.25 inches apart where incoming sound signals have a frequency of 1275 Hz.

FIG. 11 is a graph illustrating the response of a hearing aid system employing two omni-directional microphones 5.25 inches apart where incoming sound signals have a frequency of 1000 Hz.

FIG. 12 is a graph illustrating the response of a hearing aid system employing two omni-directional microphones 5.25 inches apart where incoming sound signals have a frequency of 1500 Hz.

FIG. 13 is a graph illustrating the response of a hearing aid system employing two directional microphones 5.25 inches apart where incoming sound signals have a frequency of 1275 Hz.

FIG. 14 is a diagram illustrating an exemplary beam pattern exhibited by a microphone array and beamformer according to an embodiment of the present invention.

FIG. 15 is a diagram illustrating the exemplary beam pattern shown in FIG. 14 in relation to a first exemplary sound environment.

FIG. 16A is a graph illustrating an uncorrupted input signal from the speaker shown in FIG. 15 to be listened to with the hearing aid system of the present invention.

FIG. 16B is a graph illustrating the input signal of FIG. 16A corrupted with random noise.

FIG. 16C is a graph illustrating the beamformer output of the hearing aid system of the present invention.

FIG. 17 is a diagram illustrating the exemplary beam pattern shown in FIG. 14 in relation to a second exemplary sound environment.

FIG. 18A is a graph illustrating an uncorrupted input signal from the speaker shown in FIG. 17 to be listened to with the hearing aid system of the present invention.

FIG. 18B is a graph illustrating the input signal of FIG. 18A corrupted with directional noise, random noise and reverberation.

FIG. 18C is a graph illustrating the beamformer output of the hearing aid system of the present invention.

DETAILED DESCRIPTION

[0006] FIG. 1 is a diagram illustrating a human equipped with a hearing aid system 10 according to the present invention. Hearing aid system 10 includes left earpiece 12, right earpiece 14 and medallion 16 worn round the user's neck or clipped onto the user's shirt, for example. As will become apparent in the detailed description of hearing aid system 10 to follow, earpieces 12 and 14 and medallion 16 are equipped with microphones, wireless transceivers, processing circuitry, or a combination of these components, enabling hearing aid system 10 to provide performance above and beyond the performance of the individual earpieces or medallion.

[0007] FIG. 2 is a diagram illustrating the configuration of a first embodiment of hearing aid system 10a. Left earpiece 12 includes FM receiver 22, and right earpiece 14 includes FM receiver 24. Medallion 16 includes microphones 26, 28 and 30 and FM transmitter 32. FM transmitter 32 is operable to wirelessly transmit signals and data to FM receiver 22 of left earpiece 12 via wireless link 24, and to FM receiver 24 of right earpiece 14 via wireless link 36.

[0008] In an exemplary mode of operation, microphones 26, 28 and 30 operate to receive incoming sound signals from the environment around the hearing aid system user. Medallion 16 includes processing means (not shown in FIG. 2) to interpret the incoming sound signals received by microphones 26, 28 and 30 and generate appropriate control signals for reproducing sounds in the ears of the user at earpieces 12 and 14. The control signals are transmitted from medallion 16 via FM transmitter 32 along wireless links 34 and 36 to FM receivers 22 and 24 in earpieces 12 and 14. Earpieces 12 and 14 are operable in response to the control signals to reproduce the appropriate sounds in the ears of the user.

[0009] FIG. 3 is a diagram illustrating the configuration of a second embodiment of hearing aid system 10b. Left earpiece 12 includes FM transceiver 22 and microphone 23. Right earpiece 14 includes FM transceiver 24 and microphone 25. Medallion 16 includes microphones 26, 28 and 30 and FM transceiver 32. FM transceivers 22, 24 and 32 are operable to wirelessly transmit signals and data between left earpiece 12, right earpiece 14 and medallion 16 on wireless links 34 and 36.

[0010] In an exemplary mode of operation, microphones 23 and 25 in earpieces 12 and 14, respectively, and microphones 26, 28 and 30 in medallion 16 operate to receive incoming sound signals from the environment around the hearing aid system user. Data representing the sound signals received by microphone 23 in left earpiece 12 and microphone 25 in right earpiece 14 is sent from FM transceiver 22 on wireless link 34 and from FM transceiver 24 on wireless link 36 to FM transceiver 32 in medallion 16. Medallion 16 includes processing means (not shown in FIG. 3) to interpret the incoming sound signals received by microphones 26, 28 and 30 and the data signal received from earpieces 12 and 14 by FM transceiver 32. The processing means generates appropriate control signals for reproducing sounds in the ears of the user at earpieces 12 and 14. The control signals are transmitted from medallion 16 via FM transceiver 32 along wireless links 34 and 36 to FM transceivers 22 and 24 in earpieces 12 and 14. Earpieces 12 and 14 are operable in response to the control signals to reproduce the appropriate sounds in the ears of the user.

[0011] FIG. 4 is a block diagram illustrating the functional components of medallion 16 utilized in hearing aid system 10 of the present invention. In an exemplary embodiment, medallion 16 houses the main processing circuitry of hearing aid system 10, in addition to an array of microphones and an FM transceiver. Microphones 26, 28, 30 and 31 are spatially arranged on medallion 16 to optimize the ability of the microphones to distinguish the direction from which an incoming sound originates. The details of this spatial arrangement may vary; a simplistic example showing the effects of different spatial arrangements is discussed below with respect to FIGS. 6-13. Any number of microphones may be provided in medallion 16, as schematically demonstrated in FIG 4. The signals received by microphones 26, 28, 30 and 31 are amplified by amplifiers 46, 48, 50 and 51, respectively. The outputs of amplifiers 46, 48, 50 and 51 are coupled to analog multiplexer and analog-to-digital (A/D) converter 52. Analog multiplexer and A/D converter 52 converts the analog signals from amplifiers 46, 48, 50, 51 into digital representations of those signals and sequences the signals into a digital data packet for input to digital signal processor (DSP) 54. In an embodiment such as hearing aid system 10b shown in FIG. 3, signals from remote microphones in earpieces worn by the user are transmitted on wireless links 34 and 36 to FM transceiver 32 in medallion 16. These signals are converted into digital form by FM radio receiver 58 and coupled as input to DSP 54.

[0012] DSP 54 implements a numerical algorithm to process the signals received from analog multiplexer and A/D converter 52 and FM radio receiver 58 in a predetermined manner. Given a desired processing scheme for the input signals, it is within the expertise of one skilled in the art to configure the DSP 54 to imple-

ment the appropriate numerical algorithm to achieve the desired processing scheme. The objectives of such processing schemes are described below with respect to FIGS. 7-13. Executing the algorithm produces control signals for generating appropriate signals in the earpieces worn by the user. The control signals are output from DSP 54 to FM radio transmitter 56 for wireless transmission via FM transceiver 32 on wireless links 34 and 36 to the respective earpieces.

[0013] FIG. 5 is a block diagram illustrating the functional components of earpiece 12 (or 14) utilized in hearing aid system 10 of the present invention. Incoming sound signals are received by directional microphone 23a and omni-directional microphone 23b. In an alternative embodiment, only one of directional microphone 23a and omni-directional microphone 23b is provided in earpiece 12. The signals received by microphones 23a and 23b are amplified by amplifiers 66 and 68, respectively, which are in turn coupled to analog multiplexer and analog-to-digital (A/D) converter 70. Signals from remote microphones in a medallion worn by the user are transmitted on wireless link 34 to FM transceiver 22. These signals are converted into digital form by FM radio receiver 74 and coupled as input to DSP 72.

[0014] As with DSP 54 shown in FIG. 4, DSP 72 implements a numerical algorithm to process the signals received from analog multiplexer and A/D converter 70 and FM radio receiver 74 in a predetermined manner. Executing the algorithm produces control signals for generating appropriate signals in the earpieces worn by the user. The control signals are output from DSP 72 directly to receiver 78 in earpiece 12, and also to FM radio transmitter 76 for wireless transmission via FM transceiver 22 on wireless link 34 to the medallion worn by the user, where the signal will be relayed to the other earpiece worn by the user.

[0015] In the embodiment schematically pictured in FIG. 5, DSP 72 is shown as being located in earpiece 12. In this embodiment, DSP's may be employed in the earpieces only, with a medallion worn by the user serving as an additional location for microphones in the microphone array and as an FM relay station for signals to be transmitted between earpieces. Alternatively, an additional DSP may also be located in the medallion, to distribute the processing functions between the physical components of the hearing aid system, or for redundancy purposes. In another embodiment, a DSP may only be located in the medallion (as shown in FIG. 4), with no DSP in the earpieces. Other arrangements of functional components within the physical parts of the hearing aid system are contemplated by the present invention.

[0016] With the components provided as shown in FIGS. 1-5, the hearing aid system of the present invention is able to achieve high performance operation and listening features that were not possible with prior art hearing aids. To understand the performance advantages enabled by the present invention, a simplified description of a multi-sensor processing technique called beamforming is beneficial. Beamforming is a technique that works by combining the signals received by an array of sensor elements, such as microphones, to generate a desired composite response. For example, a hearing aid system beamformer boosts the signal arriving from some directions and attenuates signals arriving from other directions, to enable the hearing aid system user to "focus" attention on a particular sound source. The direction of maximum response, referred to as the maximum response axis (MRA), can be steered in different directions by properly combining the signals from each sensor element.

[0017] FIG. 6 depicts a simple example where multiple sensor elements are positioned in a straight line. The angle perpendicular to a line that passes through the elements is defined as the "boresight" angle, or zero degrees. The physical angle of incident sound is therefore defined within a range of -180 to +180 degrees, where 0 degrees is boresight, ±180 degrees is straight behind, +90 degrees is to the right, and -90 degrees is to the left. This simple example is illustrated in FIG. 6, where microphones 80, 82 and 84 are linearly aligned at a distance d apart and an incoming sound signal having wavelength λ creates an angle θ with the microphone line. The difference in time of the sound signals received by adjacent microphones in the array is defined by:

$$x = \frac{360*d*\sin\theta}{\lambda} \text{ degrees of phase or}$$

$$\frac{d*\sin\theta}{c} \text{ seconds,}$$

where c is the speed of the waves. This difference in time may be utilized to determine the direction from which sound signals are originating.

[0018] In one scenario, the objective is to maximize the response of the system along the boresight axis and minimize the response in all other directions. This is a simple processing scenario - the signals from the sensors need only be added together with equal weight given to the signals from each sensor. The results of this scheme are simplistically shown in FIGS. 7-9, where it is assumed that there are only two sensor elements for illustration purposes. FIG. 7 illustrates that where the incoming sound signals are in phase with each other (that is, the sound signals reach the two sensors at the same time, meaning that their origination direction is "boresight"), and the signals received by the sensors are as illustrated by curves 90 and 92, adding the signals will result in curve 94 having the sum of the amplitudes of curves 90 and 92. FIG. 8 illustrates that where the incoming sound signals are 180 degrees out of phase (that is, the sound signals reach the sensors at

times separated by a half cycle), and the signals received by the sensors are as illustrated by curves 100 and 102, adding the signals will result in a zero signal 104 - the signals completely cancel. This will occur when the sound signals are coming from an angle that is ±90 degrees from boresight. FIG. 9 illustrates that where the incoming sound signals are somewhat out of phase (that is, the sound signals reach the sensors at times separated by less than a half cycle), and the signals received by the sensors are as illustrated by curves 110 and 112, adding the signals will result in curve 114 having an amplitude that is less than the sum of the amplitudes of curves 110 and 112. The angle of arrival of the incoming sound signals can be calculated based on the difference in time of arrival, where the spacing between microphones is known.

[0019] It can be appreciated from the discussion above that the spacing of sensor elements is important to the ability to determine the origination direction of incoming sound signals. The ideal spacing of sensor elements is a half wavelength, so that an incoming sound signal coming from 90 degrees to boresight reaches adjacent sensors at times separated by a half cycle and the signals completely cancel one another. With this spacing, the range of combined signal amplitudes extends from 0 (complete cancellation) to twice the amplitude of the incoming signal, for the two-sensor example, which is the maximum range. Where microphones are spaced more than a half wavelength apart (typically for higher frequencies which have lower wavelengths), spatial aliasing occurs and grating lobes form in the response pattern, which makes accurate determination of the origination of the sound signal more difficult.

[0020] FIGS. 10-13 show the response of the two-microphone array over the full range of sound signal origination angles, with 0 degrees being boresight, -90 degrees being to the left, and +90 degrees being to the right. FIG. 10 illustrates the scenario where the two microphones are omni-directional microphones spaced 5.25 inches apart and the frequency of incoming sound signals is 1275 Hz (at 1275 Hz, 5.25 inches is a half wavelength). Curve 120 shows that the peak response of the system (adding the signals received at the two microphones) is at angles of 0 and ±180 degrees, with a deep "null" (attenuated response) at an angle of ±90 degrees. FIG. 11 illustrates the same microphone scenario where the frequency of the incoming sound signals is 1000 Hz - at this frequency, using the same adding formula, curve 130 shows that the nulls at ±90 degrees are much less definitive. FIG. 12 illustrates the same microphone scenario where the frequency of the incoming sound signals is 1500 Hz - at this frequency, using the same adding formula, curve 140 shows that side lobes are formed at ±90 degrees, with lower peak amplitudes, and the nulls are shifted to about ±60 degrees and ±120 degrees. These curves illustrate the importance of having microphone elements that are a half wavelength apart; where the microphone spacing is more or less than a half wavelength, the response curves are not as well defined, which tends to result in less ability for the user of a hearing aid system to focus on particular sounds.

[0021] FIG. 13 illustrates an alternative scenario where the microphones utilized in the two-element array are directional microphones, spaced 5.25 inches apart, where the frequency of incoming sound signals is 1275 Hz. Curve 150 shows that the peak response of the system is again at the boresight angle, with a lesser peak at ±180 degrees, and wide nulls in the vicinity of ±90 degrees. The use of directional microphones can potentially allow the hearing aid user to more effectively focus on frontal sounds while attenuating sounds originating from the rear.

[0022] FIG. 14 is a diagram illustrating an exemplary beam pattern exhibited by microphone array 200 and an associated beamformer according to an embodiment of the present invention. In the embodiment depicted in FIG. 14, microphone array 200 exhibits a large frontal or main lobe 202, representing sounds coming from the front of a user. Microphone array 200 also exhibits two side lobes 204 and 206 and a back lobe 208. The beam former outputs are such that sounds in main lobe 202 are amplified the most, while sounds in side lobes 204 and 206 are attenuated somewhat and sounds in back lobe 208 are attenuated even more. This beam pattern is designed to allow the user to effectively focus on sounds originating in front of the user (where the user is typically looking), even in an environment where random noise exists to the user's sides and rear. It should be understood that other beam patterns may be formed according to the present invention, and the pattern shown in FIG. 14 is an example of one particular beam pattern that may be implemented when desirable.

[0023] FIG. 15 is a diagram illustrating the exemplary beam pattern shown in FIG. 14 in relation to a first exemplary sound environment. The sound environment includes multiple sources of random noise 210 (such as a crowd of people) at several points around the hearing aid user (wearing microphone array 200), and a keynote speaker 212 in front of the user. As can be seen in FIG. 15, keynote speaker 212 is located at the center of main lobe 202, and sounds originating from speaker 212 will therefore be maximally amplified. Random noise 210 originates from locations at the sides of main lobe 202, and at side lobes 204 and 206 and back lobe 208, and therefore will be attenuated to a level below that of keynote speaker 212.

[0024] FIGS. 16A, 16B and 16C are graphs depicting an uncorrupted sound signal from keynote speaker 212 (FIG. 15), the sound signals received at the left and right input channels of the hearing aid system worn by the user, and the beamformer output from the hearing aid system to the ears of the user. The uncorrupted signal is shown in FIG. 16A. The sound signals received at

the left and right input channels are shown in FIG. 16B. The original input signal (shown in FIG. 16A) is received at each input channel, with a time-shift that is based on the physical distance between the left and right input channel microphones. The left and right channel signals are also corrupted by some level of random noise that persists throughout the listening time frame. The beamformer output is shown in FIG. 16C. The beamformer recognizes the characteristics of the random noise and of the original input signal, and also recognizes, based on the time-shift of the input signal at the left and right channels, which direction the input signal originates from. Since the signal originates from the user's front (see FIG. 15), the signal is amplified to a higher level, while the random noise is attenuated to a lower level, thereby permitting the hearing aid user to better distinguish between the desired sound (keynote speaker 212, FIG. 15) and random noise (noise sources 210, FIG. 15).

[0025] FIG. 17 is a diagram illustrating the exemplary beam pattern shown in FIG. 14 in relation to a second exemplary sound environment. The sound environment includes multiple sources of random noise 210 (such as a crowd of people) at several points around the hearing aid user (wearing microphone array 200), a keynote speaker 212 in front of the user, and a relatively loud directional noise source 214. The sound environment may also include reverberation 216 of the desired noise signal from the walls of the room. As can be seen in FIG. 15, keynote speaker 212 is located at the center of main lobe 202, and sounds originating from speaker 212 will therefore be maximally amplified. Random noise 210, directional noise 214 and reverberation 216 originate from locations at the sides of main lobe 202, and at side lobes 204 and 206 and back lobe 208, and therefore will be attenuated to a level below that of keynote speaker 212.

[0026] FIGS. 18A, 18B and 18C are graphs depicting an uncorrupted sound signal from keynote speaker 212 (FIG. 17), the sound signals received at the left and right input channels of the hearing aid system worn by the user, and the beamformer output from the hearing aid system to the ears of the user. The uncorrupted signal is shown in FIG. 18A. The sound signals received at the left and right input channels are shown in FIG. 18B. The original input signal (shown in FIG. 18A) is received at each input channel, with a time-shift that is based on the physical distance between the left and right input channel microphones. The left and right channel signals are also corrupted by some level of random noise that persists throughout the listening time frame, a higher level of directional noise, and reverberation of the input signal from the walls of the room. The beamformer output is shown in FIG. 18C. The beamformer recognizes the characteristics of the random noise, directional noise, reverberation, and the original input signal, and also recognizes, based on the time-shift of the input signal at the left and right channels, which direction the input signal originates from. Since the signal originates from the user's front (see FIG. 17), the signal is amplified to a higher level, while the random noise and the directional noise is attenuated to a lower level, thereby permitting the hearing aid user to better distinguish between the desired sound (keynote speaker 212, FIG. 17) and noise (noise sources 210, directional noise source 214, FIG. 17).

[0027] The hearing aid system of the present invention, as shown in FIGS. 1-5, provides an extensive sensor array and processing capability that enables significant flexibility and control of the response of the system to particular sound patterns. The shape of the response curves (shown simplistically in FIGS. 10-13 for a two-microphone example where the signals are merely added together) can be adjusted by performing different numerical algorithms on the signals received by the sensors. This adjustment can involve a technique called "adaptive null steering" which operates to move the nulls in the response pattern to a particular angular location, so that a particular noise source may be somewhat blocked out of the user's hearing, enabling better focus on the desired sound source. The provision of wireless communication links between earpieces and a medallion worn around a user's neck allows a number of spacings between microphones in the array to be utilized to provide the optimum half wavelength spacing to accommodate a higher range of frequencies of incoming sound signals. The hearing aid system therefore is able to provide superior performance compared to prior hearing aid devices, effectively enabling a listener to focus attention on a desired sound source in a variety of listening environments.

[0028] Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

Claims

1. A hearing aid system comprising:

   an earpiece for producing sound representative of a listening environment;
   a module in wireless communication with the earpiece;
   a plurality of microphones located in the module to receive incoming sound signals from the listening environment;
   processing circuitry in the module for analyzing the incoming sound signals received by the plurality of microphones and generating control signals to govern the production of sound by the earpiece.

2. The hearing aid system of claim 1, further comprising:

at least one microphone located in the earpiece to receive incoming sound signals from the listening environment.

3. The hearing aid system of claim 2, wherein the at least one microphone located in the earpiece comprises an omni-directional microphone.

4. The hearing aid system of claim 2, wherein the at least one microphone located in the earpiece comprises a directional microphone.

5. The hearing aid system of claim 2, wherein the at least one microphone located in the earpiece comprises an omni-directional microphone and a directional microphone.

6. The hearing aid system of claim 2, wherein the earpiece and the module each include a wireless transceiver for effecting communication between the earpiece and the module.

7. The hearing aid system of claim 1, wherein the earpiece includes a wireless receiver and the module includes a wireless transmitter for transmitting information from the module to the earpiece.

8. The hearing aid system of claim 1, further comprising a second earpiece for producing sound representative of the listening environment, the module being in wireless communication wit the second earpiece.

9. The hearing aid system of claim 8, further comprising:

at least one microphone located in the first-named and second earpieces to receive incoming sound signals from the listening environment.

10. The hearing aid system of claim 9, wherein the first-named and second earpieces and the module each include a wireless transceiver for effecting communication between the earpieces and the module.

11. The hearing aid system of claim 9, wherein the at least one microphone in the first-named and second earpieces comprises an omni-directional microphone.

12. The hearing aid system of claim 9, wherein the at least one microphone in the first-named and second earpieces comprises a directional microphone.

13. The hearing aid system of claim 9, wherein the at least one microphone in the first-named and second earpieces comprises an omni-directional microphone and a directional microphone.

14. The hearing aid system of claim 8, wherein the first-named and second earpieces each include a wireless receiver and the module includes a wireless transmitter for transmitting information from the module to the earpieces.

15. The hearing aid system of claim 1, wherein the processing circuitry comprises a digital signal processor for performing a numerical algorithm on the incoming sound signals received by the microphones to shape a response of the hearing aid system that is represented by the sound produced by the earpiece.

16. A method of producing sounds in the ears of a user that represent a listening environment, the method comprising:

providing a plurality of microphones in a module worn by the user to receive incoming sound signals from the listening environment;
processing the incoming sound signals received by the microphones to amplify sound signals originating from desired directions and to attenuate sound signals originating from undesired directions;
generating control signals to govern the production of sound in the user's ears according to the result of the processing step; and
communicating the control signals to earpieces located in the user's ears to govern the production of sound therein.

17. The method of claim 16, further comprising:

providing at least one microphone in the earpieces located in the user's ears to receive incoming sound signals from the listening environment.

18. The method of claim 16, wherein the processing step comprises:

performing a numerical algorithm on the incoming sound signals received by the microphones to modify the signals according to a predetermined scheme for locating peaks and nulls in the response of the hearing aid system.

19. The method of claim 16, wherein the communicating step comprises wirelessly transmitting the control signals from the module to the earpieces.

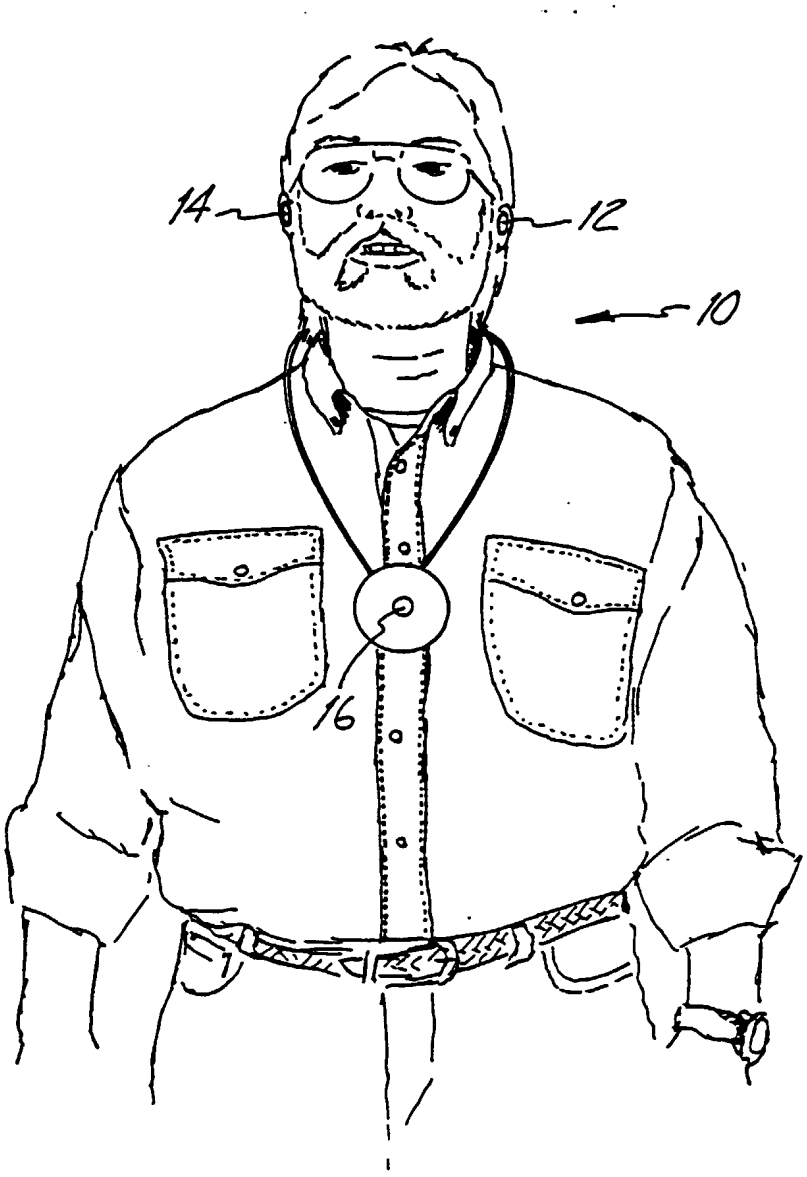


Fig. 1

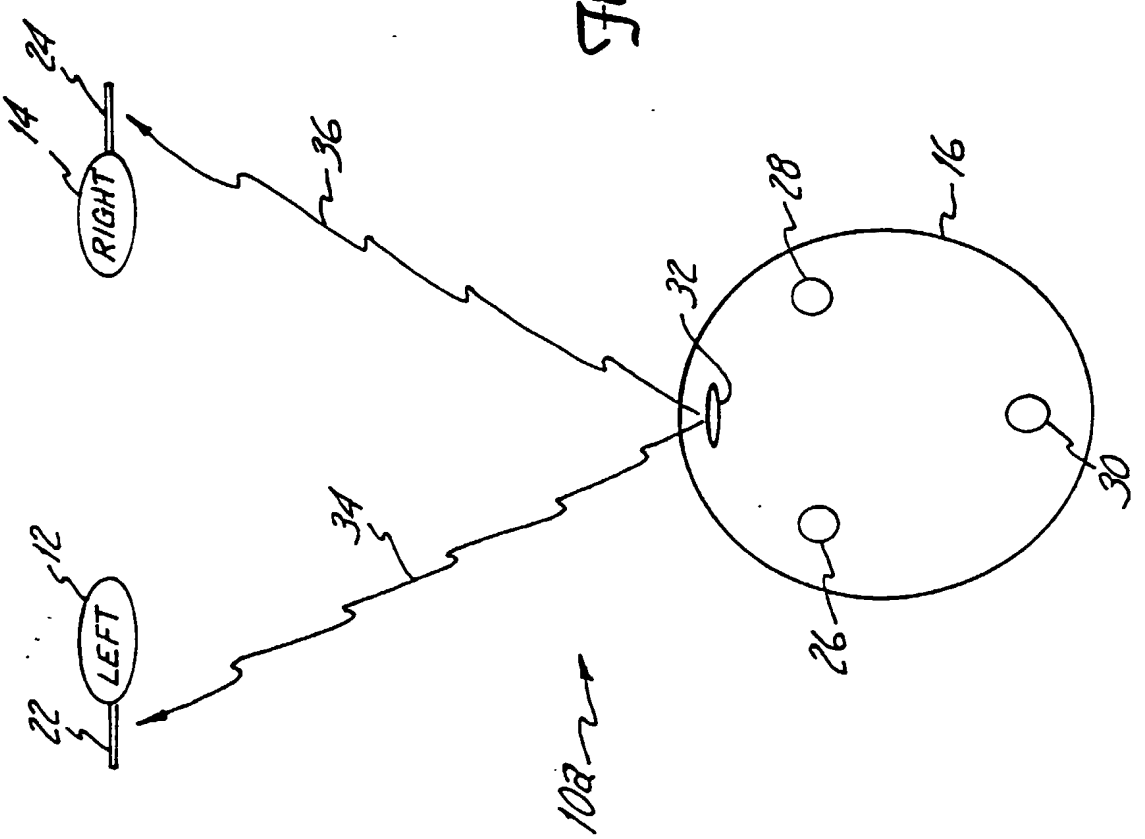
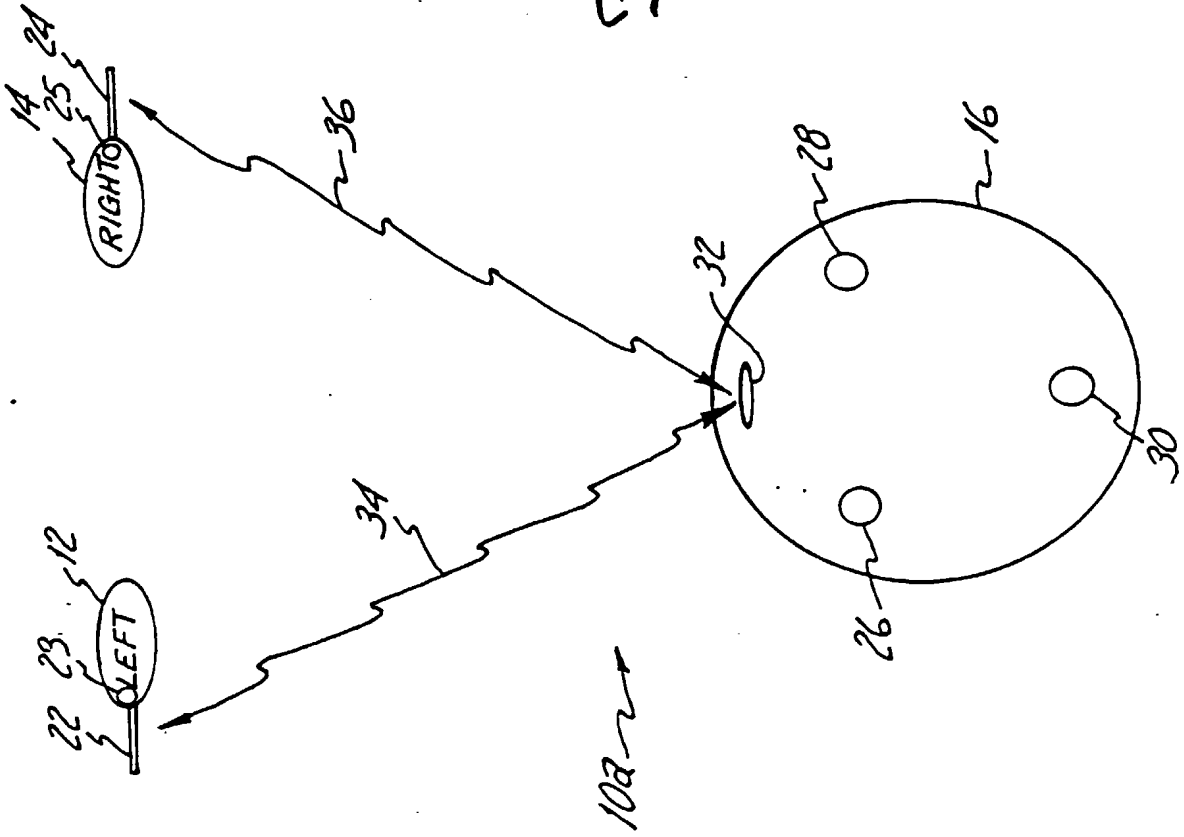


Fig. 2


Fig. 3
14
24
25
RIGHT
36
28
16
32
30
34
12
23
LEFT
22
26
10a

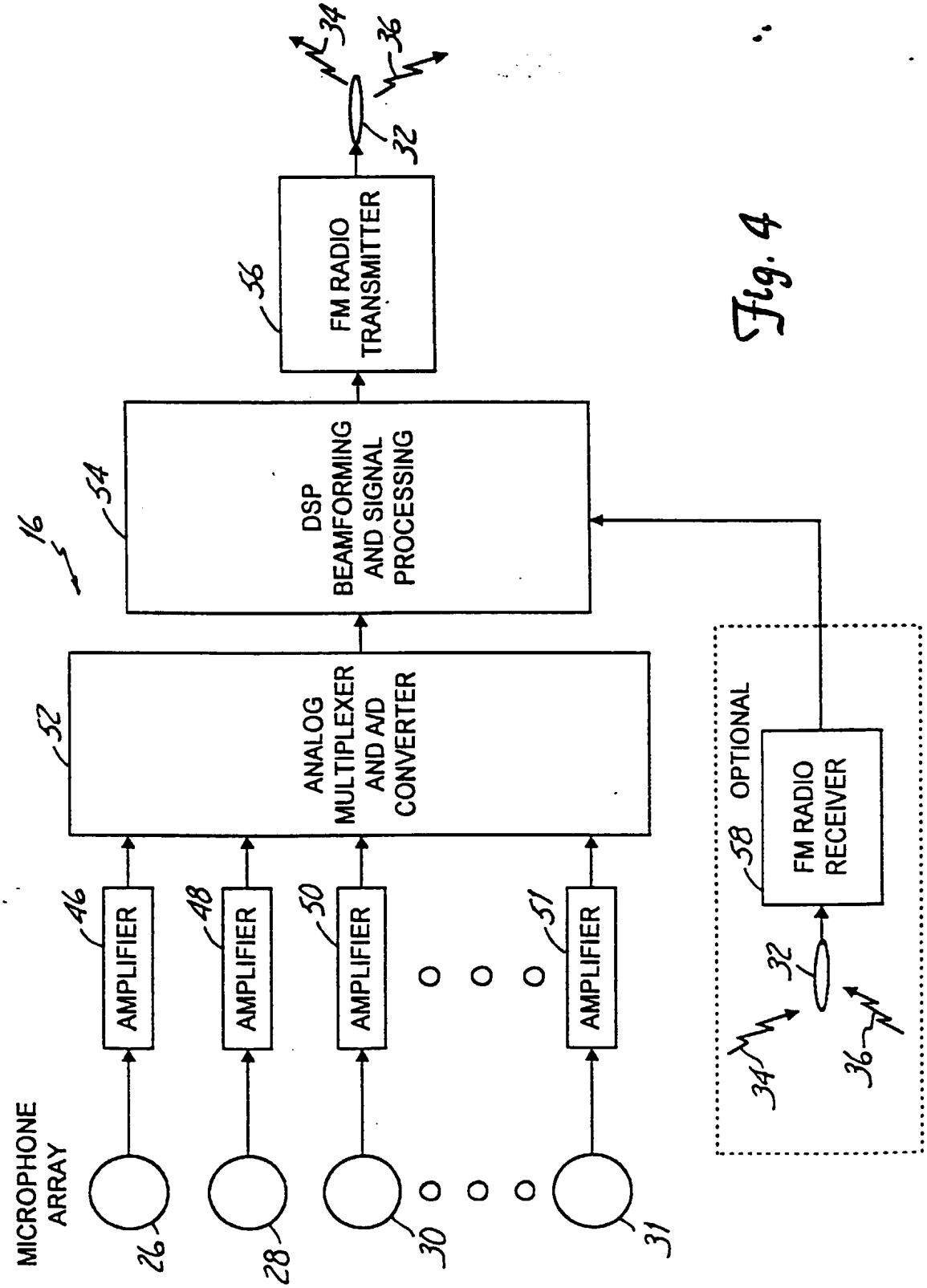

MICROPHONE ARRAY
26
28
30
31
AMPLIFIER
46
AMPLIFIER
48
AMPLIFIER
50
AMPLIFIER
51
ANALOG MULTIPLEXER AND A/D CONVERTER
52
DSP BEAMFORMING AND SIGNAL PROCESSING
54
16
FM RADIO TRANSMITTER
56
32
34
36
OPTIONAL
FM RADIO RECEIVER
58

Fig. 4

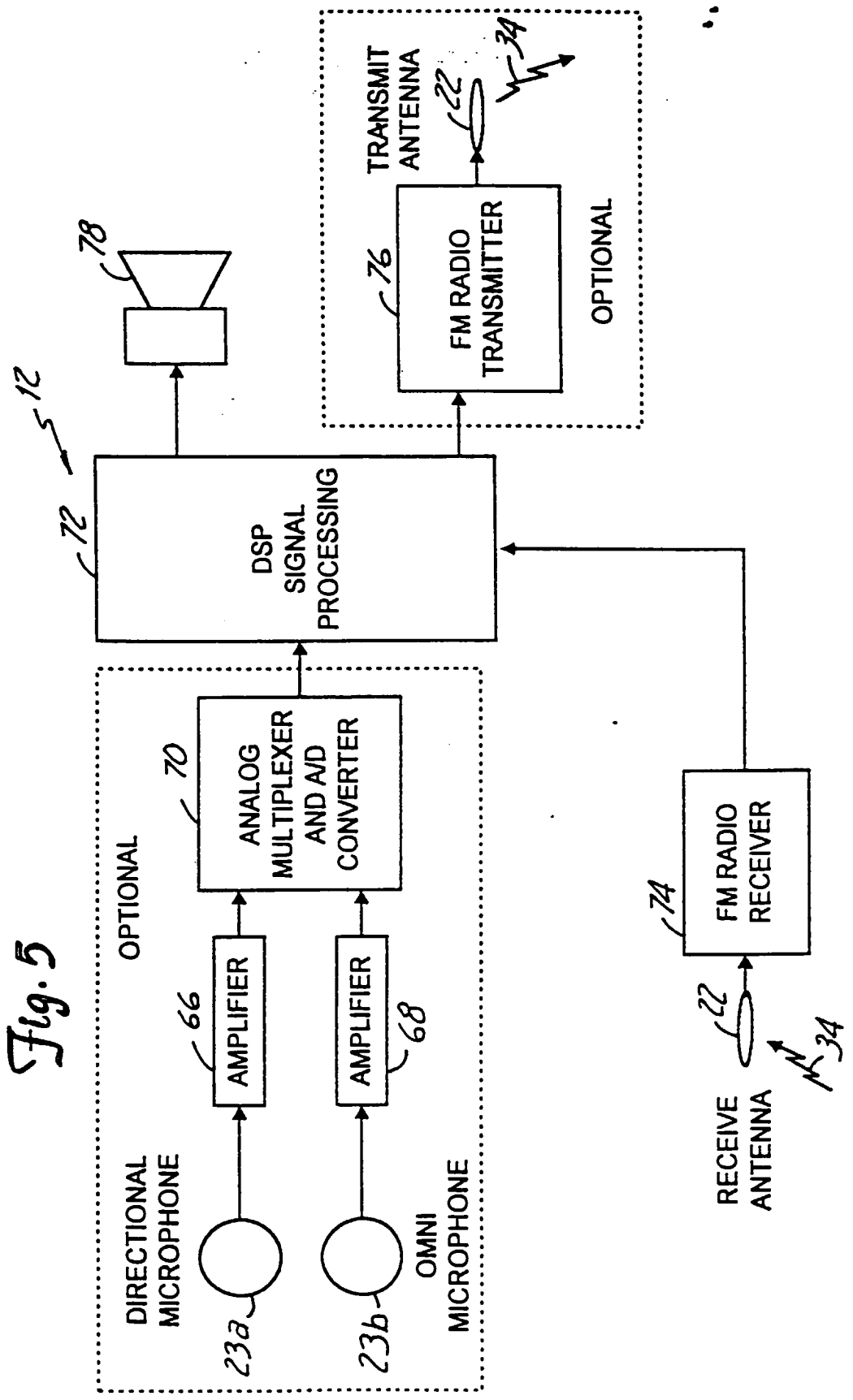

12
72
DSP SIGNAL PROCESSING
78
76
FM RADIO TRANSMITTER
OPTIONAL
TRANSMIT ANTENNA
22
34
70
ANALOG MULTIPLEXER AND A/D CONVERTER
OPTIONAL
66
AMPLIFIER
68
AMPLIFIER
DIRECTIONAL MICROPHONE
23a
23b
OMNI MICROPHONE
74
FM RADIO RECEIVER
22
34
RECEIVE ANTENNA

Fig. 5

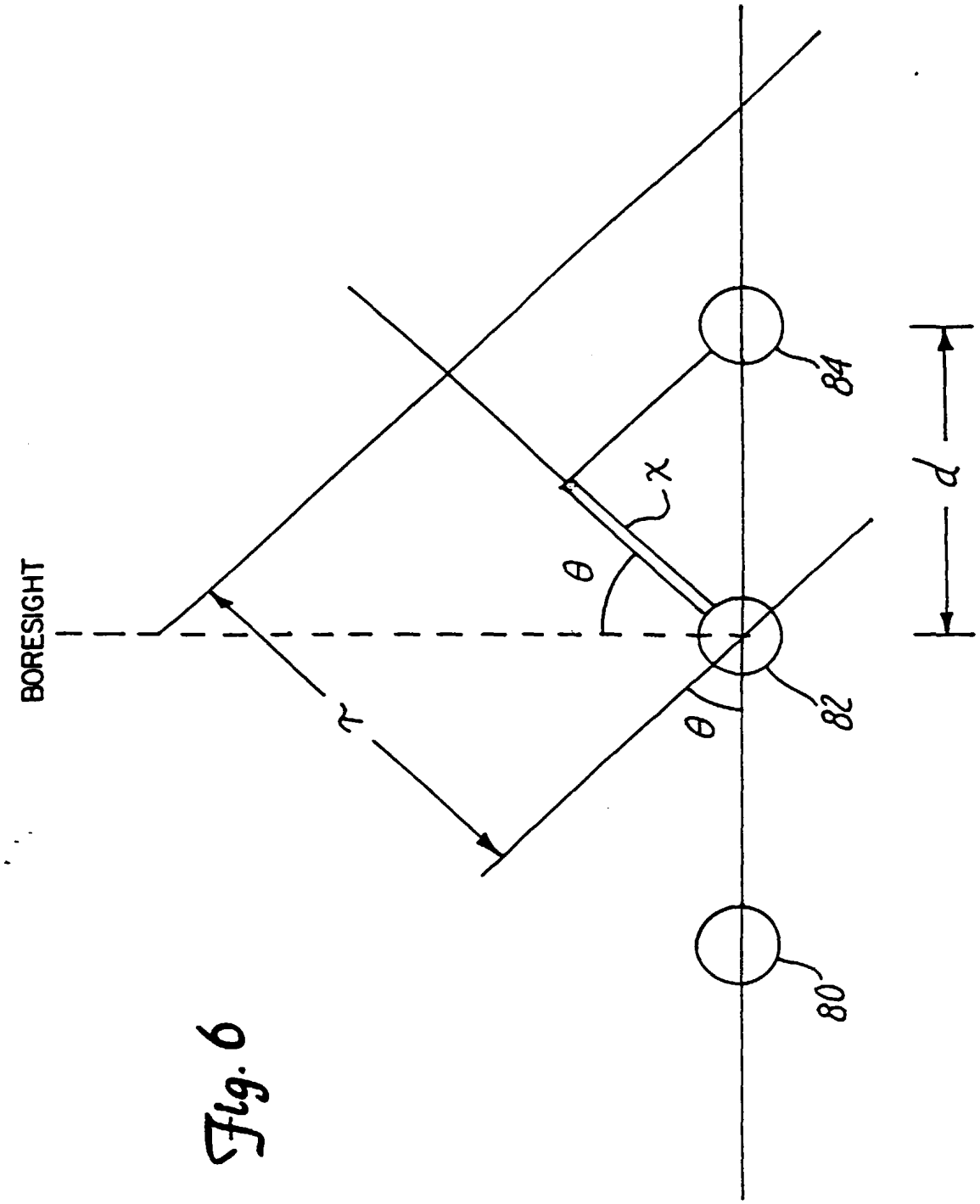


Fig. 6

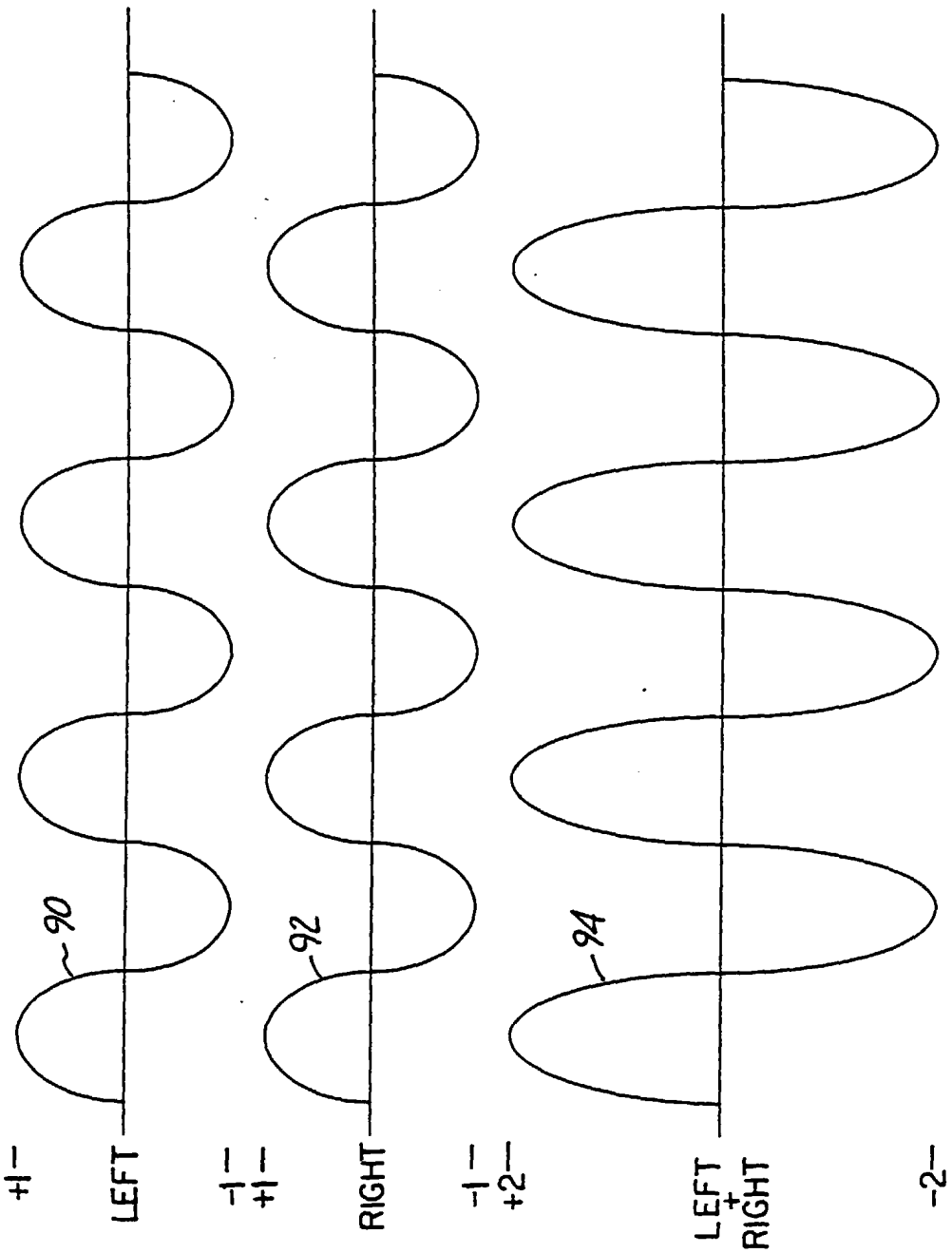


Fig. 7

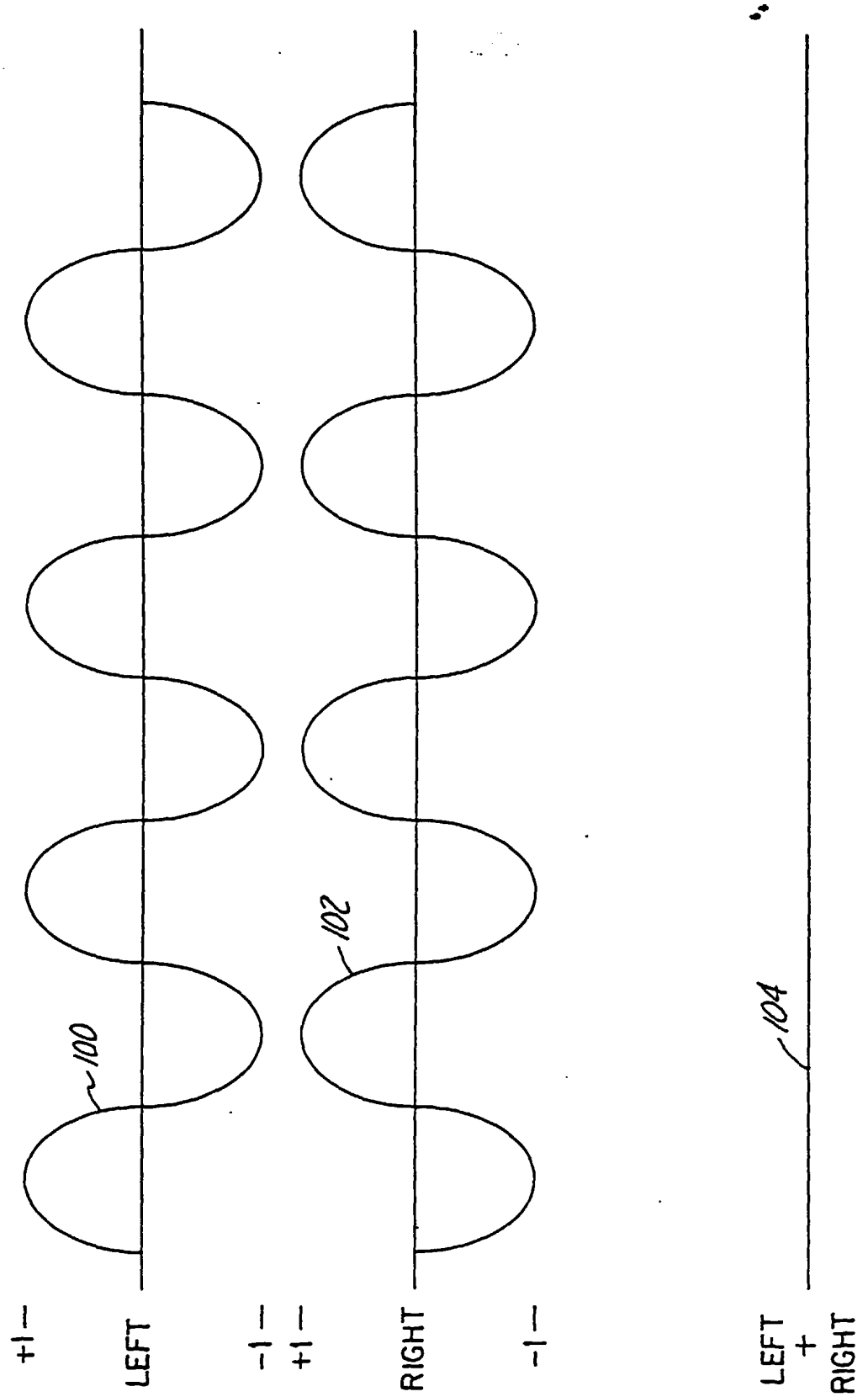


Fig. 8.

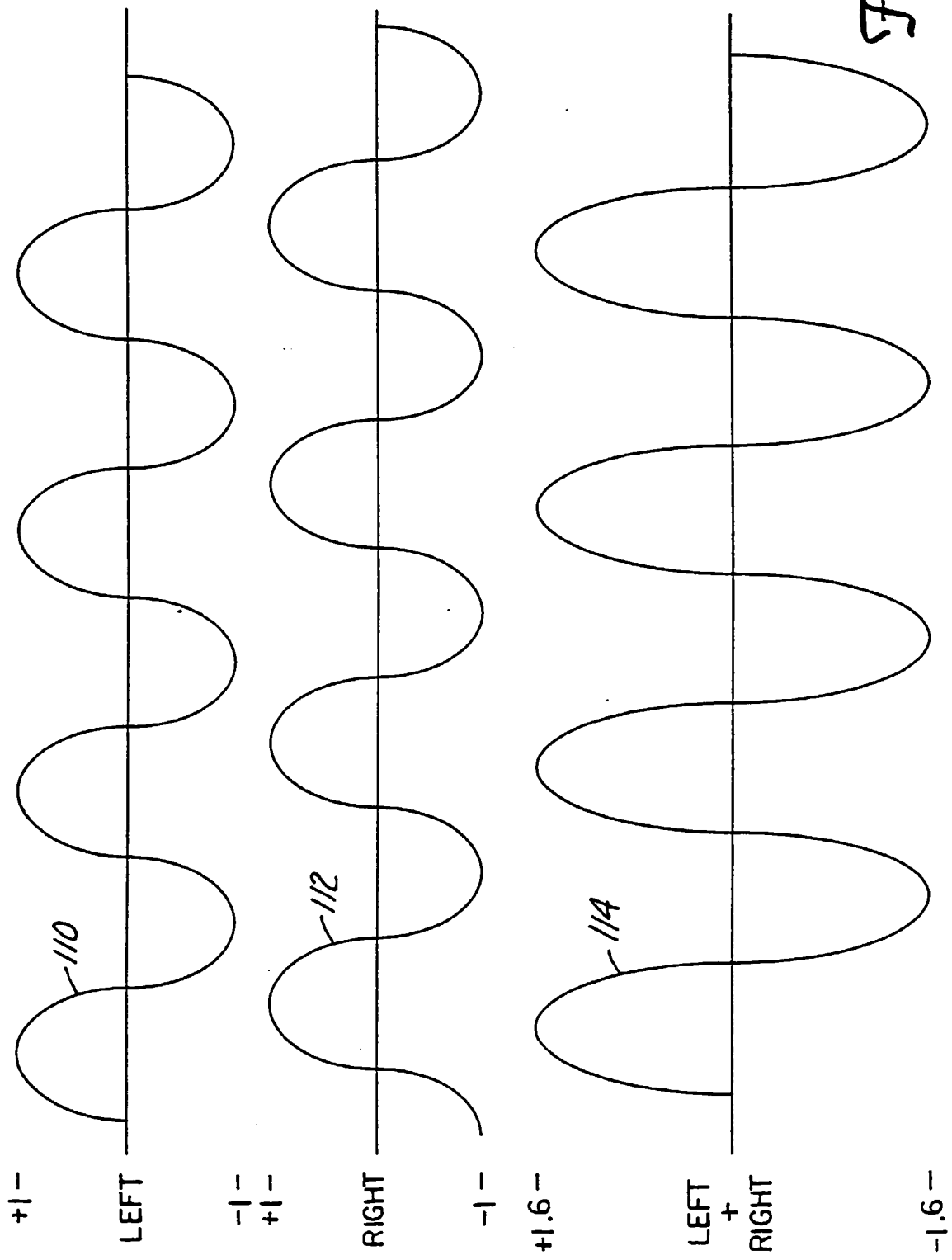


Fig.9

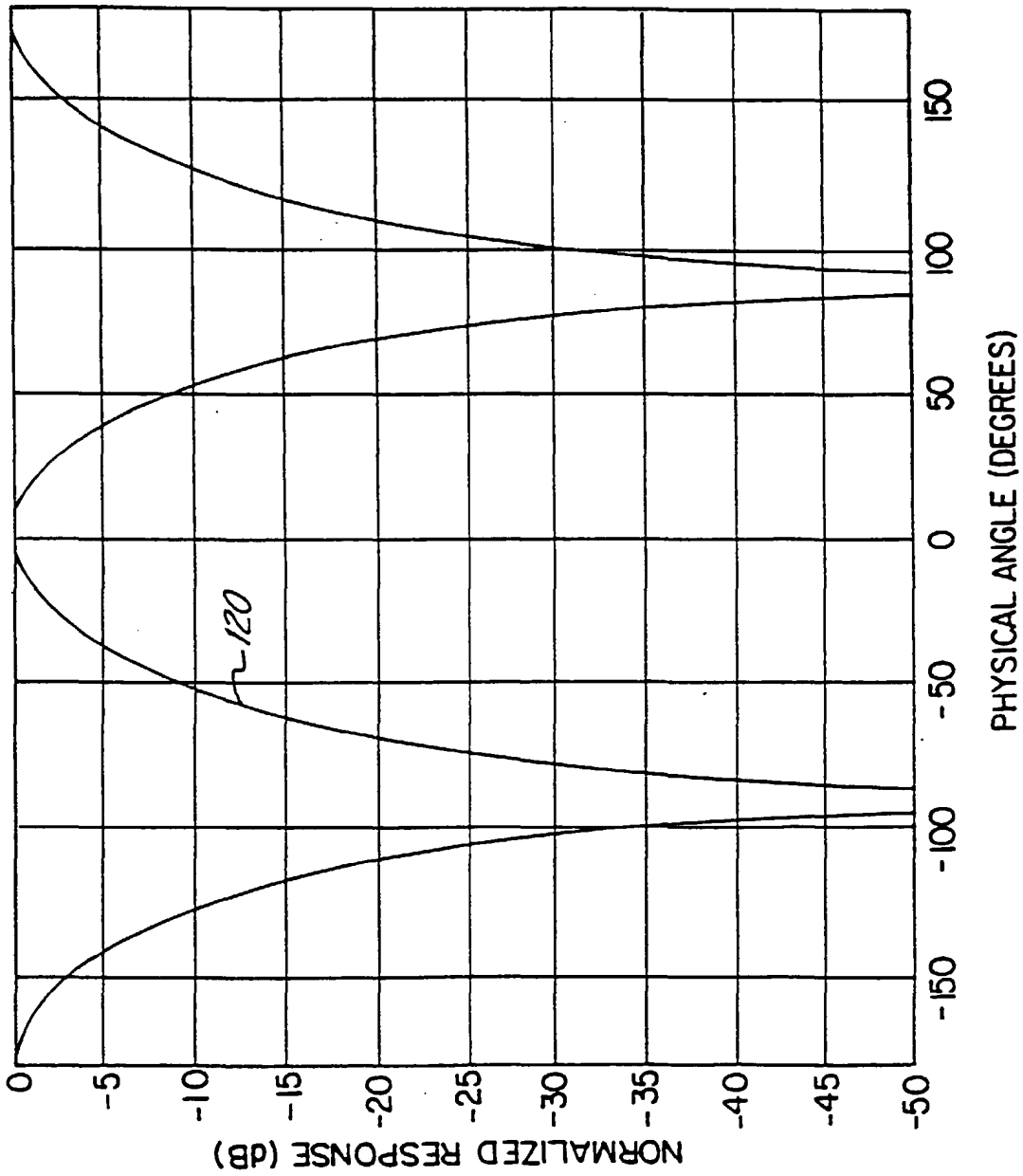

NORMALIZED RESPONSE (dB)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
PHYSICAL ANGLE (DEGREES)
150
100
50
0
-50
-100
-150
120

Fig. 10

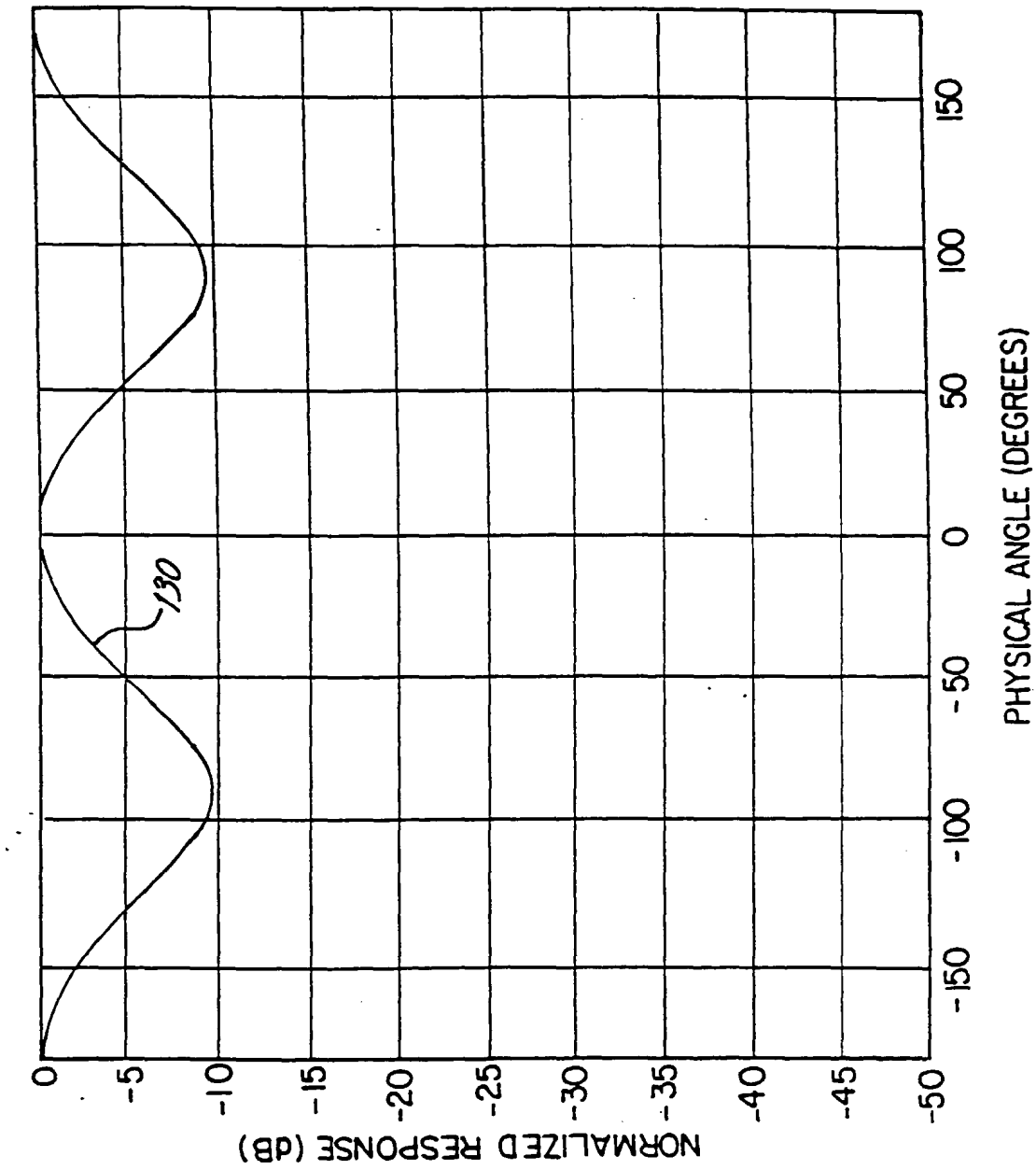

NORMALIZED RESPONSE (dB)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
PHYSICAL ANGLE (DEGREES)
150
100
50
0
-50
-100
-150
130

Fig. 11

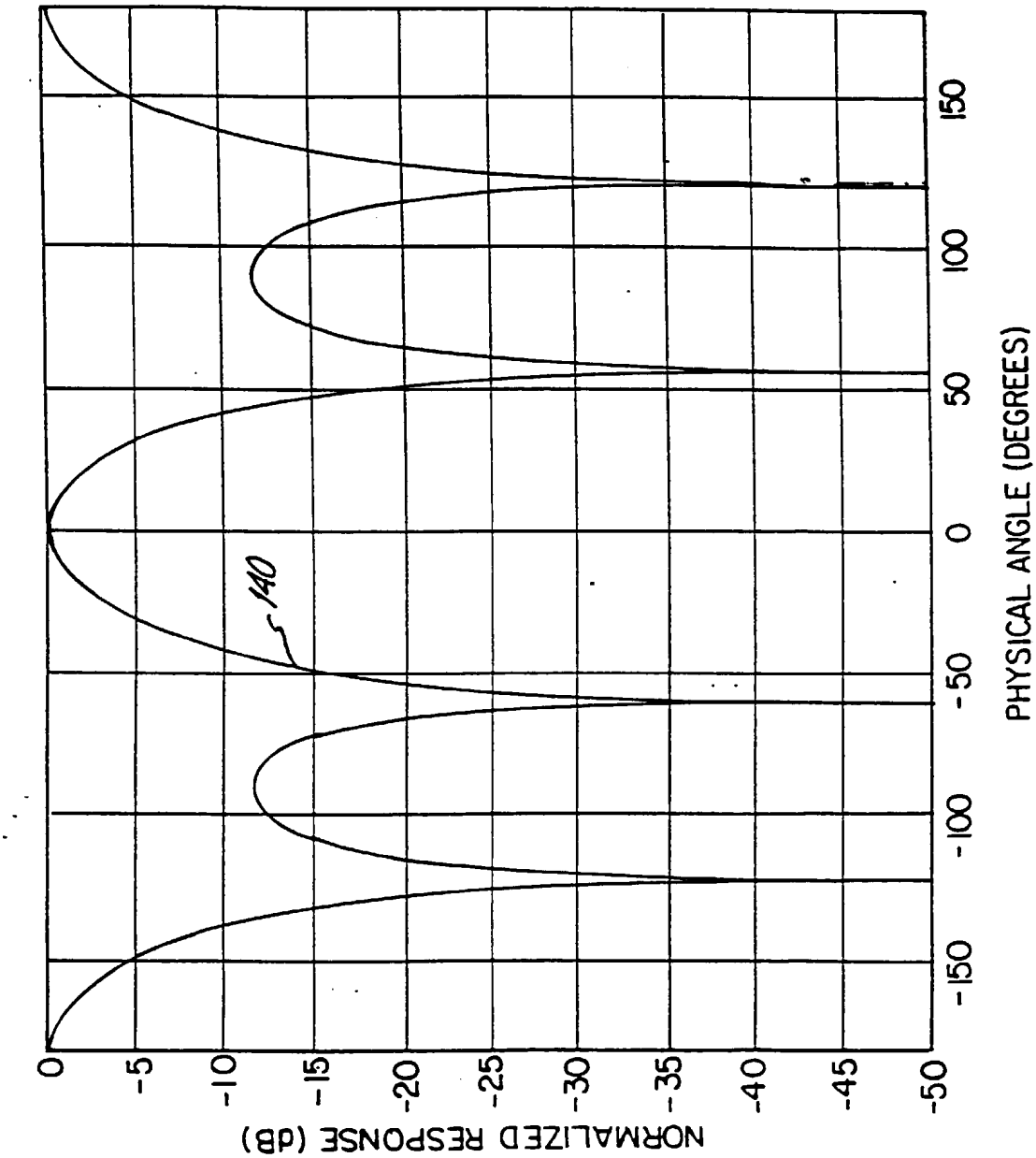

NORMALIZED RESPONSE (dB)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
PHYSICAL ANGLE (DEGREES)
150
100
50
0
-50
-100
-150
140

Fig. 12

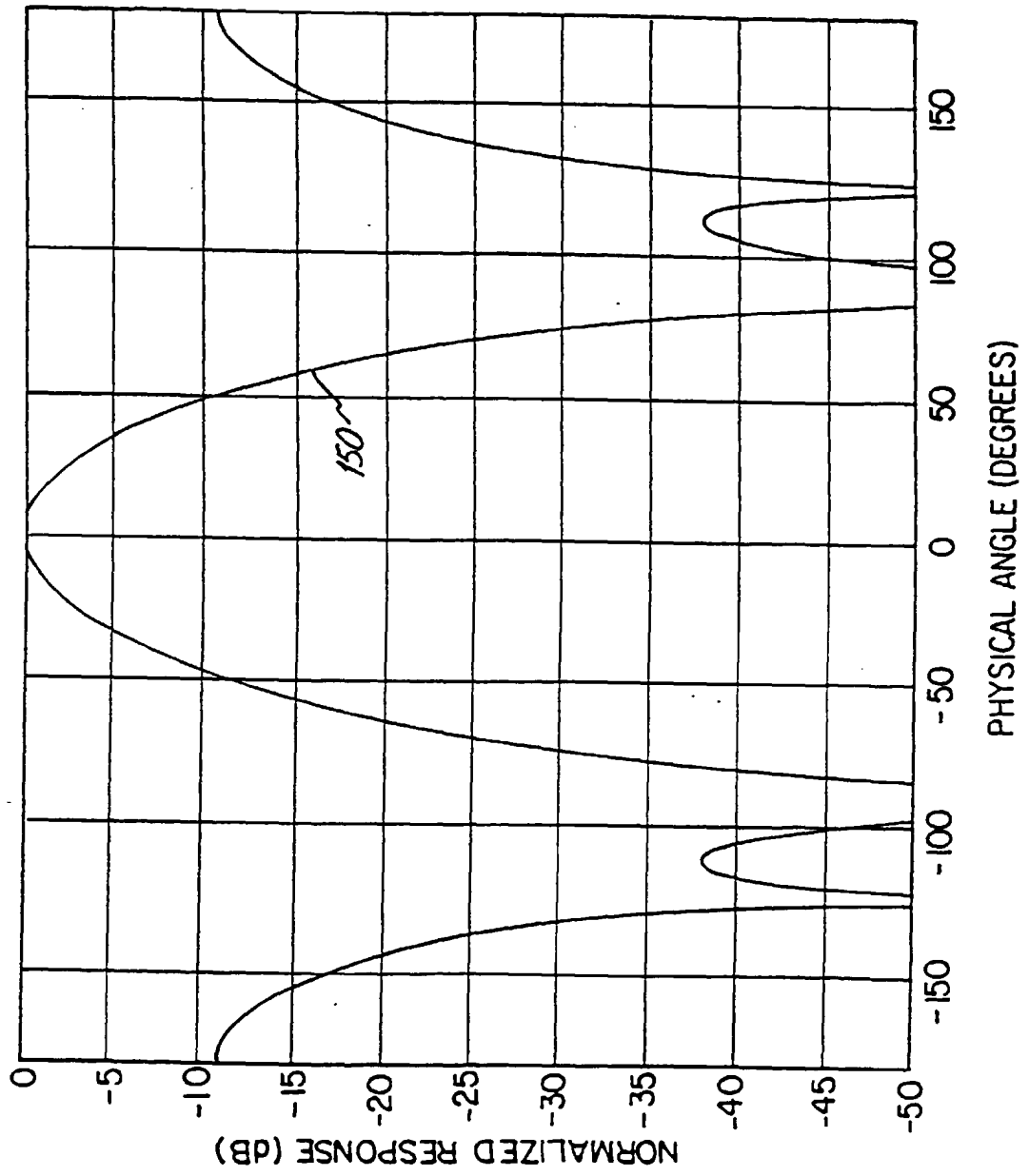

NORMALIZED RESPONSE (dB)
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
PHYSICAL ANGLE (DEGREES)
150
100
50
0
-50
-100
-150
150

Fig. 13

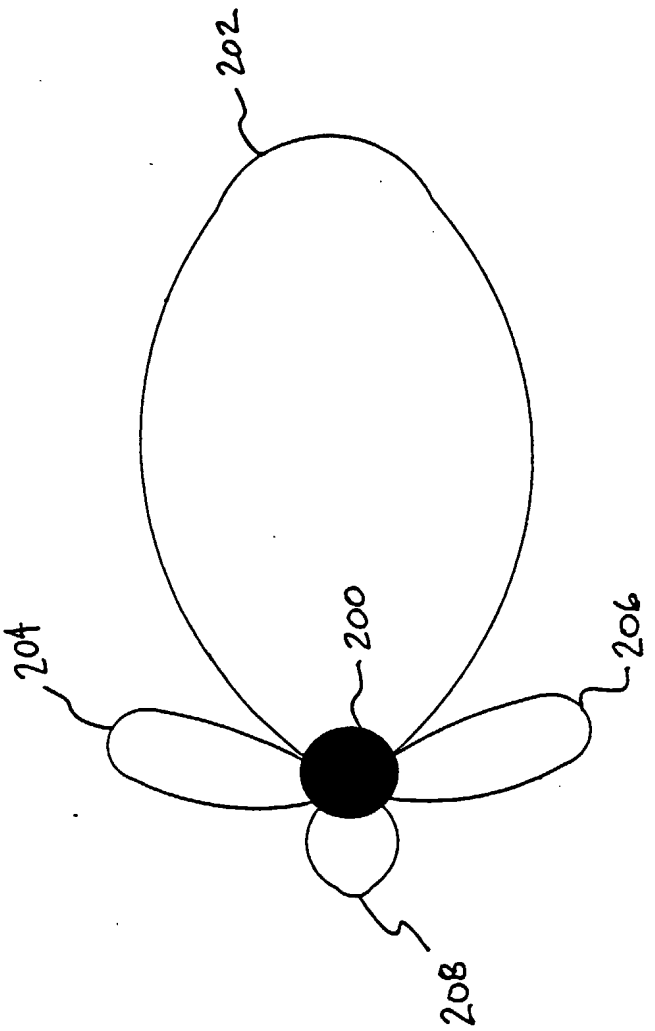


FIG. 14

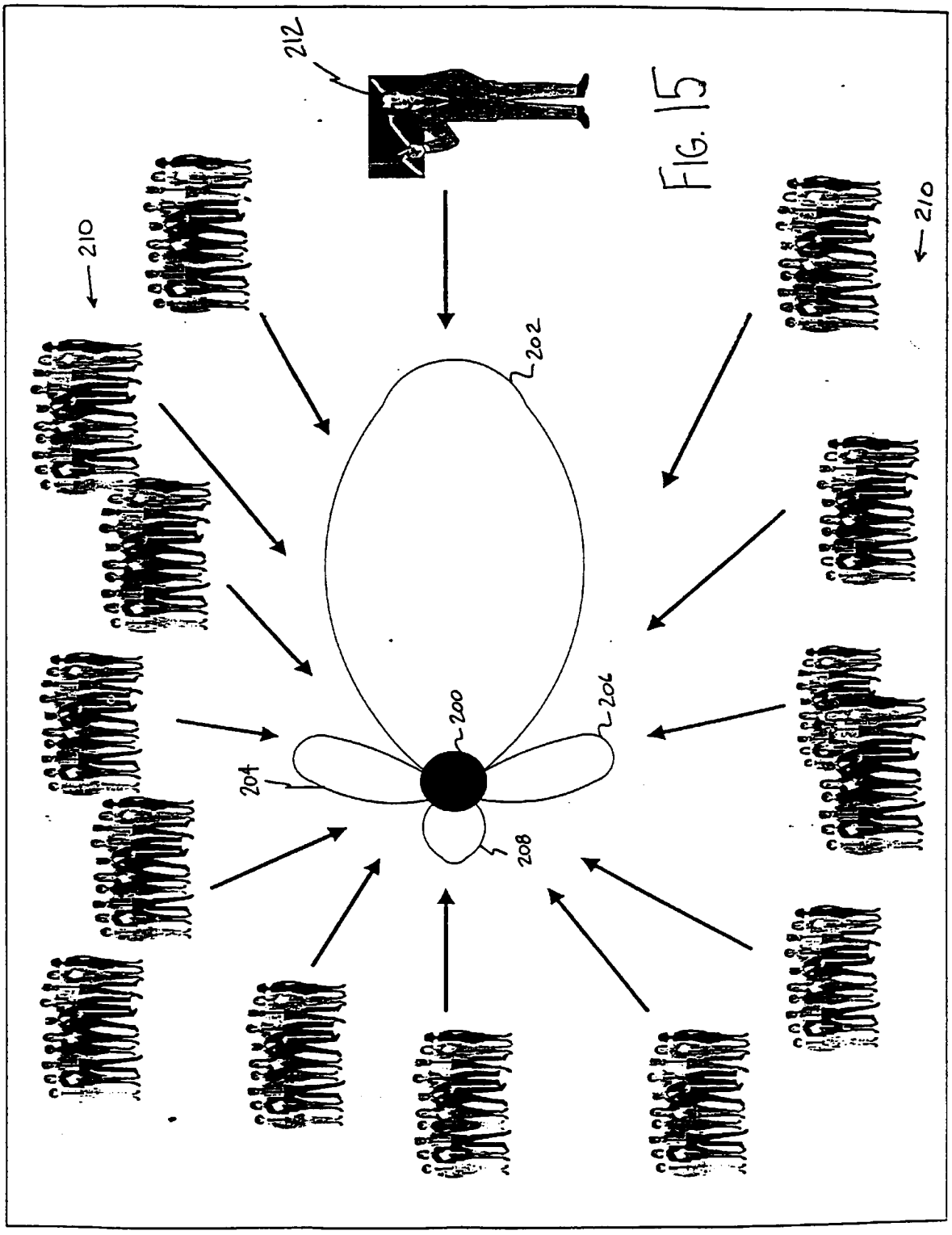
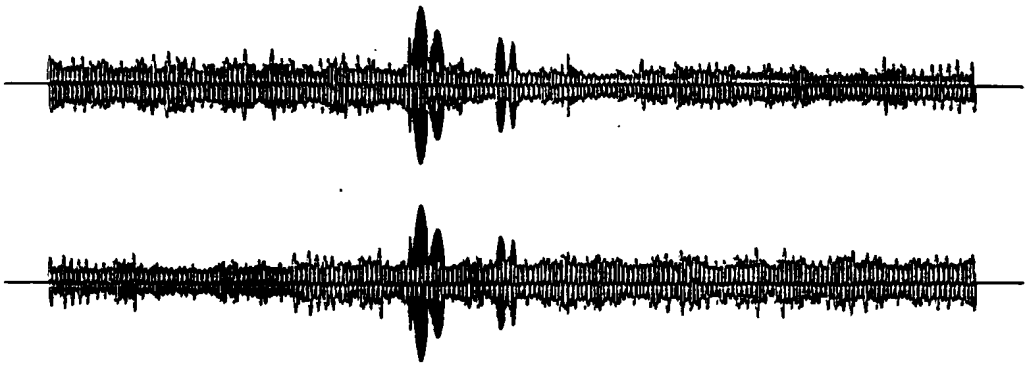


FIG. 15



Uncorrupted Signal

FIG. 16A



Left and Right Input Channels
(corrupted with random noise)

FIG. 16B

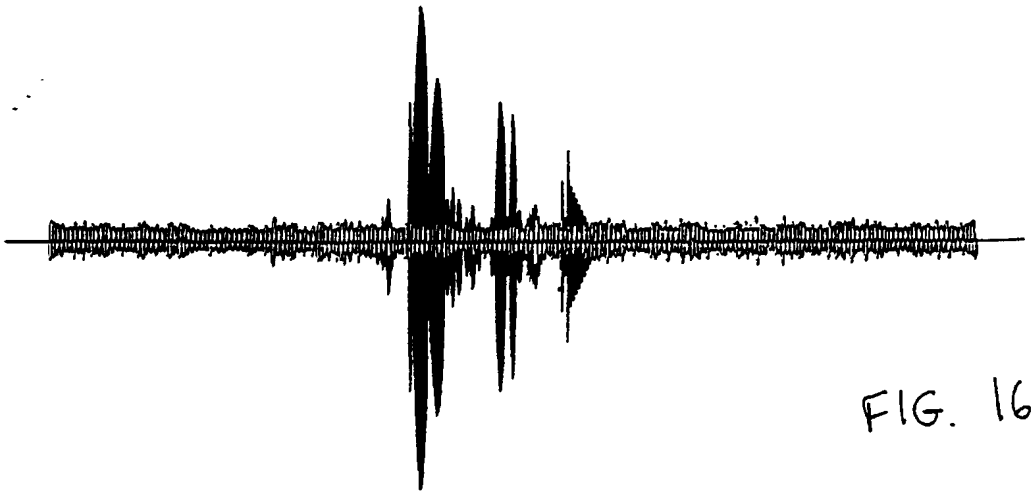


FIG. 16C

Beamformer Output

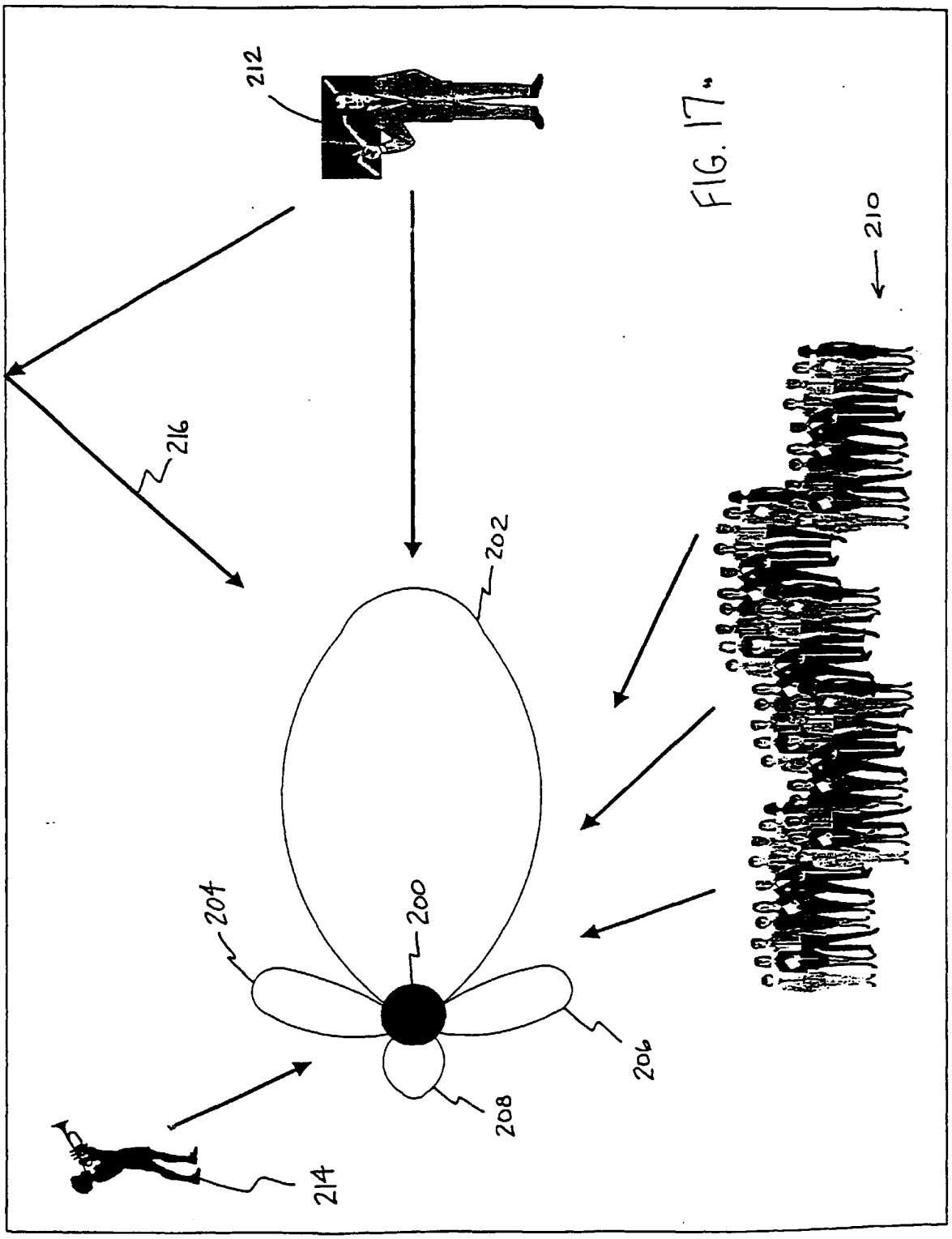


FIG. 17.



Uncorrupted Signal

FIG. 18A

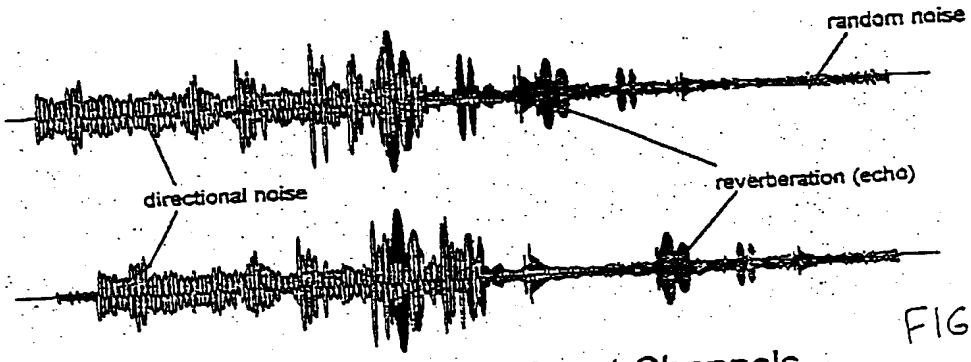


FIG. 18B

Left and Right Input Channels
(corrupted with random noise, directional noise and reverberation)

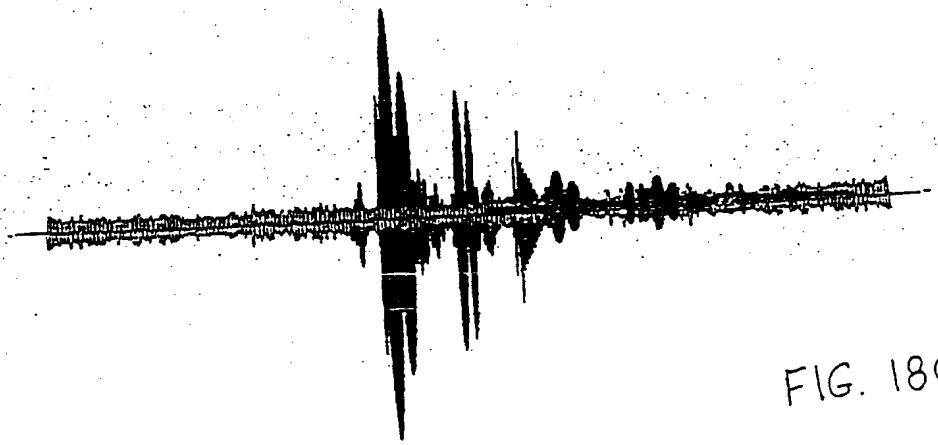


FIG. 18C

Beamformer Output

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(54) A short-range radio terminal adapted for data streaming and real time services

(57) A local services platform including a server subsystem (106) is connected to one or more APs (106-106n); an application subsystem and provides headset/terminals (HS) with real-time services. A streaming interface is installed between the server (108) and the application (110). The HS (110) is capable of being activated and paired with a host device, typically a telephone (221) under standard Link Control Protocol. The HS includes an extra button, when operated, causes the host to place the HS in an "idle" mode. During the "idle" mode, the HS listens to AP inquiries or carries out inquiries (406). When an AP beacon is detected (406), the HS requests a HOLD state from the paired telephone and receives streaming data after completing a connection to the AP beacon. When the streaming data is in channels, the HS can switch among the channels or end the transmission by operating the idle button.

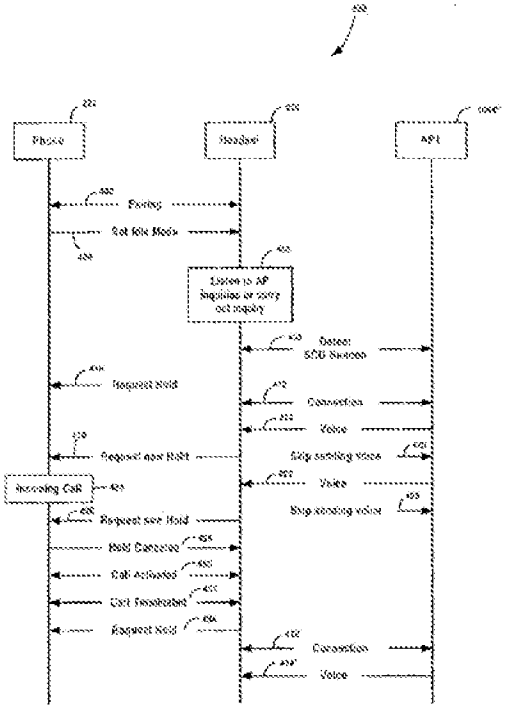


FIG. 4

EP 1 469 659 A1

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Description

BACKGROUND OF INVENTION

1. Field of Invention:

[0001] This invention relates to communication devices, systems and methods. More particularly, the invention relates to a short-range radio terminal, system and method adapted for data streaming and real-time services.

2. Description of Prior Art:

[0002] Short-range communication technology, typically Bluetooth provides synchronous connection oriented (SCO) links capable of delivering 64 kilobytes per second (KPS) channels to active clients. The datastream includes any content, but in general consists of voice. The data stream can be applied to Bluetooth headsets using headset or hands-free profiles. Bluetooth Access Points (AP) serve as Bluetooth voice beacons, i.e., voice streams from the AP to the headset as the active terminal. The Access Point may also provide real time location aware or listening services to the headset. However, the headset must be paired with a host device, e.g., a telephone, before voice streaming or listening services are provided to the headset. Alternatively, the headset can be paired with an AP, and can be dynamically paired any time to any device. Pairing means that two devices have a common Link Key. Even though device A and B are paired, the device A can be also paired with device C, etc. During this state, already paired headsets in active connection to the host cannot receive Bluetooth beacon voice streams or location aware listening services.

[0003] It would be desirable to extend the functions of short-range terminal headsets to receive streaming voice or listening services while the headset is paired with a host device. By so doing, headset users will be able to receive a wide variety of new services enhancing the utility and interest in headsets.

[0004] Prior art related to short-range terminal headsets receiving streaming data or listening services includes the following:

1. USPA 2002/0111140, entitled," Wireless Headset Capable of Automatic Link Connection and Method for Controlling the Same", published February 13, 2001 discloses a wireless headset including a microphone supporting member having a microphone installed and being able to be forwarded to or unforwarded from the main body of the wireless headset, and a sensing device connected to a connector of the microphone supporting member. The sensing device senses whether the microphone supporting member is folded or unfolded. If the microphone supporting member is unfolded, an attempt to register and ID (Identification) of the wireless headset in a counterpart terminal and to connect a Bluetooth TM, wireless communication link between the wireless headset and the counterpart terminal is preformed using the Bluetooth TM module.

2. USPA 2002/0068610, entitled, "Method and Apparatus For Selecting Source Device And Content Delivery Via Wireless", published June 27, 2002 discloses a headset or other interactive device comprising a user interface apparatus, a wireless transceiver, and a switching module; wherein, the wireless transceiver is used for transport of content between the user interface device and a plurality of source devices, and the switching module is coupled to and interposed between the user interface apparatus and the wireless transceiver and is used to select specified source devices for wireless coupling with the user interface.

3. USPA 2002/0082057, entitled, " System and Method for Utilizing Mobile Communication Terminal as Wireless Headset", published June 27, 2002 discloses a mobile communication terminal as a wireless headset, comprising a personal computer (PC) adapted to access to an internet phone service through an internet network; and mobile communication terminal for performing a function of a wireless headset of the PC when the PC accesses the internet phone service, wherein, the mobile communication terminal have a Bluetooth function. The Bluetooth built-in function makes possible the user of an internet phone call service. When an operation mode of the mobile communication terminal is set to a headset mode, a speech signal of a user inputted through a microphone is transmitted to the PC directly, via a Bluetooth device and the speech signal of a counterpart inputted to the mobile communication terminal from the PC is applied to a speaker via the Bluetooth device.

4. USP 6,334,052 B1, entitled, "Subscription-Based Mobile Station Idle Mode Cell Selection", issued December 25, 2001 discloses subscription-based information in a mobile telecommunications systems utilized to control idle mode operations of a mobile station. In one aspect, cell-related information is broadcast from cells. A mobile station then uses the received cell-related information to determine whether any given cell is part of a predefined service area that is reserved for use by only certain subscribers to the exclusion of other subscribers. The cell-related information may be a cell identifier that uniquely identifies a corresponding cell, or it may alternatively be a service area identifier that uniquely identifies a service that comprises one or more cells. In either case, the mobile terminal

makes its determination by accessing a memory such as a Subscriber Information Module (SIM), and retrieving therefrom stored information that defines the predefined service areas. In another aspect, the SIM may store information identifying preferred cells for the mobile station to camp on during idle mode.

5. USP 6138003 entitled "System and Method For Authorization Of Location Services", issued October 24, 2000 discloses a telecommunications system and method which performs authorization checks prior to allowing a location service to position a mobile terminal within a cellular network. The various checks involve ensuring that the requesting agency has authorization to request positioning of mobile terminals, determining whether positioning of mobile terminals is allowed within the cellular network that the mobile terminal is currently located in, verifying the authenticity of the identity of the mobile positioning center, ascertaining whether the mobile subscriber has allowed the requesting agency to position the mobile terminal, and confirming that all relevant criteria for positioning have been met by both the mobile subscriber and the requesting agency.

6. USP 4,163,123 entitled "Electronic Tour Guide System", issued July 31, 1979 provides messages about exhibits in a museum or the like to visitors carrying portable receivers. Audio sources which generate various messages are provided at a central location which are multiplexed and digitized and applied to one or more cables which extend to the covered areas. Receiver-transmitters are located along the cables and are adapted to decode one of the messages and transmit the same via infrared energy into a well defined area adjacent the exhibit, enabling a visitor having a receiver to receive the infrared radiated signal information and hear the message.

[0005] None of the prior art discloses or suggest a short-range terminal, typically a Headset adapted for receiving streaming voice or listening services from a voice beacon, typically an Access Point (AP) while in a paired state with a host device, typically a telephone by switching the terminal into a "Idle state" where the paired device is in a passive condition, typically a HOLD state and disconnecting from the streaming voice when the host device becomes active.

SUMMARY OF THE INVENTION

[0006] A short-range radio terminal, such as a Bluetooth terminal, typically a Headset (HS) in an active state (paired with a telephone or communicating with another device) is set in an "idle mode" and receives streaming data from a streaming data source (e.g. an Access Point (AP) serving as a Bluetooth voice beacon). A local server subsystem is connected to one or more APs and to an application subsystem including a local services platform. A streaming interface is installed between the local server subsystem and an application subsystem. Streaming content (i.e., voice) is stored statically in the local server or even in the APs. The HS is paired with a host device, typically a telephone under standard Link Control Protocol, although the HS can also operate fully independently and does not need to be paired with a host device. The stream is delivered to the HS from the AP voice beacon via a synchronous connected oriented (SCO) link. The HS includes an extra switch which when operated places the HS in an "idle" mode. During the "idle" mode, the HS listens to AP inquiries or carries out inquiries. When an SCO beacon is detected, the HS requests a HOLD state from the paired telephone and receives streaming voice after completing a connection to the AP beacon. During the connection state the, HS may switch among streaming voice channels available from the AP by operating the extra or "idle" switch. Alternatively, the HS can also operate without the telephone. When the HS receives an incoming call while receiving streaming voice, the HS requests a new HOLD period to terminate the streaming voice. Afterwards, the HOLD is terminated and the call activated. When the call is terminated, a new HOLD request is made by operating the "idle" switch, and the HS listens to AP inquiries from streaming voice. Real time services are available to the HS from locations equipped with local services platform. The platform receives and re-transmits information, i.e. news or other content to active HSs in the vicinity of the platform or information stored in the platform is broadcast to the HSs. When the AP and HS establish a connection, the AP may also send an event message to the platform. The message may be processed to send a stream to the HS or the message may be re-transmitted to the application subsystem included in or connected to the platform.

[0007] An aspect of the invention is a terminal/headset, including a switching apparatus, which when operated, switches the headset into a "idle" state while connected to a paired host device.

[0008] Another aspect is a terminal/headset having a terminal ID for use in selecting appropriate streaming data from a database, which enables personalized contact delivery in addition to location aware contact delivery.

[0009] Another aspect is a terminal/ headset including switching means setting the terminal/headset in a mode to form or end a connection to the AP and/or switching the terminal/headset between different content channels of an AP.

[0010] Another aspect is a headset, which can operate independently from a terminal and after pairing with a host device receive streaming data from an Access Point while in an idle mode.

[0011] Another aspect is a synchronous connection-oriented profile for a headset to automatically set the headset in a mode to form or end a connection to the AP and/or switch the headset between different content channels of an AP.

[0012] Another aspect is a headset receiving streaming data, while paired with a host device an in an idle mode, and able to communicate with the host device between data packets.

[0013] Another aspect is a host device including a User interface for setting a paired HS in a "beacon listening mode" and/or switching the HS between available content channels from an AP.

[0014] Another aspect is a host device as a master device including a list of available AP channels and enabling a headset user to graphically select an appropriate AP content channel.

[0015] Another aspect is a host device establishing contact with an AP and delivering AP content to a paired headset.

[0016] Another aspect is the addition of a streaming interface between a local service subsystem and an application subsystem providing streaming data to Access Points and if there are active terminals connected to the Access Points, the stream is delivered there via SCO links.

[0017] Another aspect stores previously loaded stream content in a local server and thereafter delivers the content to active clients via Access Points, the Access Points being identified by their addresses and the stream database content having the same Access Point thereby assuring appropriate content is delivered to appropriate Access Points.

DESCRIPTION OF THE DRAWINGS

[0018] The invention will be further understood from the following detailed description of a preferred embodiment, taken in conjunction with an appended drawing, in which:

Figure 1 is a representation of a short-range radio headset/terminal linked to a location aware based server via an Access Point for receiving streaming voice or location aware services and incorporating the principles of the present invention;

Figure 2 is a representation of the short-range terminal and headset design in Fig. 1 for receiving streaming voice or location aware services while paired with a host device;

Figure 2A is a representation of a switching module for initiating or terminating an "idle mode" for the terminal and headset of Figure 2;

Figure 3 is a prior art representation of a headset profile for communicating with the Access Point of Figure 1;

Figure 4 is a message flow diagram of the headset of Figure 2 interacting with a host device and an Access Point to receive streaming voice or location aware services while in an idle mode paired with a host device;

Figure 5 is a flow diagram of one embodiment of a headset design of Figure 2 receiving location aware services in the system of Figure 1;

Figure 6 is another embodiment of the headset design of Figure 2 receiving location aware services in the system of Figure 1.

DESCRIPTION OF PREFERRED EMBODIMENT

[0019] A brief description of short-range wireless systems is believed appropriate before describing the preferred embodiment.

[0020] Short-range wireless systems have a typical range of one hundred meters or less. They often combine with systems wired to the Internet to provide communication over long distances. The category of short-range wireless systems includes wireless personal area networks (PANs) and wireless local area networks (LANs). They have the common feature of operating in unlicensed portions of the radio spectrum, usually either in the 2.4 GHz Industrial, Scientific, and Medical (ISM) band or the 5 GHz Unlicensed-National Information Infrastructure (U-NII) band. Wireless personal area networks use low cost, low power wireless devices that have a typical range of ten meters. The best known example of wireless personal area network technology is the Bluetooth Standard, which operates in the 2.4 GHz ISM band. It provides a peak air link speed of one Mbps and a power consumption low enough for use in personal, portable electronics such as PDAs and mobile phones. The Bluetooth Special Interest Group, Specification of The Bluetooth System, Version 1.0B, Volumes 1 and 2, December 1999, describes the principles of Bluetooth device operation and communication. The preferred embodiment will be described in terms of the Bluetooth Standard.

[0021] Briefly, Bluetooth devices are designed to find other Bluetooth devices within their ten-meter radio communications range and to discover what services they offer, using a service discovery protocol (SDP). The SDP searching function relies on links being established between the requesting Bluetooth device in a client role and the responding Bluetooth device in a server role. Once a link has been established, it can be used to find out about services in the responding Bluetooth device and how to connect to them.

[0022] A connection between two Bluetooth devices is initiated by an inquiring device sending out an inquiry message searching for other devices in its vicinity. Any

other Bluetooth device that is listening by means of conducting an inquiry scan, will recognize the inquiry message and respond. The inquiry response is a message packet containing the responding device's Bluetooth Device Address (BD_ADDR). A Bluetooth device address is a unique, 48-bit IEEE address that is electronically engraved into each Bluetooth device.

[0023] The inquiring device uses the information provided in the inquiry response packet, to prepare and send a paging message to the responding device. To establish a connection, the inquiring device must enter the page state. In the page state, the inquiring device will transmit initial paging messages to the responding device using the access code and timing information acquired from the inquiry response packet. The responding device must be in the page scan state to allow the inquiring device to connect with it. Once in the page scan state, the responding device will acknowledge the initial paging messages and the inquiring device will send a paging packet that provides the clock timing and access code of the inquiring device to the responding device. The responding device responds with a page acknowledgment packet. This enables the two devices to form a connection and both devices transition into the connection state. The inquiring device that has initiated the connection assumes the role of a master device and the responding device assumes the role of a slave device in a new ad hoc network piconet.

[0024] Each piconet has one master device and up to seven active slave devices. All communication is directed between the master device and each respective slave device. The master initiates an exchange of data and the slave responds to the master. When two slave devices are to communicate with each other, they must do so through the master device. The master device maintains the piconet's network clock and controls when each slave device can communicate with the master device. Members of the ad hoc network piconet join and leave as they move into and out of the range of the master device.

[0025] However, other examples of short range networks designed for either the 2.4 GHz ISM band or the 5 GHz U-NII may incorporate the principles of the present invention and include: (1) IEEE 802.11 (a) and (b) described in the IEEE 802.11 Wireless Standard, described in three parts IEEE 802.11; 802.11 (a) and802.11 (b); (2) HiPERLAN Type 1 described in the publication HIPERLAN Type 1 Standard, ETSI ETS 300652, WA2 December 1997; (3) HIPERLAN Type 2 Data Link Control (DLC) Layer; Part 4. Extension for Home Environment, ETSI TS 101761-4 V1.2.1 (2000-12); (4) IEEE 802.15 Wireless Personal Area Network (WPAN) Standard; (5) Infrared Data Association Standard (IrDA); (6) the Shared Wireless Access Protocol (SWAP) standard; (7) Japanese 3rd Generation wireless standard and (7) the Multimedia Mobile Access Communication (MMAC) Systems Standard of the Japanese Association of Radio Industries and Businesses.

[0026] Now referring to Figure 1, a location aware services system 100 provides listening services to a mobile terminal 102 via Access Points 106^1, 106^2 ....106^n and air link 105. The Access Points are coupled to a Local Services Platform 106 including a local server 108. An application subsystem 110 is coupled to the server 106. Details of the system 100 in providing listening services to the terminal 102 are described in Serial No. 10/334,449, filed December 30, 2002, assigned to the assignee of the present invention and fully incorporated herein by reference. However, to provide streaming data to the terminal 102, a modification is required to add a "streaming data" interface (not shown) between the server 108 and the application subsystem 110. A streaming data interface is described in the text "The MPEG Handbook" by John Watkinson, published by Focal Press, Woburn, Mass (2001)(ISBN 0 240 51656 7) at pages 35 -38. The interface provides the transfer of digital data to the terminal 102 via the platform and Access Points as a steady and continuous stream of packetized data. A number of streaming technologies are available. The streaming can be TCP/UDP/IP based. The local server 108 can provide more than one interface. Each stream is directed either to all APs or to a set of previously defined APs. The form of the stream can be video or IP, digital sound via PCM, catalog voice digitized in the local server. The server may transmit streaming data to the terminal(s) via various profiles, including Headset, Handsfree, Intercom or PAN. The streams are delivered by synchronous connection-oriented (SCO) link. Either real-time stream or previously stored content/stream can be forwarded directly to a particular terminal, hence, enabling personalized content. An AP can offer seven different stream channels with each of the short-range communication modules installed within the AP. If the channels do not contain private content, a terminal can switch among the channels. However, the terminal is adapted to search and discover AP's transmitting streaming data of interest and connect to the AP while paired to a host device, typically a mobile telephone until a call is received by the paired terminal.

[0027] Figure 2 shows the mobile terminal 102 (Fig. 1) modified as a headset/terminal 200 having Bluetooth search and discovery features, previously described, and enabling a mobile terminal 201 and a headset 220 to operate jointly or the headset to operate independent of the terminal. It is believed appropriate to describe the headset/terminal 200 before describing the implementation of the system 100 in providing listening services as streaming data to the terminal 102, modified as headset/terminal 200, able to search, discover, connect to AP's and select channels in streaming data while paired to a host device.

[0028] In a paired state the host device (mobile terminal 201) and the headset terminal 220 share a link based on a common link key after link key negotiation and authentication where the host device is the master device

and the headset terminal 220 is the slave device. Additional details on pairing are described in the text "Bluetooth Connect Without Cables", Second Edition, by J. Bray et al, published by Prentice Hall PTR, Upper Saddle River, NJ 07458, 2002 at pages 283 - 286.

[0029] In Fig. 2, the terminal 201 is worn or carried by the user and includes an antenna 202, which may be linked to other devices 221, such as APs via airlink 240. The antenna 202 module is coupled to a short-range transceiver 204 for interacting with e.g. the APs or other devices in discovering, connecting to and receiving all kinds of short-range radio communication. A network transceiver 206 is also connected to the antenna 202 module for interacting with base stations and other mobile devices at distances greater than 100 meters. It should be noted that the terminal 201 is a functional representation of a mobile terminal. There are actually two separate antenna modules, wherein one is dedicated to short-range communication and the other is dedicated to network communication. A processor 208 interacts with the transceivers 204 and 206 executing network and short-range communications protocols with the other terminals and Access Points. The network and short-range communication protocol stacks, along with an operating system are stored in a memory 210, typically a ROM or in a storage device 212, typically a RAM. While the operation of the headset/terminal 200 will be described in terms of the Bluetooth protocols, the protocols for other short-range communication systems, described above, may be substituted. The Bluetooth network protocols are described in the text "Bluetooth Connect Without Cables", supra at pages 5 -6. The short-range communication profile may be a headset or handsfree profile. A headset profile 300 is shown in Figure 3. Briefly, the headset profile includes an audio gateway, e.g. master device/Access Point having an audio port emulation layer 301 emulating an audio port and interacting with an audio port driver application layer 302 in the headset. Headset control layers 303 and 304 interact in setting up a Bluetooth connection using SDP/RFCOMM layers 305 and 306. L2CAP layers 307 and 308 interact for implementing communication between the gateway and the headset. The host controller interface modules 309 and 310 together with link managers 311, 312 and link controller modules 313, 314 implement Host Control Interface protocols to transfer data via radio modules 315 and 316 across various physical connectors. Additional details relating to the headset profile are described in the text "Bluetooth Revealed" by Miller et al., published by Prentice Hall, PTR, Upper Saddle River, NJ 07458, dated 2001 (ISBN 013-090294-2) at pages 234-237.

[0030] Returning to Figure 2, an I/O system 217 is coupled to the processor 208. A switching module 218 connected to the I/O circuit is operated by a push button 216 at a terminal interface 215, as shown in Figure 2A. The push button is spring controlled and engages a base plate 219 with a contact member 216a. The base plate includes an electric source 223 which is activated by the contact member to supply voltage to a circuit 225 for measuring the contact voltage and a circuit 227 for measuring the time of contact. A circuit 229 generates a push button event according to the length of the push-button stroke, as determined by the voltage and time measurements. If the circuit 229 detects the stroke length is short as determined by voltage and time measurements, it determine if the headset terminal is in a normal or paired mode or an "idle mode". In the normal mode, the switching circuit initiates a request message to the paired headset terminal 220 in an operation 233 to set the headset terminal into an idle state, wherein the connection between the terminal 201 and the headset terminal is set typically to a HOLD mode (See Bluetooth Connect Without Cables, supra at pages 301-302, supra). During the idle state, the headset 220 may send inquiry or search messages and page or discover messages to establish connections with Access Points transmitting streaming data, while keeping the non-active connection with the terminal 20,1 as will be described in more detail hereinafter. It should be noted that if the headset terminal 220 serves as a slave device, it cannot actively send inquiry messages.

[0031] If the circuit 229 determines the headset terminal is in the "idle mode", the circuit in an operation 235 terminates the connections to the Access Point beacon and returns the headset terminal to the normal mode.

[0032] If the circuit 229 detect a long pushbutton stroke by the voltage and time measurements, the circuit in an operation 237 ends the current Access Point connections and finds and forms new connections to new Access Points.

[0033] The module 218 is further designed to enable a user to select among channels of streaming data transmitted by the Access Point to which the headset terminal 220 is connected. In one embodiment, multiple depressions of the idle button change the tuning frequency of the short-range transceiver to select a channel of choice. A display 219, connected to the processor 208, enables the user to view the process in interacting with the headset terminal 220 and the Access Point to which the headset terminal 220 is connected (e.g. any of the Access Points 106^1 ...106^N (see Fig. 1)). A power supply (not shown) provides the operating voltages and currents for the terminal elements

[0034] Returning to Figure 2, the headset 220, typically resides on the user's head, and is capable of operations of searching, discovering, connecting to and selecting channels of streaming data transmitted by an Access Points after pairing to the terminal device 201. The headset includes an antenna 222 for communicating with the terminal 201 via short-range radio link and with an Access Point 106 transmitting streaming data. In an alternative embodiment, the headset terminal is capable of operating independently. Then, the antenna 222 is also coupled to the Access Points. A short-range radio system 224 connected to the antenna 222 proc-

esses data in discovering, connecting to and receiving data captured by the antenna 202 from the terminal antenna 202 or an Access Point. An I/O block 226 performs ancillary functions in inputting or buffering data processed by the radio system 224. The I/O module is connected to a switching module 218' including an idle button 216', which when operated initiates/terminates the idle mode and may select among channels of the streaming data transmitted by an Access point. In some embodiments, the headset terminal may be equipped also with a dedicated channel selection button (not shown).

[0035] The processor 228 under the control of an operating system (not shown) implements the short-range communication protocols stored in memory 230 for interacting with the host device or an Access Point. In one embodiment, the headset protocol 300 shown in Figure 3 may be employed to interact with a gateway, e.g. a host device or an Access Point.

[0036] The processor also executes software instructions 232 for placing the headset into an idle state or mode after connection to the paired host device (terminal 201). The instructions generate a request to the host or master device for an idle state in which a passive, or non-active connection, e.g. HOLD is established with the host device. However, the host device is capable of activating the non-active connection with the headset at any time, particularly when a third party call is received by the host for the headset. While in the idle state, the headset may search for an AP transmitting streaming data while continuing to maintain a non-active connection to the paired host device 201. When an AP streaming beacon is detected, the headset continues the non-active connection to the host device and completes a connection to the AP beacon. The streaming data from the AP is received by the short-range radio system 224 and passed to an audio processing amplifier unit 231 via the processor 228 after depacketizing the streaming data using well known processes. The Audio unit 231 assembles the packets into an audio signal, which is provided to a loud speaker 236 as an output to the user. The text "The MPEG Handbook", supra at pages 42-45 provide details for assembling audio signals from the packets. A microphone 238 is connected to the audio processing unit 231 for responding to incoming calls from the host device 221.

[0037] Fig. 4 in conjunction with Figs. 1 and 2 will describe a message flow process 400 for the headset terminal 220 in pairing with the host device 221, e.g. a phone to establish an idle state for searching, discovering, connecting to the Access Point 106^N for streaming data and selecting among the channels of the streaming data.

[0038] A pairing message flow 402 between the headset and host device generates a shared link between the host device and the headset. After authentication, the host device serves as the master device and the headset as the slave device.

[0039] The user may depress the button 216 on the headset user interface or alternatively on the host terminal user interface, designated as an "idle" button, which activates the switching module 218 to communicate a request message (not shown) between the host device and the headset for an idle state. When in the idle state, the headset and host connection is passive or non-active, e.g. a HOLD and the headset no longer actively listens to packets from the host. A set idle mode message 404 may be sent by the host to the headset, which places the headset in the passive or non-active connection state, e.g. HOLD, with the headset being discoverable via an Inquiry Scanning and connectable via Page Scanning to another device, typically a streaming data beacon from an access point. However, the host device may activate the paired connection with the headset at any time, particularly if an incoming call is received by the host device for the headset. It should be also noted that the host device may also control the headset while in "idle" mode. A user of the host device is capable of selecting between channels by using the user interface including the display and input buttons of the host device to instruct the headset to request another channel from a streaming Access Point.

[0040] While in the idle mode state, the headset listens to AP inquiries or carries out inquiries using the service discovery protocol in an operation 406. It should be noted that if the headset serves as a slave device, it cannot actively send inquiry messages (i.e. search for new connections). Bluetooth service discovery protocols are described in the text, "Bluetooth Connect Without Cables", supra at pages 96-223.

[0041] After the headset detects a streaming (synchronous-oriented connection (SCO)) Access Point as a result of exchanged inquiry messages 408 between the headset and the Access Point, a request hold message 410 is transmitted to the phone by e.g. depressing the idle button (216). The phone responds by extending the passive, non-active state of the paired connection between the phone and the headset. Connection messages 412 are exchanged between the headset and the Access Point, and after the connection is established, the access point transmits streaming data 414, typically voice to the headset through a SCO link. The details of connection establishment between the headset and the Access Point are described in the text, "Bluetooth Connect Without Cables", supra, pgs. 151 - 175. Alternatively, the connection details can be handled automatically using a special headset beacon profile and the software instructions 232 implemented by the processor 228.

[0042] During the streaming data transmissions messages 414, the headset may communicate with the phone between data packets. In the case of synchronous connection-oriented (SCO) packets, the SCO links do not apply retransmission and the SCO links consume only about fifty percent of the time. The headset has time to communicate with the phone between the SCO pack-

ets. Alternatively, the headset enters into the HOLD state with the Access Point for several milliseconds and activates the connection to the phone or vice-versa.

[0043] Where the Access Point is capable of transmitting channels of streaming data, the switching elements 218, 218' may be operated by e.g. multiple depressions of the idle button to switch the headset among the channels.

[0044] When the timed interval of the non-active connection or hold state ends, the headset may transmit a request message 416 for a new non-active or hold state and during this period it may transmit a skip sending data message 420 to the Access Point. After a new HOLD state is established, the headset re-establishes the connection to the AP to begin receiving streaming data messages 422.

[0045] When an incoming call 424 to the headset is received, the phone or master device activates the connection to the headset. A new request for hold message 426 is transmitted to the host device to provide time for the headset to send a skip sending voice message 428. The connection to the AP is terminated and the streaming data ends.

[0046] The phone sends a "hold cancelled" message 428 to the headset and proceeds to exchange caller activation messages 430 using telephone protocol specification (TSC or TSC-BIN) described in the text of "Bluetooth Connect Without Cables", supra, pgs. 251-271.

[0047] When the call is terminated, the phone and the headset exchange call termination messages 430, which returns the phone and headset to a paired state enabling the headset to send a "request hold" message 434 to retransmit connection messages 412' to restore data messages 414'.

[0048] At any time, the headset may terminate the streaming data transmissions by pressing the idle button to re-activate the active state of the paired connection and terminate the idle state of the headset.

[0049] In another embodiment, if the terminal user interface is in the host or phone, a list of available channels can be displayed at the terminal and the user can graphically select among the available channels. Also, the phone interface may be used to set the headset into a beacon listening mode.

[0050] In another embodiment, the headset 220 can be paired with an access without the need for the terminal 201. The switching device 218 included in the headset activates the speak and listening mode 408. By pressing the idle button e.g. two seconds at a time, the user can separate the speak and listen mode from normal call establishment.

[0051] In another embodiment, the phone connects to the Access Point after detection of an SCO beacon. The Access Point content is delivered to the phone for retransmission to the headset over the paired connection. The switching of channels of the streaming data can be handled by the phone.

[0052] Now returning to Fig. 1, the headset/terminal 220 can receive personalized services from the platform 106 after the user or terminal device is authenticated.

[0053] In one embodiment, the headset terminal device "personalizes" itself for a service by storing personalization information into the headset/terminal. The personalization content can contain key words or other user preferences capable of authenticating interest and the like. The platform transmits content to the Access Point in an inquiry state. The headset/terminal listens for and responds to inquiries. The platform server uses the headset/terminal address and clock estimate to send its pages to the headset/terminal. The headset/terminal matches the keywords to the paging content and enters a slave response based on a match or rejects the connection if a mismatch occurs.

[0054] Where the personalization information is stored to a service provider, the service provider is responsible to ensure that appropriate content is delivered to the terminal. Where the personalization information is stored at the terminal, the terminal and provider must exchange such information in connection formation based on the SDP of Bluetooth, Obex packet or the like. In the case of private personalization content delivery, only the correct terminal can gain access to the content after pairing, authentication and encryption are applied to the content.

[0055] In another embodiment of providing real-time services to the headset/terminal, the system stores previously loaded stream content to the local server 108 and delivers the content to active clients via APs. Each AP can be identified from the AP_ID (e.g. MAC address of the AP) and appropriate content to the appropriate AP. Also, the terminal ID (e.g. terminal address) can be applied in selecting appropriate content from a database, which enables personalized content delivery in addition to location aware content delivery. For example, a voice message to a friend can be stored in a specific place (e.g., cover of Access Point x). The friend receives the message only in the same place the message was stored.

[0056] In still another embodiment, an Access Point sends an event message to a local server when a terminal forms a connection to the Access Point or vice-versa. The server can process the event (i.e., sending a stream to the terminal) or re-transmit to the application domain. The event message consists of the following elements:

[0057] Event Message {Terminal identification (e.g., BD_ADDR or other), Terminal Location (e.g. AP_ID), IP Number and Port to the Terminal's Streaming Interface/audio/video}

[0058] An example of personalized, time-aware, location aware, real-time services is disclosed in process 500 described in Fig. 5 in conjunction with Figs 2 and 4.

[0059] In block 502, a Local Services Platform 100 is installed in a museum.

[0060] In block 504, Access Points 106 are installed in regions of interest to visitors, (e.g. besides famous

paintings) and routing points for directing the visitors through the museum.

[0061] In block 506, location-aware sound content related to the regions of interest and routing is stored on the local server 108 or at the Access Points 106 for broadcast of streaming audio in an AP beacon.

[0062] In block 508, visitors are provided with headsets/terminals 200 and depress the idle button to set the headset/terminal in a discoverable/connectable for automatic connection to an AP 106.

[0063] In block 510, the visitor enters a region of interest. The headset/terminal automatically connects to the AP. The sound content stored in the local server is streamed to handset/terminal after automatic connection to the AP. The sound content ends when the visitor departs the region of interest or depresses the idle button to disconnect from the AP.

[0064] It should be noted that the APs may have several channels available servicing client devices, which results in a system wherein the same information may be transmitted to several client devices, wherein the client devices could receive the same information in different stages. This means that when a certain headset terminal enters an AP coverage area, it may connect to the AP and start receiving the SCO transmission while other terminals may have already been receiving the same transmission for some time.

[0065] In block 512, the visitor is directed to the next region of interest by routing APs installed in the museum corridors, provided the handset/terminal is in a discoverable/connectable state.

[0066] Block 510 is repeated at the next and other regions of interest until the visitor disconnects from the AP and returns the headset/terminal to the museum.

[0067] Fig. 6 describes a process 600 which provides a user with streaming data (e.g., news, music, information) while in a traveling state (e.g. train, bus, airplane)

[0068] In block 602, a Local Services Platform 100 is installed in or on a movable vehicle for reception of radio station broadcasts.

[0069] In block 604, the Local Services Platform receives music, news and other information from a radio broadcast and transmits the content as an AP beacon 106 providing streaming data in channels to users using SCO specific profiles.

[0070] In block 606, a user equipped with a headset/terminal 200 sets the terminal 200 in a discoverable/connectable state by operating the idle button and automatically connecting to the platform using SCO profiles to receive the streaming data. The user operates the idle button to select a channel of choice among the streaming channels.

[0071] In block 608, the user operates the idle button to pair the headset/terminal with a service provider, which receives and provides the streaming data to the user.

[0072] In block 610, the user operates the idle button to switch among the platform channels or end the reception of streaming data.

[0073] While the short-range terminal adapted for voice streaming and location aware services in real-time has been described in terms of a preferred embodiment, various changes can be made therein without departing from the spirit and scope of the invention, as defined in the appended claims, in which:

Claims

1. A short-range wireless communication terminal adapted for receiving streaming data, comprising:

   a) a short-range radio communication protocol stack enabling the terminal to interact with other terminals and Access Points using a short-range radio communication packet structure and link controller states;

   b) switching means for switching the terminal into an "idle" state for enabling a connection for receiving of streaming data from a streaming data source while maintaining a non-active connection to a paired device; and

   c) communication apparatus for connecting to and receiving the streaming data from the streaming data source while maintaining the non-active connection to the paired device.

2. The terminal of Claim 1 further comprising:

   d) terminating apparatus terminating the connection for receiving streaming data after receiving an activation request from the paired device.

3. The terminal of Claim 1 or 2 further comprising:

   e) a profile stored in the short-range protocols for automatic connection of the terminal to an Access Point transmitting streaming data.

4. The terminal according to any preceding Claim wherein operation of the switching means switches the terminal among data stream channels.

5. The terminal according to any preceding Claim wherein operation of the switching means activates the terminating apparatus for terminating the connection for receiving streaming data.

6. A system enabling a short-range wireless communication terminal to receive streaming audio data, comprising.

   a) a short-range radio communication protocol

stack enabling the terminal to interact with other terminals and Access Points using a short-range radio communication packet structure and link controller states;

b) a local server system linked to the Access Points;

c) an application subsystem linked to the server via a streaming voice interface;

d) switching apparatus switching the terminal into an "idle" state after connection to a paired device;

e) transmitting apparatus delivering streaming audio to terminals in an active state and linked to an Access Point Beacon transmitting streaming audio; and

f) terminating apparatus terminating the streaming audio to the terminal when a terminating request is received from the terminal.

7. The system of Claim 6 further comprising:

g) means storing previously loaded stream content in the local server and thereafter delivering the content to active clients via Access Points, the Access Points being identified by their addresses and the stream database content having the same Access Point thereby assuring appropriate content is delivered to appropriate Access Points.

8. The system of Claim 6 or 7 further comprising:

h) a streaming interface installed between the local server system and the application subsystem providing streaming data to Access Points and if there are active terminals connected to the Access Points, the stream is delivered there via synchronous connection-oriented links.

9. The system of according to any one of Claims 6 to 8 further comprising:

i) apparatus terminating the streaming audio to the terminal when the terminal receives a phone call.

10. The system of according to any one of Claims 6 to 9 further comprising:

j) apparatus for selecting among channels of the Access Points providing streaming audio.

11. A method of transmitting streaming audio to a Bluetooth terminal comprising the steps of:

a) pairing a Bluetooth terminal including a Bluetooth protocol stack with another terminal in an active state;

b) switching the terminal into an "idle" state;

c) listening to Access Point inquiries by the terminal;

d) detecting a synchronous connection oriented beacon transmitting streaming audio by an Access Points;

e) requesting a HOLD from the another terminal; and

f) connecting the Bluetooth terminal to the Access Point Beacon to receive streaming audio.

12. A short-range wireless headset apparatus adapted for receiving streaming data, comprising:

a) a short-range radio communication protocol stack enabling the headset apparatus to interact with other terminals and Access Points using a short-range radio communication packet structure and link controller states;

b) switching means for switching the headset apparatus into an "idle" state for enabling a connection for receiving of streaming data from a streaming data source; and

c) communication apparatus for connecting to and receiving the streaming data from the streaming data source.

13. A Bluetooth headset/terminal system adapted for receiving streaming data, comprising:

a) an antenna coupled via a Bluetooth link to the headset apparatus;

b) a short range transceiver connected to the antenna and using a Bluetooth protocol stack enabling the terminal to interact with the other terminals and the Access Points via a Bluetooth communication packet structure and link controller states;

c) a network transceiver connected to the antenna for network communications;

d) a processor connected to the short range transceiver and the network transceiver, the processor executing software programs stored

in a memory for placing the Bluetooth link between the terminal and the headset into a passive or non-active condition enabling the headset to be discoverable and connectable; and

e) an I/O system connected to the processor for user input signals and activating the Bluetooth link between the terminal and the headset.

14. The system of Claim 13 further comprising:

f) switching means to activate the Bluetooth connection if receiving a phone call through the network transceiver.

g) means to switch received SCO channels of the headset device.

15. A headset apparatus for receiving streaming data, comprising:

a) antenna means linked to terminals and to access points providing streaming data;

b) a short-range radio system coupled to the terminals and to the Access Points via the antenna, the radio system using a Bluetooth protocol stack enabling the radio system to interact with the terminals and the Access Points using the Bluetooth packet structure and link controller states;

c) an I/O system interacting with the Access Points via the radio system for processing and buffering streaming data;

d) a processor controlling and interacting with the radio system and the I/O system, the processor executing stored software programs for placing the headset in a passive or non-active condition with a paired device while receiving streaming data and enabling the headset to be discoverable and connectable; and

e) an audio processing system linked to the I/O system via the processor and responsive to a microphone, the audio processing system providing the streaming data as an output to a loudspeaker, after processing by the processor.

16. The headset of Claim 15 further comprising:

f) switching means in the I/O system operable to place the headset in a passive or non-active condition with the paired device.

17. The headset of Claim 15 or 16 wherein the headset has an ID for use in selecting appropriate streaming data from a database for personalized contact delivery in addition to location aware contact delivery.

18. The headset according to any one of Claims 15 to 17 further comprising:

g) a synchronous connection-oriented profile to automatically set the headset in a mode to form or end a connection to the Access Point and/or switch the headset between different content channels of the Access Point.

19. The headset according to any one of Claims 15 to 18 further comprising:

h) means enabling the headset to communicate with the paired device between data packets.

20. The headset according to any one of Claims 15 to 19 further comprising:

i) a host device including a user interface for setting a paired headset in a "beacon listening mode" and/or switching the headset between available content channels from an Access Point.

21. The headset of Claim 20 wherein

the host device serves as a master device providing a list of available AP channels and enabling a headset user to graphically select an appropriate AP content channel.

22. The headset of Claim 20 or 21 wherein the host device establishes contact with an Access Point and delivers Access Point content to a paired headset.

23. The headset of Claim 20, 21 or 22 wherein the host device serves as the interface for the terminal with the Access Point.

24. A terminal (220) comprising:

means (222, 224) for communicating via a packet-based, short-range wireless communications network; and

means (216', 218', 226, 228, 232) for switching said terminal into a given communication mode such that the terminal is configured to maintain a non-active, but activatable connection with a paired terminal and to permit connection to and receipt of data from a streaming source using said communication means.

25. A computer program comprising instructions (232) which, when executed by a terminal (220), causes said terminal to maintain a non-active, but activatable connection with a paired terminal and to permit

connection to and receipt of data from a streaming source using means (222, 224) for communicating via a packet-based, short-range wireless communications network.

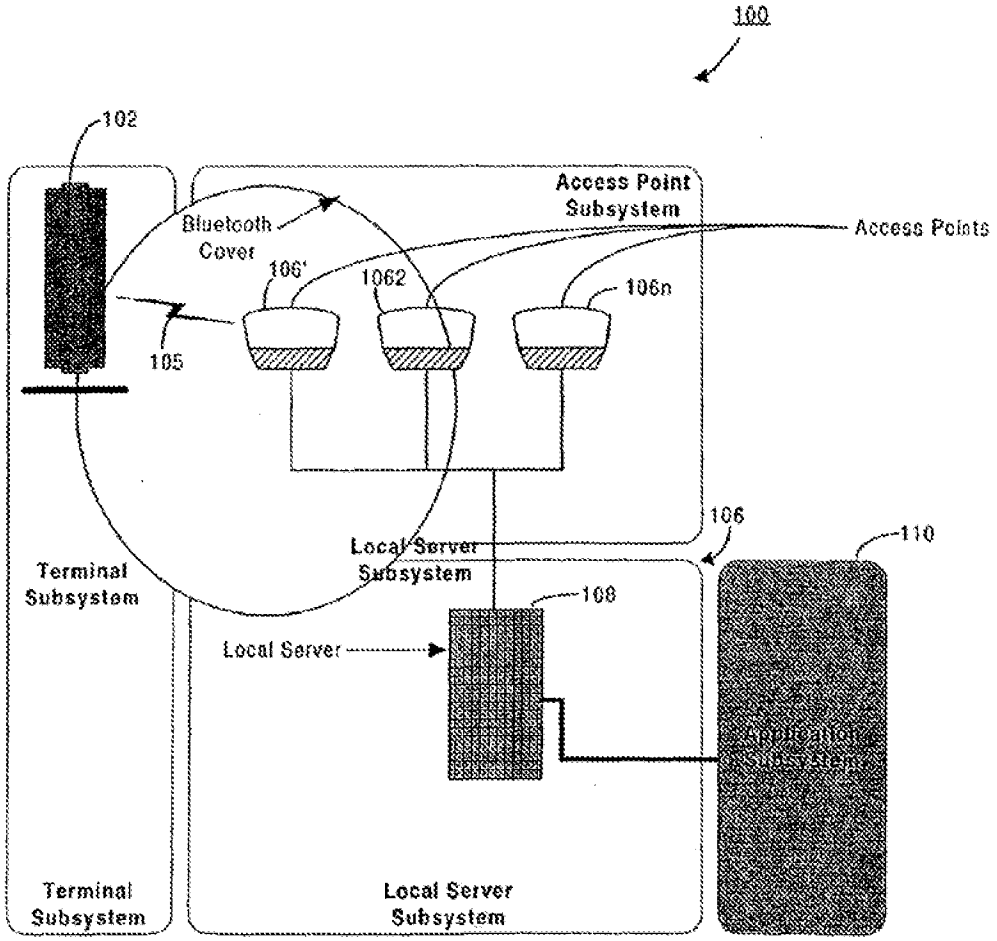

100
102
Access Point Subsystem
Bluetooth Cover
Access Points
106'
1062
106n
105
106
110
Local Server Subsystem
Terminal Subsystem
108
Local Server
Terminal Subsystem
Local Server Subsystem

FIG. 1

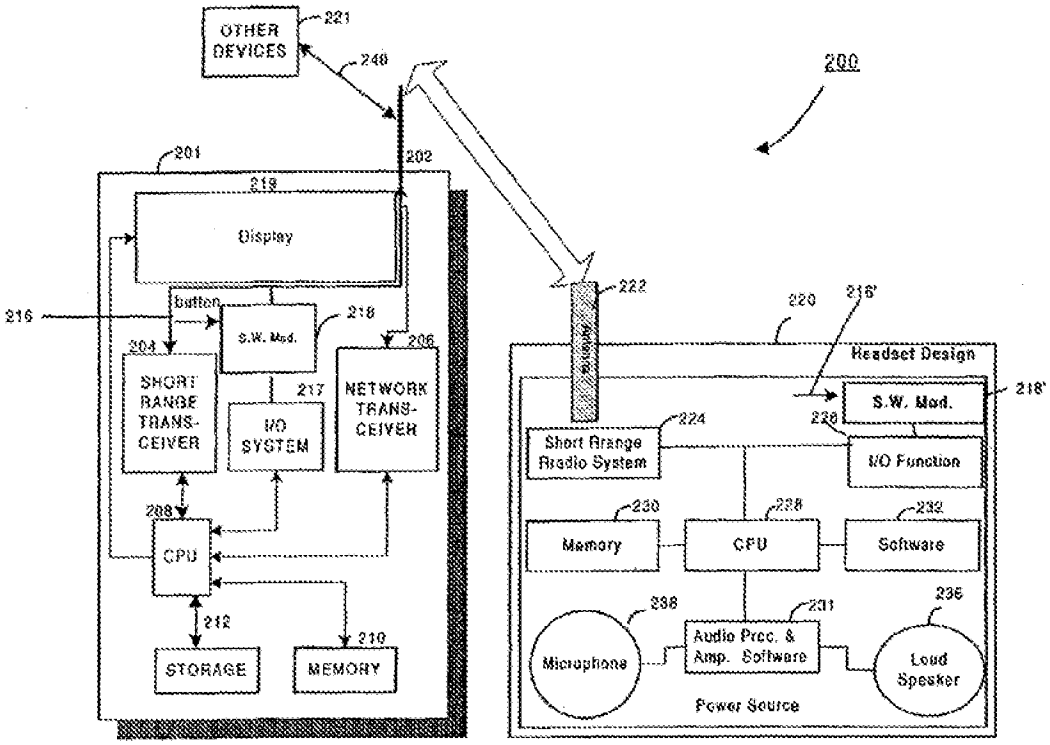

OTHER DEVICES
221
240
200
201
202
219
Display
Button
216
S.W. Mod.
218
204
206
SHORT RANGE TRANS-CEIVER
217
I/O SYSTEM
NETWORK TRANS-CEIVER
208
CPU
212
210
STORAGE
MEMORY
222
220
216'
Headset Design
S.W. Mod.
218'
224
Short Range Radio System
226
I/O Function
230
Memory
228
CPU
232
Software
238
231
236
Audio Proc. & Amp. Software
Microphone
Loud Speaker
Power Source

FIG. 2

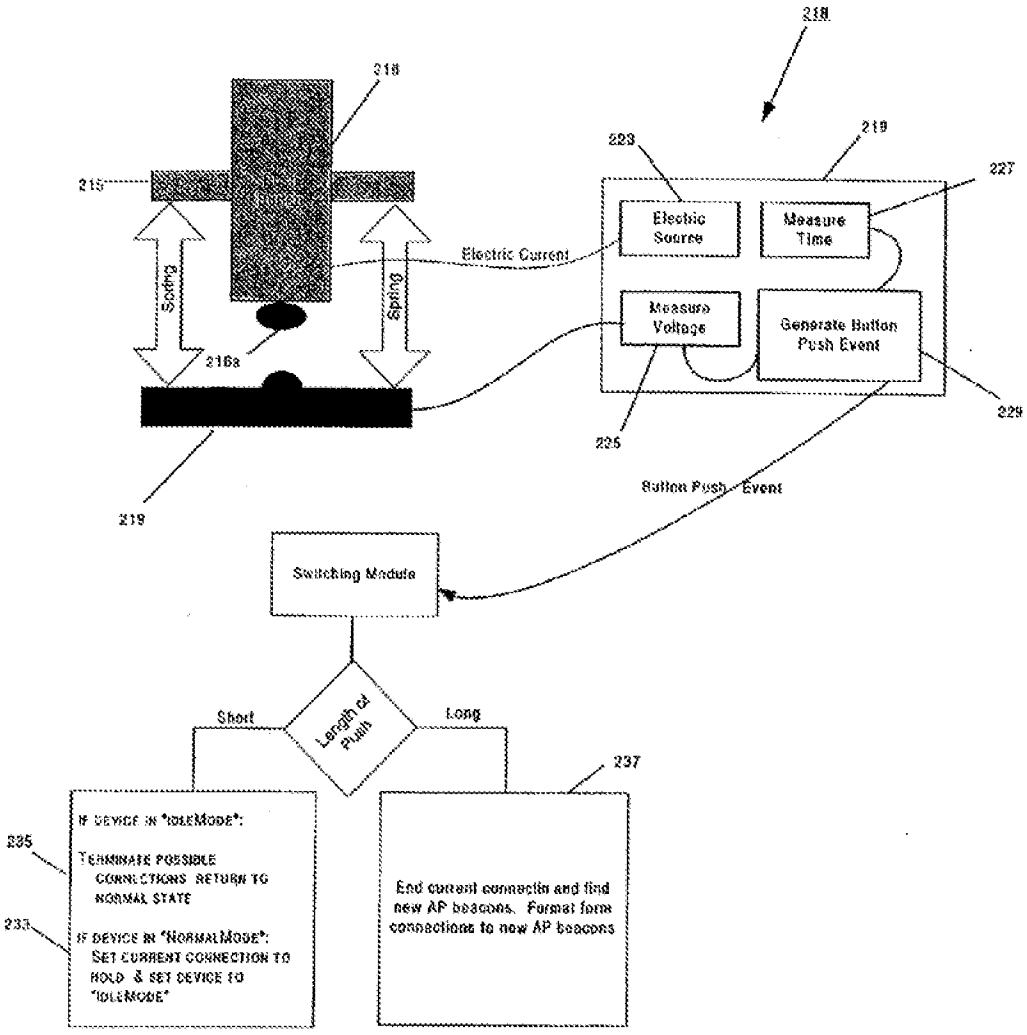
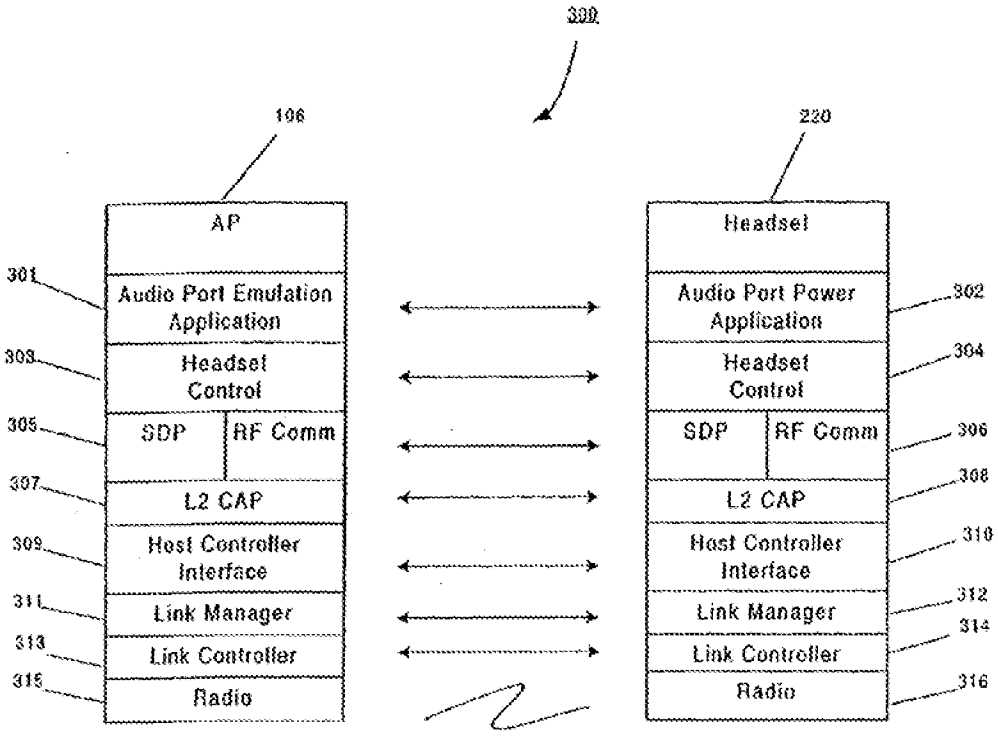

218
216
215
Spring
Spring
216a
219
Electric Current
223
219
227
Electric Source
Measure Time
Measure Voltage
Generate Button Push Event
225
229
Button Push Event
Switching Module
Length of Push
Short
Long
237
235
233
IF DEVICE IN "IDLEMODE":
TERMINATE POSSIBLE CONNECTIONS RETURN TO NORMAL STATE
IF DEVICE IN "NORMALMODE":
SET CURRENT CONNECTION TO HOLD & SET DEVICE TO "IDLEMODE"
End current connectin and find new AP beacons. Format form connections to new AP beacons

FIG. 2A



Headset Profile Stack Protocol

FIG. 3

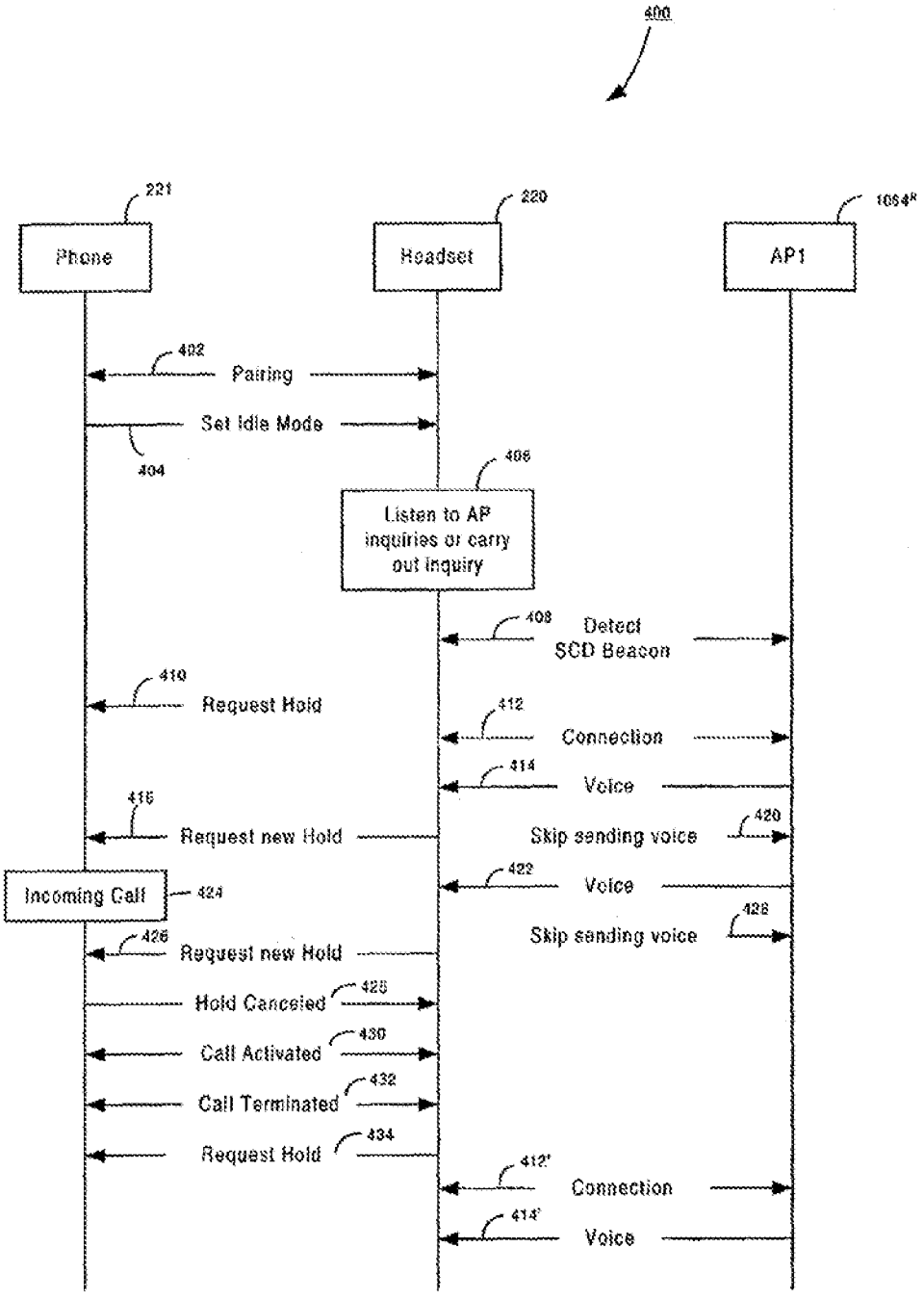

400
221
Phone
220
Headset
105A'
AP1
402
Pairing
Set Idle Mode
404
406
Listen to AP inquiries or carry out inquiry
408
Detect SCD Beacon
410
Request Hold
412
Connection
414
Voice
416
Request new Hold
420
Skip sending voice
Incoming Call
424
422
Voice
426
Skip sending voice
426
Request new Hold
428
Hold Canceled
430
Call Activated
432
Call Terminated
434
Request Hold
412'
Connection
414'
Voice

FIG. 4

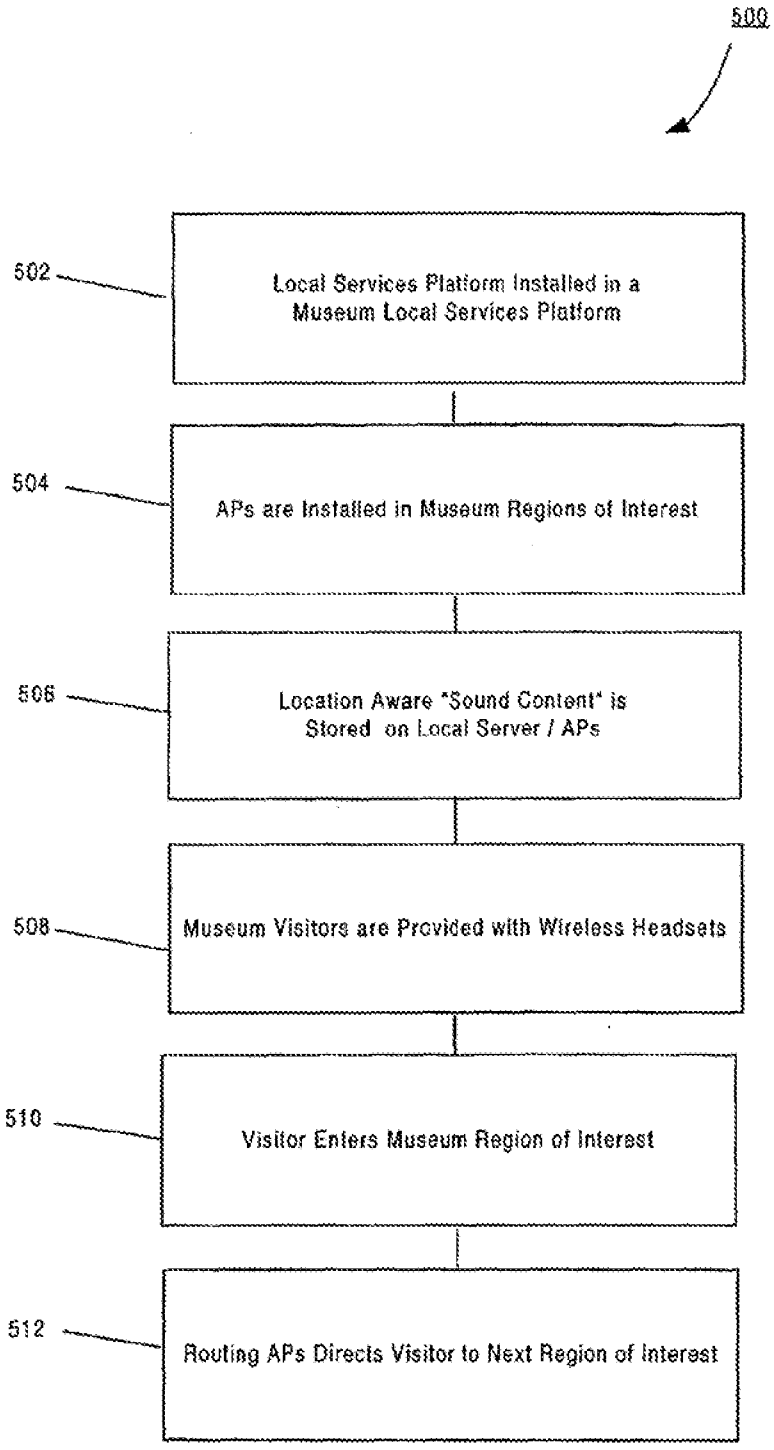

500
502
Local Services Platform Installed in a Museum Local Services Platform
504
APs are Installed in Museum Regions of Interest
506
Location Aware "Sound Content" is Stored on Local Server / APs
508
Museum Visitors are Provided with Wireless Headsets
510
Visitor Enters Museum Region of Interest
512
Routing APs Directs Visitor to Next Region of Interest

FIG. 5

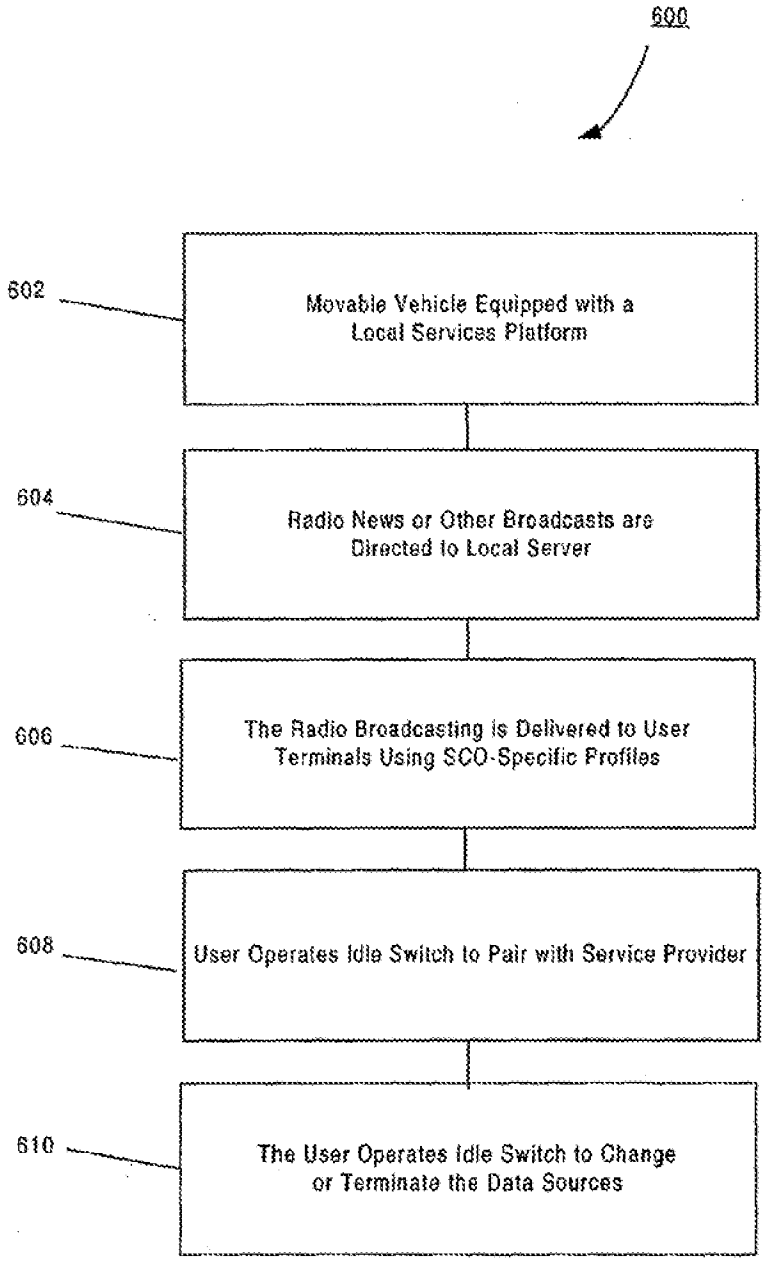

600
602
Movable Vehicle Equipped with a Local Services Platform
604
Radio News or Other Broadcasts are Directed to Local Server
606
The Radio Broadcasting is Delivered to User Terminals Using SCO-Specific Profiles
608
User Operates Idle Switch to Pair with Service Provider
610
The User Operates Idle Switch to Change or Terminate the Data Sources

FIG. 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 25 2129

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	US 2002/098878 A1 (CANNON JOSEPH M ET AL) 25 July 2002 (2002-07-25) * abstract * * figures 1,3 * * paragraph [0005] * * paragraph [0008] * * paragraph [0011] * * paragraph [0018] * * paragraph [0021] - paragraph [0023] * * paragraph [0026] - paragraph [0031] *	1-25	H04M1/725 H04L12/56
Y	"BLUETOOTH SPECIFICATION VERSION 1.0 B, CORE, LINK MANAGER PROTOCOL" BLUETOOTH SPECIFICATION VERSION, XX, XX, vol. 1, 1 December 1999 (1999-12-01), pages 185-244, XP002174828 * page 195, paragraph 3.3 - page 197 * * page 208, paragraph 3.15 - page 209 * * page 220 - page 221 *	1-25	
A	US 2002/173296 A1 (GRIPENBERG CASPER ET AL) 21 November 2002 (2002-11-21) * figures 1,2a,3,4a,4b * * abstract *	6,17	TECHNICAL FIELDS SEARCHED (Int.Cl.7) H04M H04L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 July 2004	Matt, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 25 2129

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-07-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002098878 A1	25-07-2002	NONE	
US 2002173296 A1	21-11-2002	EP 1389399 A1	18-02-2004
		WO 02096135 A1	28-11-2002

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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(11) EP 2 903 186 A1

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BA ME

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(54) BLUETOOTH APPARATUS WITH ULTRA-LOW STANDBY POWER CONSUMPTION AND IMPLEMENTATION METHOD THEREOF

(57) The present invention provides a Bluetooth apparatus with ultra-low standby power consumption and an implementation method thereof. The Bluetooth apparatus comprises a main body and a switch apparatus. A control circuit is arranged in the main body, and the control circuit comprises a Bluetooth module, a low-level-triggered ultra-low power consumption switch module and a high-level-triggered reset switch module. The low-level-triggered ultra-low power consumption switch module is connected to a deep sleep control pin of the Bluetooth module, and the high-level-triggered reset switch module is connected to an ON/OFF end of the Bluetooth module. A switching apparatus controls the low-level-triggered ultra-low power consumption switch module and the high-level-triggered reset switch module to work. According to the present invention, when a 50 mAh battery is used on a Bluetooth headset, the standby current is 0.5 uA, and theoretical standby time can reach 2500 hours, which is amounted to 104 days. When the novel technology is used on the Bluetooth headset, standby time can increase from 4 days to 104 days, with an increase of 100 days of standby time, which greatly reduces charging frequency and improves convenience in use.

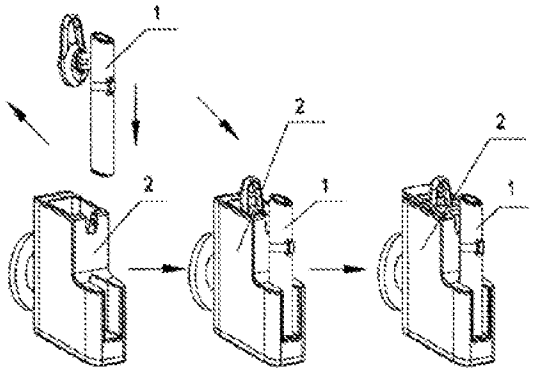


FIG. 4

EP 2 903 186 A1

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Description

Technical Field

[0001] The present invention discloses a Bluetooth apparatus, and in particular, a Bluetooth apparatus with ultra-low standby power consumption and a method for implementing same.

Related Art

[0002] As mobile phones are applied more and more in people's life, people understand the mobile phones more and more thoroughly and pay more and more attention to security of use of mobile phones. During use of mobile phones, electromagnetic radiation is the biggest harm to people when people use mobile phones. With gradual development of wireless transmission technologies, Bluetooth technologies have been gradually applied to the field of communications, and Bluetooth headsets can effectively reduce harm caused by electromagnetic radiation to a user. In most of the existing Bluetooth headsets, a built-in rechargeable battery is usually used as a power supply. However, due to the limitation of the volume of a Bluetooth headset, it is impossible to make the volume of the built-in battery very big. The battery is usually a lithium battery of 50 mAh, and when a current Bluetooth headset is in a standby state, a standby current is usually 0.5 mA to 1 mA. Therefore, theoretical standby time of the Bluetooth headset is usually 50 hours to 100 hours, and the user needs to charge the headset every two or three days, resulting in great inconvenience in use.

Summary

[0003] For the shortcomings in the prior art that a Bluetooth headset has short standby time and is inconvenient to use, the present invention provides a new Bluetooth apparatus with ultra-low standby power consumption and a method for implementing same. The Bluetooth apparatus includes a Bluetooth headset and a base used in combination with the Bluetooth headset. When the Bluetooth headset is not in use and is placed on the base, an internal circuit of the Bluetooth headset is triggered to cause the Bluetooth headset to enter a deep sleep state, which can greatly reduce the power consumption and extend the standby time.

[0004] The technical solution adopted by the present invention to solve the technical problem of the present invention is a Bluetooth apparatus with ultra-low standby power consumption. The Bluetooth apparatus includes a main body and a switch apparatus. A control circuit is arranged in the main body. The control circuit includes a Bluetooth module, a low-level-triggered ultra-low power consumption switch module, and a high-level-triggered reset switch module. The low-level-triggered ultra-low power consumption switch module is connected to a deep sleep control pin of the Bluetooth module. The high-level-triggered reset switch module is connected to an ON/OFF end of the Bluetooth module. The switch apparatus controls the low-level-triggered ultra-low power consumption switch module and the high-level-triggered reset switch module to work.

[0005] A method for implementing the Bluetooth apparatus with ultra-low standby power consumption, where the method is: arranging a trigger switch on a main body of the Bluetooth apparatus, when the Bluetooth apparatus is not in use, triggering a deep sleep control pin through the trigger switch, to make the Bluetooth apparatus in a deep sleep state, and when the Bluetooth apparatus is in use, awakening a deep sleep mode through the trigger switch, to make the Bluetooth apparatus in a normal use state.

[0006] The technical solution adopted by the present invention to solve the technical problem thereof further includes:

> The switch apparatus is a base matching the main body, and the main body and the base are electrically connected through contacts.

[0007] The contacts include out_contact, MCU_charger, and GND. The out_contact contact in the main body is electrically connected to the low-level-triggered ultra-low power consumption switch module and the high-level-triggered reset switch module. The GND contact is grounded. The MCU_charger contact charges a battery of the main body. The out_contact contact in the base is in communication with the GND contact. A charger_5v contact is electrically connected to a charging output interface.

[0008] The low-level-triggered ultra-low power consumption switch module includes a MOS transistor Q7 and a capacitor C15. The MOS transistor Q7 and the capacitor C15 are connected in series. The MOS transistor is connected to a positive power end. The capacitor C15 is connected to the deep sleep control pin of the Bluetooth module. A trigger end of the MOS transistor Q7 is connected to the switch apparatus.

[0009] The high-level-triggered reset switch module includes a capacitor C16, a bipolar junction transistor Q1, and a bipolar junction transistor Q8. One end of the capacitor C16 is connected to the switch apparatus, and the other end of the capacitor C16 is connected to the base of the bipolar junction transistor Q8. One end of the bipolar junction transistor Q8 is grounded, and the other end of the bipolar junction transistor Q8 is connected to the base of the bipolar junction transistor Q1. One end of the bipolar junction transistor Q1 is connected to positive power, and the other end of the bipolar junction transistor Q1 is connected to the ON/OFF end of the Bluetooth module.

[0010] A receiving slot for placing the main body of the Bluetooth headset is arranged on the base.

[0011] A cover body able to be opened and closed is

mounted on the base.

[0012] A limit ring is fixedly arranged on the main body of the Bluetooth headset, and corresponds to a through hole on the cover body.

[0013] A magnet is arranged in the base, and a magnet is arranged in a corresponding position on the main body of the Bluetooth headset.

[0014] The beneficial effects of the present invention are as follows: According to the present invention, when a battery of 50 mAh is used on a Bluetooth headset, a standby current is 0.5 uA, and theoretical standby time may reach 2500 hours, which corresponds to 104 days. When the novel technology is used on a Bluetooth headset, standby time may increase from 4 days to 104 days, and standby time is increased by 100 days, which greatly reduces frequency of charging and improves convenience in use.

Brief description of the drawings

[0015]

FIG. 1 is a schematic structural perspective view of the present invention;

FIG. 2 is a schematic structural view of a main body of a Bluetooth headset in the present invention;

FIG. 3 is a schematic structural view of a base in the present invention;

FIG. 4 is a schematic view of a process of putting a main body of a Bluetooth headset into a base according to the present invention;

FIG. 5 is a schematic view of a process of taking a main body of a Bluetooth headset out of a base according to the present invention;

FIG. 6 is a block circuit diagram of the present invention; and

FIG. 7 is a schematic circuit diagram of the present invention.

[0016] In the figures, 1-Main body of a Bluetooth headset, 2-Base, 3-Cover body, 4-Limit ring, 5-Out_contact contact of the Bluetooth headset, 6-GND contact of the Bluetooth headset, 7-MCU_charger contact of the Bluetooth headset, 8-Receiving slot, 9-Through hole, 10-Charger_5v contact of the base, 11-GND contact of the base, and 12-Out_contact contact of the base.

Detailed description

[0017] This embodiment is a preferred implementation manner of the present invention, and other embodiments in which the principle and basic structure are the same as or similar to those in this embodiment should fall within the protection scope of the present invention.

[0018] The present invention relates to a method for implementing a Bluetooth apparatus with ultra-low standby power consumption. The method is: arranging a trigger switch on a main body of the Bluetooth apparatus, when the Bluetooth apparatus is not in use, triggering a deep sleep control pin through the trigger switch, to make the Bluetooth apparatus in a deep sleep state, and when the Bluetooth apparatus is in use, awakening a deep sleep mode through the trigger switch, to make the Bluetooth apparatus in a normal use state.

[0019] Referring to FIG. 1, FIG. 2, and FIG. 3, the present invention mainly includes two main parts, that is, a main body 1 and a switch apparatus of a Bluetooth headset. In this embodiment, the switch apparatus is a base 2. In this embodiment, a receiving slot 8 is arranged on the base 2 and is used for placing the main body 1 of the Bluetooth headset. A cover body 3 is arranged on the base 2. The cover body 3 is rotatable. When the main body 1 of the Bluetooth headset is put into the receiving slot 8, the cover body 3 is turned to block the main body 1 of the Bluetooth headset and prevents the main body 1 from falling off. In this embodiment, a limit ring 4 is fixedly arranged at the top of the main body 1 of the Bluetooth headset. A through hole 9 is opened in a position on the cover body 3 corresponding to the limit ring 4. When the cover body 3 is closed, the limit ring 4 is arranged in the through hole 9 to clamp the cover body 3. In this embodiment, the base 2 and the main body 1 of the Bluetooth headset are fixedly provided with a magnet (not drawn in the figures) separately, and the base 2 and the main body 1 of the Bluetooth headset may be fitted together through attraction of the magnets, to make contacts on the base 2 and the main body 1 of the Bluetooth headset contact each other. In this embodiment, the base 2 and the main body 1 of the Bluetooth headset contact through three contacts. The contacts on the main body 1 of the Bluetooth headset include an out_contact contact 5 of the Bluetooth headset, a MCU_charger contact 7 of the Bluetooth headset, and a GND contact 6 of the Bluetooth headset. The contacts on the base 2 include an out_contact contact 12 of the base, a charger_5v contact 10 of the base, and a GND contact 11 of the base.

[0020] Referring to FIG. 6 and FIG. 7, in this embodiment, the main body 1 of the Bluetooth headset and the base 2 are provided with a control circuit. The control circuit in the main body 1 of the Bluetooth headset mainly includes a Bluetooth module, a low-level-triggered ultra-low power consumption switch module, and a high-level-triggered reset switch module. The Bluetooth module is mainly a Bluetooth chip. The main body 1 of the Bluetooth headset is further provided with a built-in lithium battery that supplies power to the Bluetooth chip. The low-level-triggered ultra-low power consumption switch module is connected to a deep sleep control pin of the Bluetooth module. The high-level-triggered reset switch module is connected to an ON/OFF end of the Bluetooth module. The switch apparatus controls the low-level-triggered ultra-low power consumption switch module and the high-level-triggered reset switch module to work. In this embodiment, the low-level-triggered ultra-low power consumption switch module includes a MOS transistor Q7 and a capacitor C15. The MOS transistor Q7 and the

capacitor C15 are connected in series. The MOS transistor is connected to a positive power end. The capacitor C15 is connected to the deep sleep control pin of the Bluetooth module. A trigger end of the MOS transistor Q7 is connected to the switch apparatus. The high-level-triggered reset switch module includes a capacitor C16, a bipolar junction transistor Q1, and a bipolar junction transistor Q8. One end of the capacitor C16 is connected to the switch apparatus, and the other end of the capacitor C16 is connected to the base of the bipolar junction transistor Q8. One end of the bipolar junction transistor Q8 is grounded, and the other end of the bipolar junction transistor Q8 is connected to the base of the bipolar junction transistor Q1. One end of the bipolar junction transistor Q1 is connected to positive power, and the other end of the bipolar junction transistor Q1 is connected to the ON/OFF end of the Bluetooth module. In this embodiment, the out_contact contact 5 in the main body 1 of the Bluetooth headset is electrically connected to the low-level-triggered ultra-low power consumption switch module and the high-level-triggered reset switch module, that is, the out_contact contact 5 is separately connected to the capacitor C16 and a trigger end (that is, the gate) of the MOS transistor Q7. The GND contact 6 is grounded, the MCU_charger contact 7 charges the built-in lithium battery of the main body, the out_contact contact 12 in the base 2 is in communication with the GND contact 11 through a resistor R5, and the charger_5v contact 10 is electrically connected to a charging output interface.

[0021] Referring to FIG. 4, according to the present invention, in use, the cover body 3 is closed after the main body 1 of the Bluetooth headset is placed on the base 2. In this case, the contacts on the main body 1 of the Bluetooth headset and the base 2 are attracted through the magnets in the main body 1 and the base 2 for mutual conduction. The three contacts on the main body 1 of the Bluetooth headset, that is, out_contact, MCU_charger, and GND, are respectively in contact with the three contacts on the base 2, that is, out_contact, charger_5v, and GND. The charger_5v is only used for charging a battery of the headset. When the two out_contact contacts on the main body 1 of the Bluetooth headset and the base 2 are in communication, the out_contact contact in the main body 1 of the Bluetooth headset is pulled to a low potential, and a G pin of the MOS transistor Q7 is also in a low potential. In this case, the MOS transistor Q7 is in an ON state. Due to a transient effect of the capacitor C15, a positive pulse of 3.7 V is produced at a PIO8 port. The PIO8 port is directly connected to the deep sleep control pin of the main Bluetooth chip. After receiving the positive pulse sent from the PIO8 port, the Bluetooth chip automatically enters a deep sleep mode. In this case, the standby current is 0.5 uA, and the objective of ultra-low power consumption is achieved.

[0022] Referring to FIG. 5, according to the present invention, in normal use, the cover body 3 is opened, the main body 1 of the Bluetooth headset is taken up from the base 2, and after the contacts are disconnected, the Bluetooth headset automatically enters a normal ON mode. As long as the main body 1 of the Bluetooth headset is taken up from the base 2, the out_contact contact in the main body 1 of the Bluetooth headset becomes a high potential. Due to a transient effect of the capacitor C16, a B pole (that is, the base) of the bipolar junction transistor Q8 has a high pulse to turn on the bipolar junction transistor Q8. In this case, the B pole (that is, the base) of the bipolar junction transistor Q8 is in a low potential, to cause the bipolar junction transistor Q1 to be turned on at the same time. Therefore, there is also a positive pulse of 3.7 V at the ON/OFF end. The ON/OFF end is directly connected to an ON pin of the Bluetooth headset. After receiving a high-potential pulse from the ON/OFF end, the Bluetooth headset automatically awakens the deep sleep mode to enter the normal functions of power-on and phone connection.

[0023] According to the present invention, when a battery of 50 mAh is used on a Bluetooth headset, a standby current is 0.5 uA, and theoretical standby time may reach 2500 hours, which corresponds to 104 days. When the novel technology is used on a Bluetooth headset, standby time may increase from 4 days to 104 days, and standby time is increased by 100 days, which greatly reduces frequency of charging and improves convenience in use.

Claims

1. A Bluetooth apparatus with ultra-low standby power consumption, **characterized in that** the Bluetooth apparatus comprises a main body and a switch apparatus, a control circuit is arranged in the main body, the control circuit comprises a Bluetooth module, a low-level-triggered ultra-low power consumption switch module, and a high-level-triggered reset switch module, the low-level-triggered ultra-low power consumption switch module is connected to a deep sleep control pin of the Bluetooth module, the high-level-triggered reset switch module is connected to an ON/OFF end of the Bluetooth module, and the switch apparatus controls the low-level-triggered ultra-low power consumption switch module and the high-level-triggered reset switch module to work.

2. The Bluetooth apparatus with ultra-low standby power consumption according to claim 1, **characterized in that** the switch apparatus is a base matching the main body, and the main body and the base are electrically connected through contacts.

3. The Bluetooth apparatus with ultra-low standby power consumption according to claim 2, **characterized in that** the contacts comprise out_contact, MCU_charger, and GND, the out_contact contact in the main body is electrically connected to the low-level-triggered ultra-low power consumption switch module and the high-level-triggered reset switch

module, the GND contact is grounded, the MCU_charger contact charges a battery of the main body, the out_contact contact in the base is in communication with the GND contact, and a charger_5v contact is electrically connected to a charging output interface.

4. The Bluetooth apparatus with ultra-low standby power consumption according to claim 1 or 2 or 3, **characterized in that** the low-level-triggered ultra-low power consumption switch module comprises a MOS transistor Q7 and a capacitor C15, the MOS transistor Q7 and the capacitor C15 are connected in series, the MOS transistor is connected to a positive power end, the capacitor C 15 is connected to the deep sleep control pin of the Bluetooth module, and a trigger end of the MOS transistor Q7 is connected to the switch apparatus.

5. The Bluetooth apparatus with ultra-low standby power consumption according to claim 1 or 2 or 3, **characterized in that** the high-level-triggered reset switch module comprises a capacitor C16, a bipolar junction transistor Q1, and a bipolar junction transistor Q8, one end of the capacitor C16 is connected to the switch apparatus, the other end of the capacitor C16 is connected to the base of the bipolar junction transistor Q8, one end of the bipolar junction transistor Q8 is grounded, the other end of the bipolar junction transistor Q8 is connected to the base of the bipolar junction transistor Q1, one end of the bipolar junction transistor Q1 is connected to positive power, and the other end of the bipolar junction transistor Q1 is connected to the ON/OFF end of the Bluetooth module.

6. The Bluetooth apparatus with ultra-low standby power consumption according to claim 2 or 3, **characterized in that** a receiving slot for placing the main body of the Bluetooth headset is arranged on the base.

7. The Bluetooth apparatus with ultra-low standby power consumption according to claim 6, **characterized in that** a cover body able to be opened and closed is mounted on the base.

8. The Bluetooth apparatus with ultra-low standby power consumption according to claim 7, **characterized in that** a limit ring is fixedly arranged on the main body of the Bluetooth headset, and corresponds to a through hole on the cover body.

9. The Bluetooth apparatus with ultra-low standby power consumption according to claim 6, **characterized in that** a magnet is arranged in the main body, and a magnet is arranged in a corresponding position on the main body of the Bluetooth headset.

10. A method for implementing the Bluetooth apparatus with ultra-low standby power consumption according to any one of claims 1 to 9, **characterized in that** the method is: arranging a trigger switch on a main body of the Bluetooth apparatus, when the Bluetooth apparatus is not in use, triggering a deep sleep control pin through the trigger switch, to make the Bluetooth apparatus in a deep sleep state, and when the Bluetooth apparatus is in use, awakening a deep sleep mode through the trigger switch, to make the Bluetooth apparatus in a normal use state.

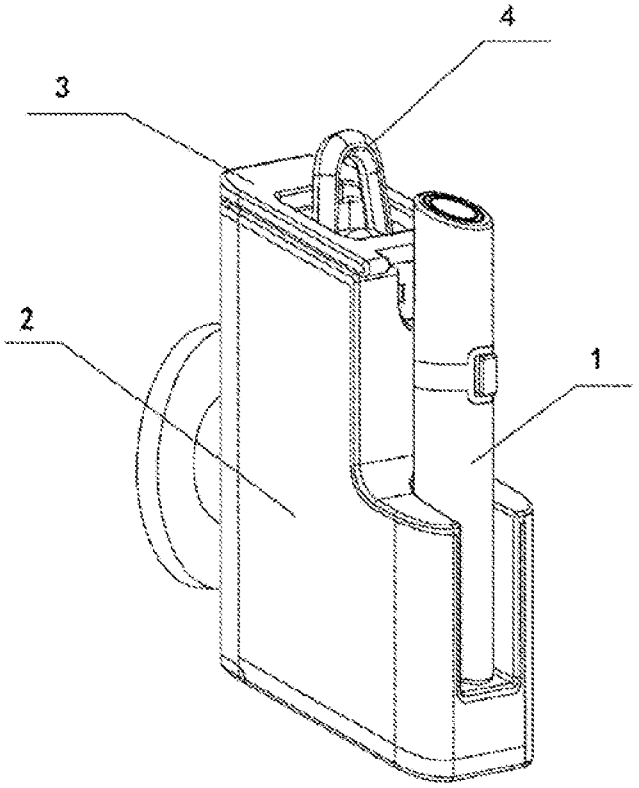


FIG. 1

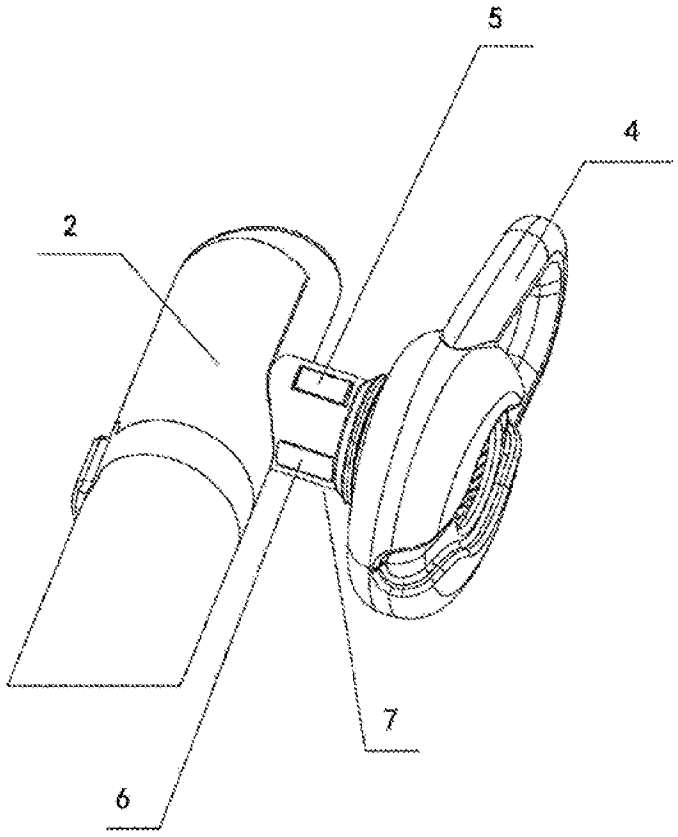


FIG. 2

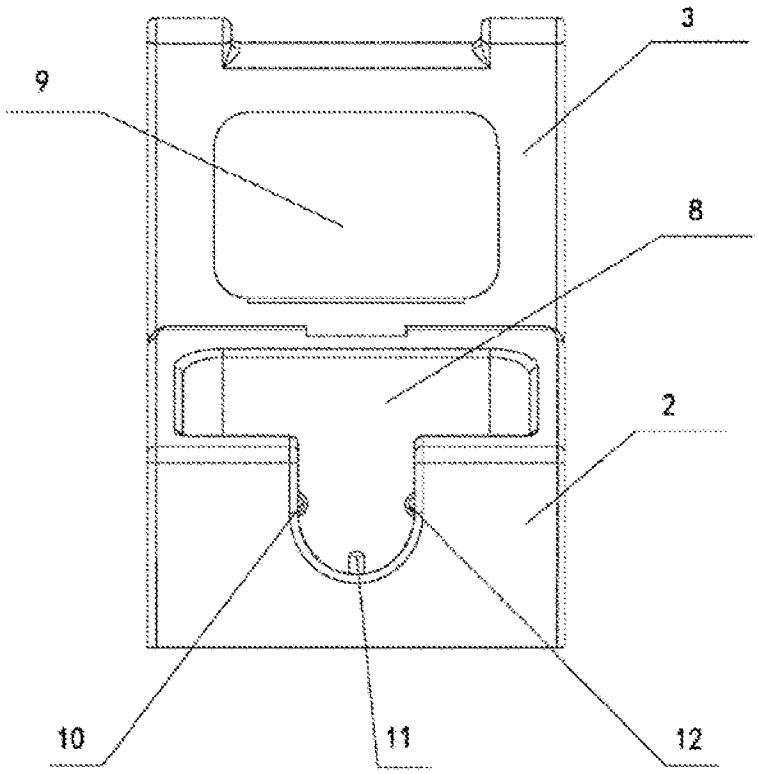


FIG. 3

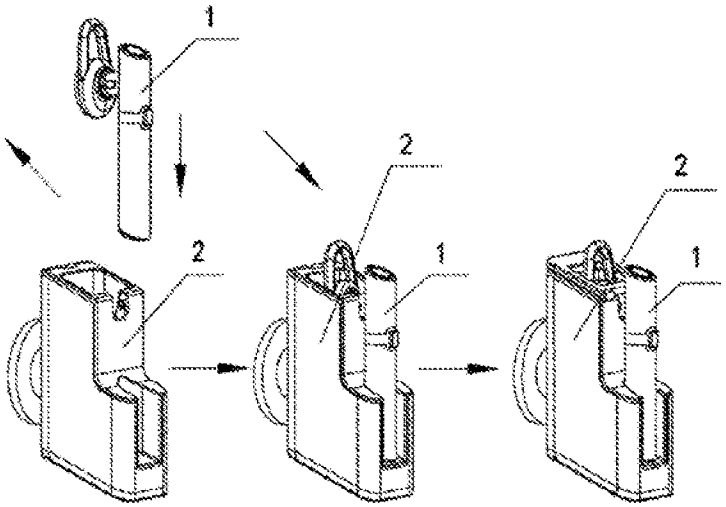


FIG. 4

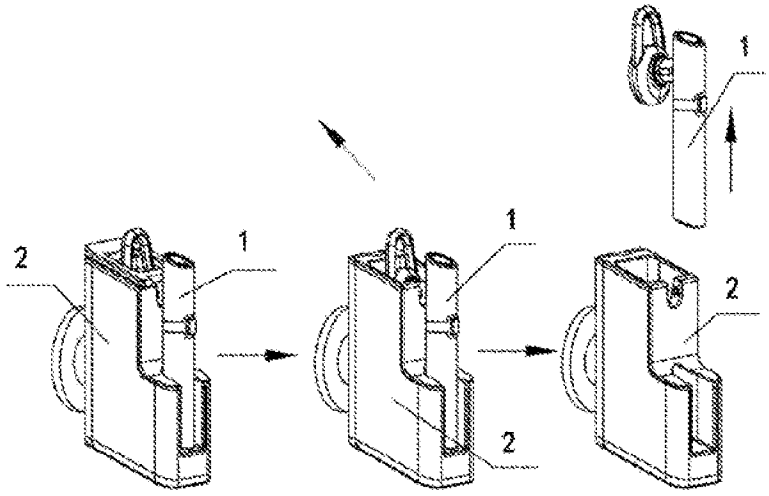


FIG. 5

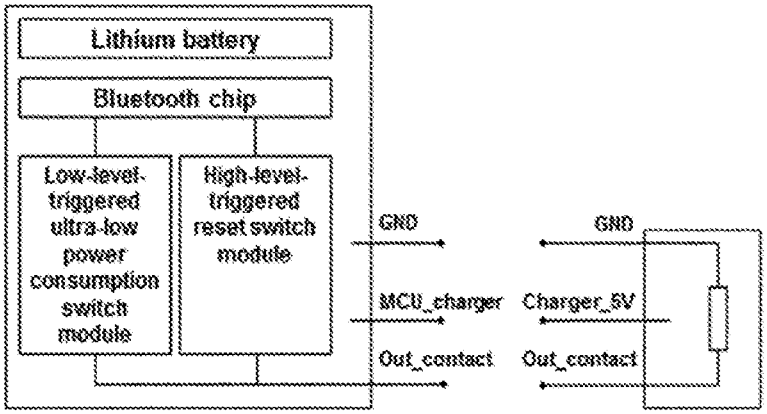

Lithium battery
Bluetooth chip
Low-level-triggered ultra-low power consumption switch module
High-level-triggered reset switch module
GND
MCU_charger
Out_contact
GND
Charger_5V
Out_contact

FIG. 6

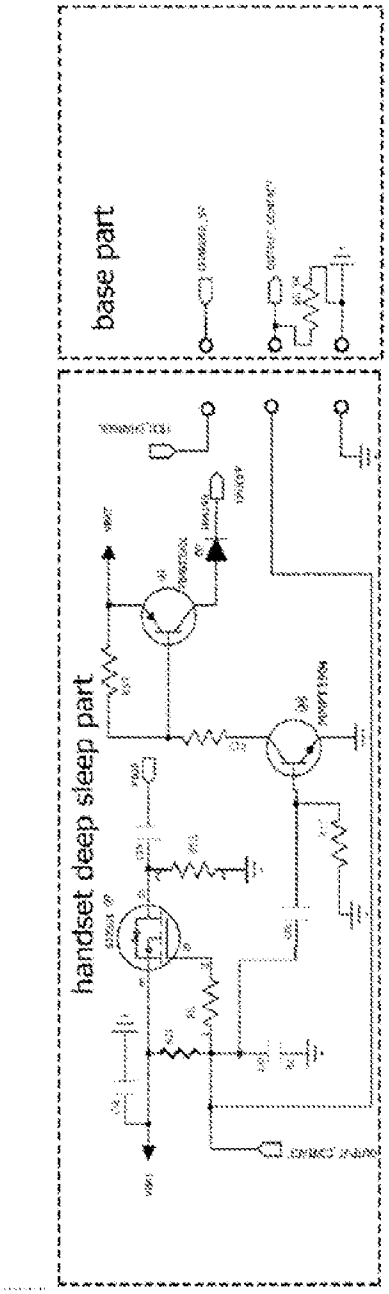


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/070712

A. CLASSIFICATION OF SUBJECT MATTER

H04B 5/00 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04B 5/-

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

VEN, USTXT, EPTXT, WOTXT: bluetooth, sleep, standby, trigger+, foot, puls+, switch, circuit, capacitance, dynatron

CNABS, CNKI: bluetooth, sleep, standby, trigger, pin, pulse, switch, circuit, capacitance, audion

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 1465972 A (GVC CORPORATION), 01 October 2003 (01.10.2003), claims 1-4	1, 10
Y	The same as above	2, 6-9
A	The whole document	3-5
Y	CN 202111824 U (MEI, Qingkai), 11 January 2012 (11.01.2012), description, paragraphs 5-20	2, 6-9
P, X	CN 102868428 A (PEI, Weicai), 09 January 2013 (09.01.2013), claims 1-10	1-10

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 June 2013 (14.06.2013)	11 July 2013 (11.07.2013)
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer SUN, Chengyu Telephone No.: (86-10) 010-62411412

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No
PCT/CN2013/070712

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
E	CN 202841127 U (PEI, Weicai), 27 March 2013 (27.03.2013), description, paragraphs 6-28	1-9
A	US 2010153762 A1 (QUALCOMM INC.), 17 June 2010 (17.06.2010), the whole document	1-10

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/070712

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 1445972 A	01.10.2003	None	
CN 202111824 U	11.01.2012	None	
CN 103068428 A	09.01.2013	None	
CN 202841127 U	27.03.2013	None	
US 2010153762 A1	17.06.2010	TW 201006740 A	16.02.2011
		US 20130028162 A1	31.01.2013
		WO 2010059752 A1	27.05.2010
		US 8307231 B2	06.11.2012

Form PCT/ISA/210 (patent family annex) (July 2009)

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(21) Application No **8112700**
(22) Date of filing **24 Apr 1981**
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(33) **Japan (JP)**
(43) Application published
4 Nov 1981
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H04B 1/46
(52) Domestic classification
H4L SS
(56) Documents cited
GB 2021902A
GB 1532495
GB 1508750
GB 1497957
GB 1412386
(58) Field of search
H4L
(71) Applicants
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London, WC2A 3LS.

(54) **A two-way communication device**

(57) A two-way communication device comprises an ear-insert member having a vibration pick up type microphone combined with a speaker. A housing unit contains an automatic Vox controlling circuit to control automatically the power levels of transmitted and received signals. The ear insert member and the housing unit are connected electrically through wires or through a wireless.

GB 2 074 817 A

FIG. 1

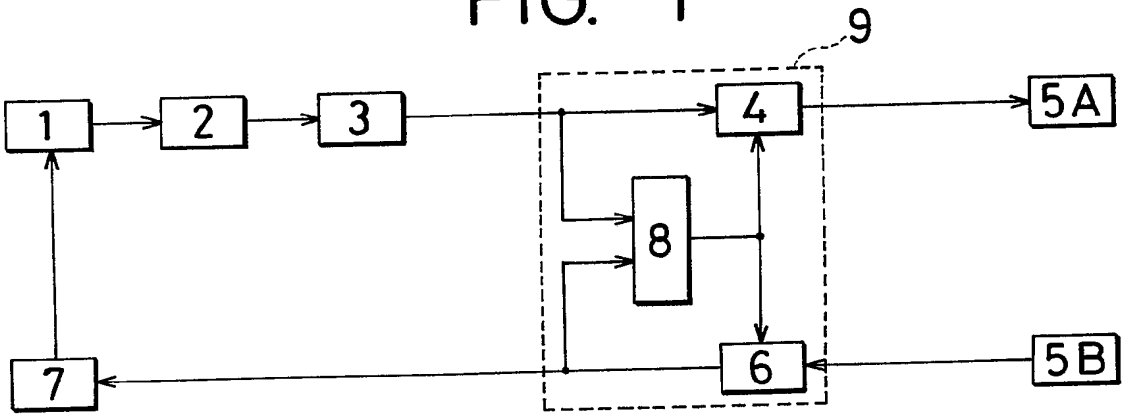


FIG. 2

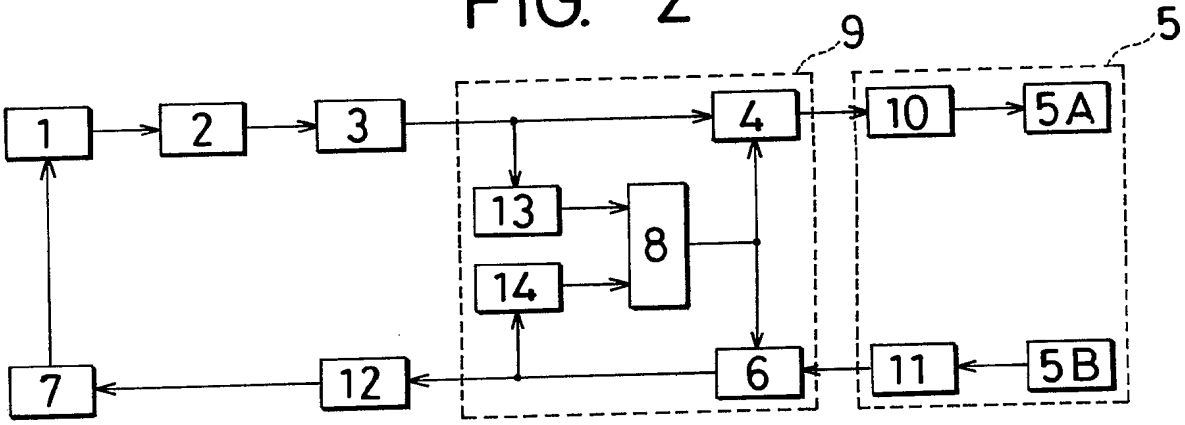


FIG. 3

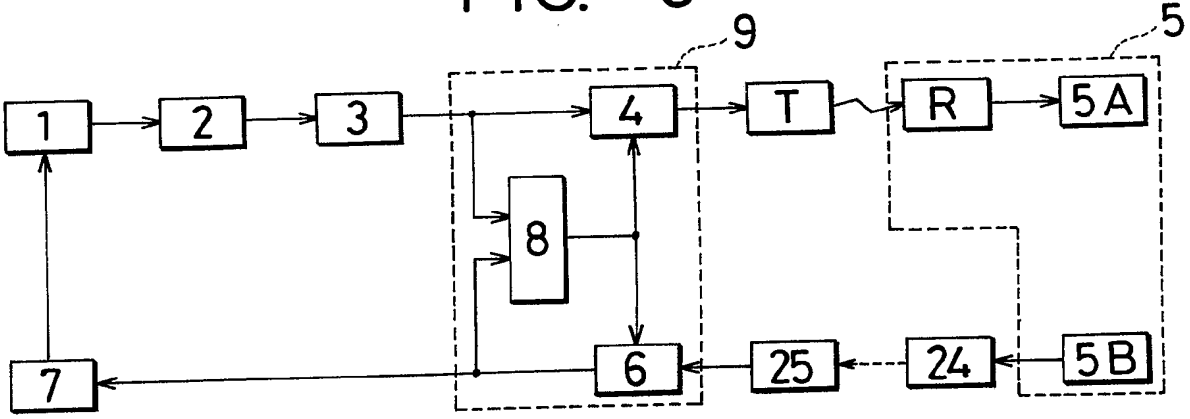


FIG. 4

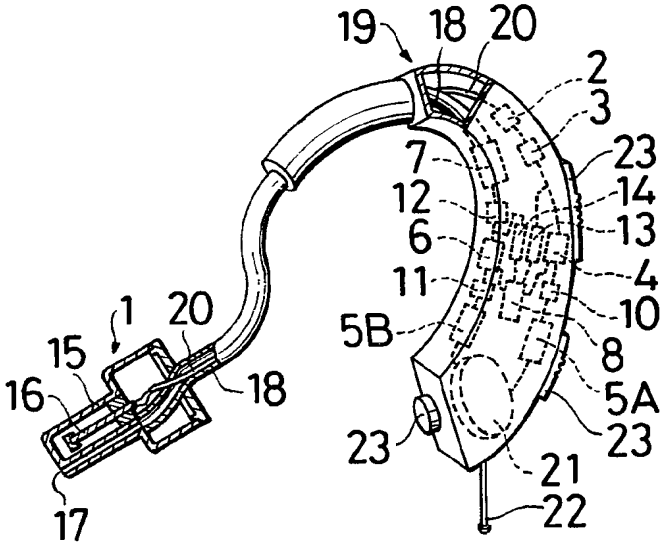


FIG. 5

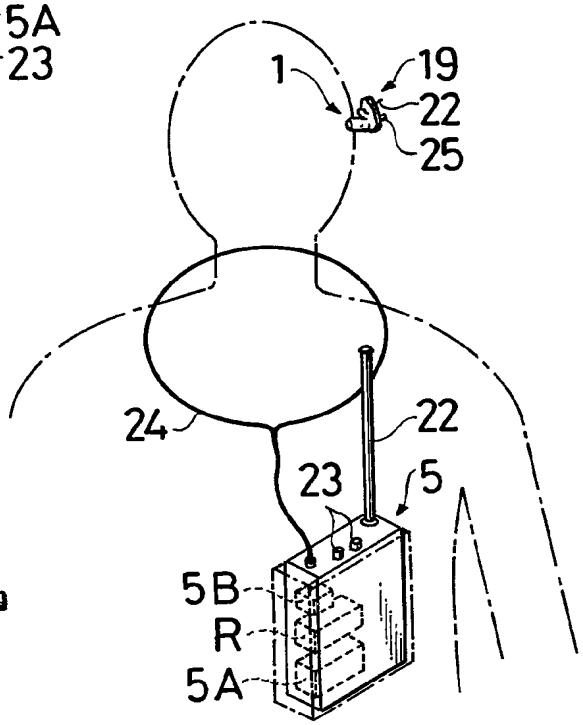
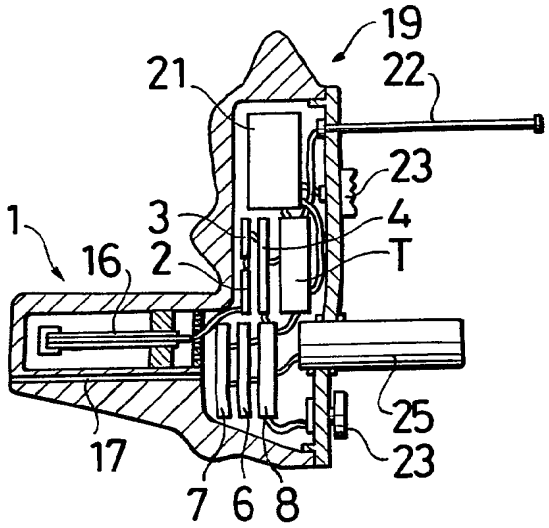


FIG. 6



SPECIFICATION

A two-way communication device

The present invention relates to a two-way communication device. Such a device allows simultaneous talking and listening and uses an ear-insert member, comprising a vibration pick-up type ear microphone combined with a sepaker which may be one of several types, inserted into one ear canal of the user to prevent the occurrence of feedback or "howl-round" when the sound level produced by the speaker is high to allow a user to listen clearly in a very noisy environment.

In a known arrangement, a vibration pick-up type ear microphone (which will hereinafter be referred to as an ear mic) is inserted into the external auditory canal of one ear of a user, and serves to pick up voice signals (vibrations) conducted through his temporal bones around the external auditory canal wall. Such a known ear mic can be combined with a speaker, for instance a conventional sound pressure type earphone or the like.

An arrangement has been tried comprises an ear-insert member comprising the ear mic and a sound pressure type speaker combined with a conventional FM transceiver in order to attempt to transmit and receive in a high noise level environment. However, the following disadvantages were found.

It had been thought that feedback phenomena or "howl-round" would not occur even if the speaker produced a relatively high sound level, because only vibrations conducted through the temporal bones should have been picked up by the ear mic. However, when the speaker sound level was increased, for example, to between 80 and 100 dB, to permit easy listening in a very noisy environment, it was found that the speaker sounds were being picked up by the ear mic, so that "howl-round" occurred.

Moreover, it was found that, if output level of the speaker was set to a relatively high level in order to allow communication in a very noisy environment, the contemplative faculty of the user was adversely influenced.

According to the invention, there is provided a two-way communication device comprising an ear-insert member and a housing unit having electrical circuits, the ear-insert member housing a vibration pick up type microphone combined with a speaker, and an automatic Vox controlling circuit to control automatically the power level of transmitted and received signals being provided in one of electrical circuits of the device.

It is thus possible to provide a two-way communication device which satisfies the following technical requirements (1) to (6):

(1) By using the ear mic in the transmitting system of the device, noises can be excluded so that clear voice sounds can be transmitted when used in a very noisy environment, for example at a sound level of 110 dB(A).

(2) By combining the ear mic with the speaker used in the receiving system of the device, communication, i.e. simultaneous talking and listening, can be achieved through at least one ear of the user leaving his hands free.

(3) The occurrence of howl round is substantially prevented, even when output level of the speaker is relatively high, for example 100 dB, thus permitting clear communication in a very noisy environment.

(4) While the user is talking, the output level of the speaker is reduced, whereas, during listening, the signal level from the ear mic is decreased and the output level of the speaker increased.

(5) When communication is performed by a wireless transmitting and receiving system, a conventional device such as a two-band transceiver can be used. If a wire system is used, a conventional wire transmitting and receiving device such as an interphone can be used.

(6) While the user is talking and listening, it is not necessary for both ears to be closed completely, so that he can listen to sounds around him to improve safety; in this case, an ear-insert member comprising the ear mic and speaker is inserted into one ear canal, which, however, is not closed up completely.

A preferred two-way communication device uses only one ear of a user into which an ear-insert member is placed comprising the ear mic and speaker and having an automatic Vox controlling circuit. The automatic Vox controlling circuit provides automatic gain controlling to make the output level of received signals in low and the input level of transmitted signals high when the user is talking, and in contrast with this, when the user is listening, to make the transmitted level low and the received level high.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:

Figures 1 to *3* are block diagrams of preferred embodiments of the present invention;

Figure 4 is an isometric view, partly cut away, of an ear hanging type embodiment of the present invention.

Figure 5 is an isometric view showing another embodiment of the present invention.

Figure 6 is a sectional view of an ear-insert member shown in Figure 5.

Figure 1 is a diagram of a first embodiment comprising a wireless system for two-way communication. The output signals of an ear mic 1, which picks up vibrations conducted through the temporal bones in the external auditory canal and converts them to electrical signals, are transmitted by a transmitting circuit 5A of a radio set 5 through amplifier 2, a band-pass filter 3, and a variable attenuator 4.

Signals received by a receiving circuit 5B of the radio set 5 are transduced to audible sounds pressure type speaker 7, which is combined with the ear mic 1, through a variable attenuator 6.

In the above transmitting and receiving system, the output and input signals are detected by a detector, and the detected signals are supplied to a comparator circuit 8 to control or correct the variable attenuator 4 and 6. Thus, an automatic Vox controlling circuit 9 is provided by the variable attenuator 4, 6 and the comparator circuit 8.

Another preferred embodiment of the present invention is illustrated in Figures 2 and 4. In a transmitting system of this embodiment, output signals of an ear mic 1 are amplified by a pre-amplifier 2 and supplied to a band-pass filter 3 having a frequency pass-band of 500 to 3,000 Hz. The signals are then supplied to an FM amplifier 10 of the wireless radio set 5 through the variable attenuator 4, and are broadcast by the transmitting circuit 5A in the form of an FM transmitter.

In a receiving system of this embodiment, input signals are received by the receiving circuit 5B, which for example comprises RX. ANT Filter and RF & LF amplifier are supplied to an AF amplifier 12 through the variable attenuator 6, to be transduced to audible sounds. In the above systems, the transmitting and receiving signals are each detected by detectors 13 and 14, and supplied to a comparator circuit 8, by which the variable attenuator 4 and 6 are controlled so as to reduce the level of the received signals when level of the transmitted signals is high, i.e. when the user is talking, and so as to reduce the level of the transmitted signals and simultaneously increase the level of the received signals when the user has finished talking.

The transmitting and receiving device is formed as a "one-ear-hanging" type, ear-insert type, or helmet type, or is housed in a spectable frame.

An embodiment of an ear hanging-type of device is shown in Figure 4. Numeral 1 represents the ear mic inserted into the external auditory canal of one ear of the user, the ear mic 1 comprising a case 15 having a sound path 17 and a vibration pick up member 16 such as a piezoelectric element. The ear mic 1 is connected to an ear hanging member 19 through a tube 18 in which leads 20 are housed to transmit output signals of the vibration pick up member 16 to electrical circuits housed in the ear hanging member 19.

In Figure 4, numeral 21 represents an electrical power source, 22 an antenna, 23 a switch, and the other numerals in this Figure represent the same parts as in Figure 2.

Although the above description relates to an embodiment using a wireless system, the invention can be used with a wire transmitting and receiving system.

The ear-insert member can be connect through a wireless system without using the tube and leads shown in Figure 4 to a portable housing unit, and such an embodiment is shown in Figures 3, 5 and 6.

In the transmitting system of this embodiment, the output signals of the ear mic 1 housed in the ear-insert member 19 are transmitted by a wireless transmitter T such as an FM transmitter housed in the ear-insert member 19, and the transmitted signals are received by a receiver R housed in a portable housing unit 5, from which the user's speech is transmitted to another user. In the receiving system, speech signals from the other user are received by a receiving circuit 5B included in the portable housing unit 5, and the received signals are transmitted to the ear-insert member 19 through an inductive system comprising a loop antenna 24 fixed to the portable housing unit 5 and an induction coil 25 fixed to the ear-insert member 19. The received signals are then transduced to audible signals by the sound pressure type speaker 7 and are passed into the external auditory canal of the user through the sound path 17. Although in this embodiment the Vox controlling circuit 9 is shown in the ear-insert member 19, it may alternatively be disposed in the portable housing unit 5.

This embodiment allows transmitting and receiving operations at high power levels to be used for remote communication, and permits greater freedom of movement to the user. Because there are no leads or the like to connect the ear-insert member to the portable housing unit, it is less likely that the ear mic would pick up electrical noise to which leads might be susceptible.

CLAIMS

1. A two-way communication device comprising an ear-insert member and a housing unit having electrical circuits, the ear-insert member housing a vibration pick up type microphone combined with a speaker, and an automatic Vox controlling circuit to control automatically the power level of transmitted and received signals being provided in one of electrical circuits of the device.

2. A two-way communication device as claimed in claim 1, wherein the ear-insert member and the housing unit are connected through a wire system which comprises a tube containing leads and defining a sound path through which audible sounds pass from the speaker into the external auditory canal of a user.

3. A two-way communication device as claimed in claim 1, wherein the ear-insert member and the housing unit are connected through a wireless system.

4. A two-way communication device substantially as hereinbefore described with eference to and as illustrated in the accompanying drawings.

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(54) Title of the Invention: **Protective housing**
Abstract Title: **Graphene housing for a camera**

(57) A protective housing 1 for a camera system mounted on a platform has a domed shape made with a layer of grapheme and covers sensitive optical systems. The housing 1 is mounted on or forms part of the external housing of the seeker system 4. The housing 1 is optically transparent whilst also being conductive. In this way, the housing 1 allows transmission of multiple wavelengths of radiation through the housing whilst also acting so as to reduce radar cross section of the platform and preventing transmission of electromagnetic RF pulse in to the sensitive optical systems of the seeker system.

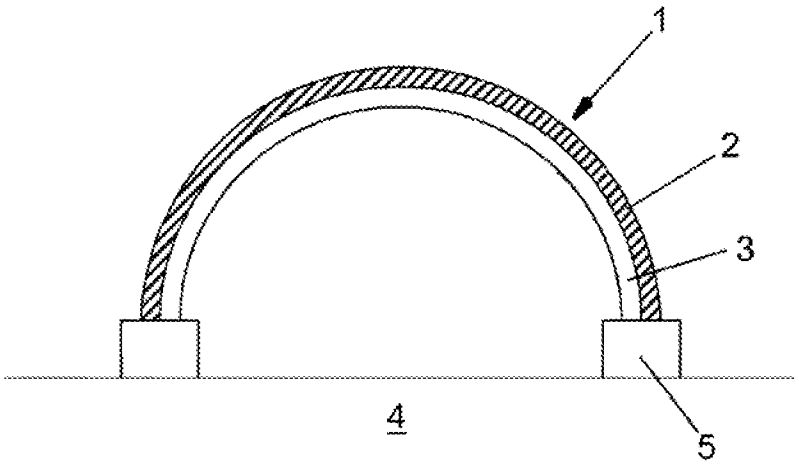


Figure 1

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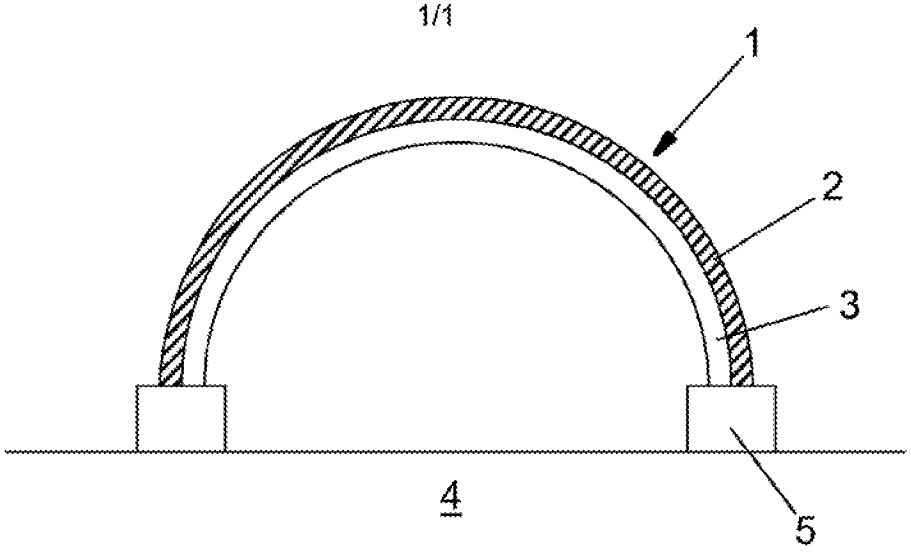
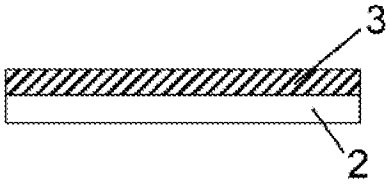
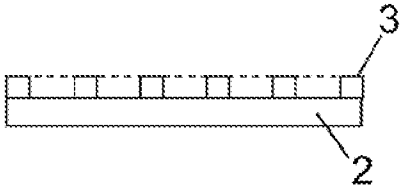


Figure 1

Figure 2a



2b



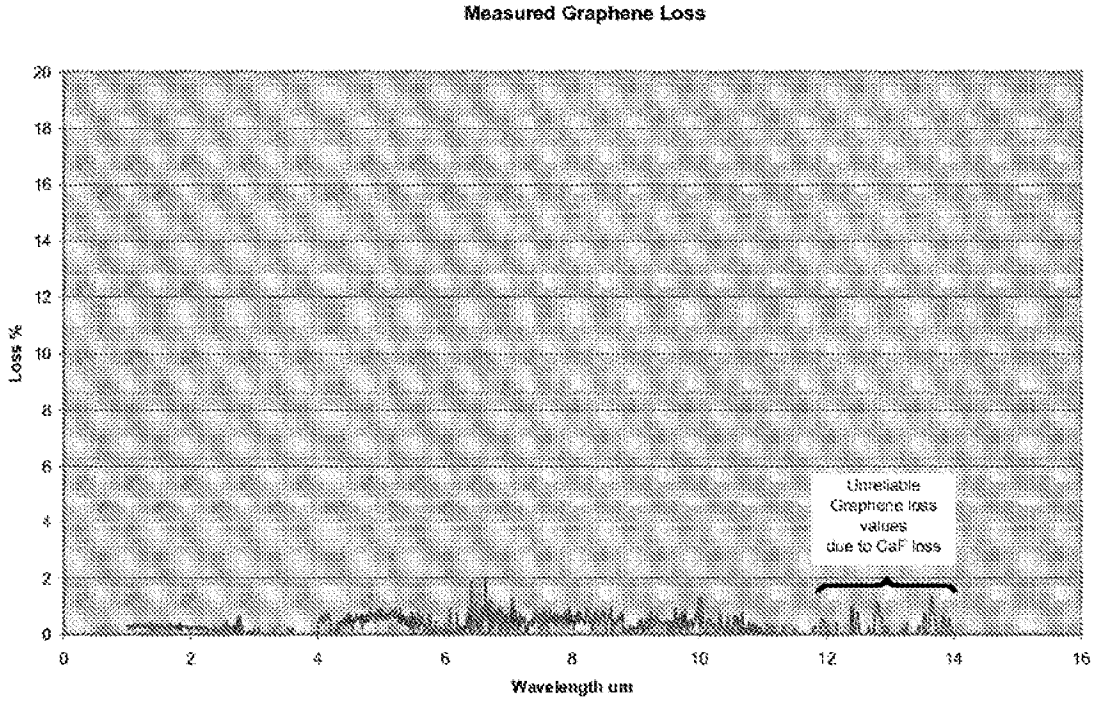


Figure 3

Protective Housing

This invention relates to a protective housing. More specifically, but not exclusively, it relates to an optically transparent protective housing for a camera mounted on a platform.

On modern platforms, such as vehicles, aircraft and missiles, and in other fields such as radiation monitoring, sensitive monitoring equipment, such as IR cameras are often utilised. Such equipment must be protected from a harsh exterior environment and this is often achieved by use of optically transparent structures that do not inhibit the 'view' from such cameras. These housings are often domed and are manufactured from materials that are transparent to the wavelength of interest such as IR or visible. These domed housings may also form the external aperture of handheld camera equipment.

In cameras built for multi-spectral use, for example Medium Wave (MW) IR and Long Wave (LW) IR imaging, or even for all the bands from visible (~400nm) to LWIR (~12-14um), using the same external aperture, optical elements, such as the housing, with high transmission in all of the bands of interest must be used.

It is advantageous for these housings to be electrically conductive. Therefore, it is known to provide these housings with a conducting layer, either a continuous 'sheet' or with some form of 'grid' structure. The layer is ideally a conformal coating on the housing, although some housings may be conductive per se. There are two reasons that a conductive housing is required. The first is to prevent electromagnetic (EM) radiation, either a counter measure or simply innocently present in the environment, entering the camera body via the aperture of the optics and disrupting the electronics. Secondly, the radar cross-section of the platform, vehicle or missile is reduced thereby reducing its susceptibility to detection and counter-measures.

Many materials used in multi-spectral optics systems to date, for example Zinc Sulphide, do not conduct. Additionally, such materials are often not robust against erosion caused by particles in the environment or even rain. This is particularly true for super-sonic operation. A 'hard' coating is often required to avoid damage to the surface over time thereby significantly impacting performance.

Transparent conductive layers for application to protective housings are typically formed by a suspension of metal particles or metal oxides. These are expected to have higher optical

loss in the IR and may have lower resistance to erosion. Other examples include those described in US patent 6,180,030; US patent 20030201164; US patent 3,698,946. However, these are limited to protective domes only transparent in the visible spectrum.

Further approaches have been utilised, for example the use of semiconductors Examples of such systems are disclosed in US patent 5,824,418, and US patent 5,724,180. Such systems use Germanium which is often used for 8-14um operation and Si which is often used for 2-5um operation. However these semiconductors cannot be easily formed as layers on complex structures or curved surfaces.

Single IR waveband domes may be made wholly of conducting materials, for example, Germanium may be used for Long Wave (LW) IR domes. If the Germanium (Ge) includes doping to allow conduction, this forms a barrier to electromagnetic waves. Robust coatings for single band domes such as Ge, are included in the work described in Proc. SPIE 2286, Window and Dome Technologies and Materials IV, 376 (September 28, 1994).

None of the above systems provide for a protective housing including a layer that can be easily manufactured with low optical loss over multiple wavebands of interest, with low resistivity, and good resistance to erosion.

It has been stated publically that no long wave or multi-spectral material was sufficiently durable and that good IR transmitting materials are highly reflective at radio frequencies for this application. Additionally it has also been stated that there is no known material with adequate infrared transparency together with adequate electrical conductivity.

The present invention aims to provide such a solution.

According to the invention there is provided a protective housing for a camera mounted on a platform, the housing comprising a layer of graphene, the graphene being conductive yet acting so as to allow transmission of radiation through the housing.

The invention will now be described with reference to the following diagrammatic drawings in which:

Figure 1 is a cross-sectional, schematic diagram of one form of the invention showing a dome-shaped protective housing for an camera, the dome being mountable on the exterior surface of a vehicle, missile or other platform;

Figure 2 is a magnified view of the domed housing of Figure 1 showing a layer of one form of the invention, on the external surface of the dome.

Figure 3 is a graph showing the optical loss in a system having a graphene coating on the dome-shaped housing, the loss shown being solely due to the graphene coating.

Figure 1 shows a typical protective dome-shaped housing 1 for use in protecting sensitive equipment such as an IR camera system (not shown). The dome 1 may form the external aperture of the IR camera system (not shown).

In a first embodiment of the invention shown in Figure 2, the dome 1 comprises a substrate 2 formed from Zinc Sulphide having a layer 3 of graphene deposited thereon. The graphene layer 3 may be in the form of a layer of one atom thickness of graphene deposited on the outside surface of the substrate 2 forming the dome 1. However, the layer 3 may be formed on the inside surface of the domed housing in order that the graphene is protected from the external environment.

It will be appreciated that the layer 3 may comprise multiple conformal layers of graphene each individual layer being of a single atom thickness.

Alternatively, the layer 3 may take the form of a single layer of graphene sandwiched between layers of suitable optically transparent material.

In the example described above, the dome 1 is mounted on the exterior surface of the platform 4 using suitable mountings 5.

The graphene layer 3 may be deposited on the substrate 1. However, it will be appreciated that any suitable manufacturing method capable of creating a layer 3 of graphene on the substrate 2 may be used.

The camera system (not shown) may be operative at a single wavelength or may operate over a number of discrete wavelength bands for example for multi-spectral use for MWIR and LWIR imaging, or even for all bands from visible (~400nm) to LWIR (~12-14um), using the same external aperture and protective housing.

In a second embodiment of the invention, the conductive layer 3 of graphene may take the form of a geometrical structure such as a grid or other required configuration. In this embodiment of the invention, the graphene layer may also form an antenna for a dual mode sensor. For example the graphene may be configured to act as a radio frequency (rf) transmitter or receiver via appropriate circuitry incorporated in the platform or camera. The structure and configuration of the graphene layer would be selected so as to produce an appropriate shape for such an application. It will be appreciated that there may be other uses for such a conductive structure within the housing and that the second embodiment is not limited to only rf antennae.

In a third embodiment of the invention, the conductive coating comprises a layered structure with Graphene sandwiched between matrix materials to make a composite. A suitable matrix material may be Zinc Sulphide. However, it will be appreciated that any other suitable optical transparent matrix material may be used. .

In a fourth embodiment of the invention the housing comprises the external aperture of a camera, the graphene acting in a similar manner as described above, the housing forming part of the optical system of the camera.

Graphene has desirable properties for the applications described above. It is conductive, can be formed in layers on substrate materials, can be easily manufactured with low optical loss over multiple wavebands of interest, has low resistivity, and good resistance to erosion. Graphene is highly conductive its resistivity being approximately 35% lower than silver at room temperature. Furthermore, measurements have shown that Graphene has a breaking strength 200 times greater than steel, with a tensile modulus (stiffness) of 1 TPa (150,000,000 psi).

It will be appreciated that there are other similar applications for the use of graphene as an optically transparent yet conductive material. For example, it is envisaged that graphene may be used for IR transparent antennas on domes for hybrid rf/IR seeker systems on missiles, or other military applications or platforms. Additionally, graphene may be used as an IR transparent fuze on a domed housing capable of activating a lethal package upon target contact.

It will be appreciated that whilst graphene has the properties required to form a suitable conducting layer the form that the layer takes is not limited to the three examples discussed

above and that any suitable form of graphene layer that achieved the objective described is envisaged.

Claims

1. A protective housing for a camera mounted on a platform, the housing comprising a layer of graphene, the graphene being conductive yet acting so as to allow transmission of imaging radiation through the housing whilst preventing radio frequency radiation being transmitted through the housing.

2. A protective housing according to claim 1 in which the housing comprises the external aperture of the camera.

3. A protective housing according to claim 1 or 2 in which the housing further comprises a conformal layer of graphene formed on or within a substrate.

4. A protective housing according to claim 1 or 2 in which the housing further comprises a grid-like structure of graphene formed on or within a substrate.

5. A protective housing according to claim 1 or 2 in which the housing comprises a graphene - substrate composite.

6. A protective housing according to any one of claims 3 to 5 in which the substrate comprises Zinc Sulphide or any other material having appropriate optical properties.

7. A protective housing according to any preceding claim in which the imaging radiation transmitted through the housing comprises radiation of a single wavelength, multiple discrete wavelengths or multiple ranges of wavelengths.

8. A protective housing according to claim 7 in which the imaging radiation transmitted through the housing comprises radiation suitable for MWIR and LWIR imaging, or radiation of all wavelengths from visible to LWIR.

9. A protective housing according to any preceding claim in which the housing is formed in a dome-like shape.

10. A camera system operative at a single discrete wavelength, in multiple discrete wavelengths or multiple ranges of wavelengths, the camera system being mounted on the external surface of a platform, the camera system comprising a single external aperture, the aperture comprising a layer of graphene, the graphene being conductive yet acting to allow

transmission of imaging radiation through the housing whilst preventing transmission of radio frequency radiation through the housing.

11. A camera system according to claim 10 in which the external aperture comprises a domed-structure.

12. A camera system according to any one of claims 9 to 11 in which the radiation transmitted through the aperture comprises radiation suitable for MWIR and LWIR imaging, or radiation of all wavelengths from visible to LWIR.

13. A seeker system comprising a protective housing, the seeker system being operative at one or more wavelengths or ranges of wavelengths, the housing being optically transparent whilst also being conductive and acting to reduce the radar cross section of the missile and protecting the seeker system from rf EM pulse.

14. A seeker system according to claim 13 in which the housing comprises graphene.

15. A seeker system according to claim 14 in which the graphene is formed in a grid-like structure.

16. A seeker system comprising a protective housing, the protective housing comprising a graphene layer, the graphene layer configured so as to act as a radio frequency transmitter or receiver via appropriate circuitry incorporated in the seeker system.

17. A protective housing, camera system or seeker system as hereinbefore described with reference to Figures 1 to 3 of the accompanying drawings.

Application No: GB1221244.5 **Examiner:** Mr Richard Nicholls

Claims searched: 1-17 **Date of search:** 30 August 2013

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
A	-	US2009/117386 A1 (HONEYWELL)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[X] :

Worldwide search of patent documents classified in the following areas of the IPC

G03B; H04N

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI

International Classification:

Subclass	Subgroup	Valid From
G03B	0017/02	01/01/2006

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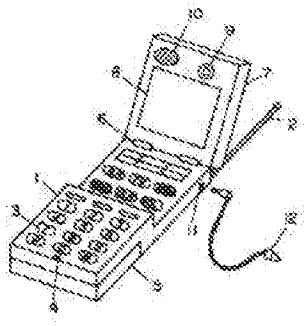
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(71)Applicant	MATSUSHITA ELECTRIC IND CO LTD
(72)Inventor	KITAMURA SHINICHI



(54)PORTABLE RADIO TYPE TV TELEPHONE

(57)Abstract
PURPOSE: To use a telephone as an ordinary portable telephone by applying an earpiece part to the ear by closing a flip part equipped with an earpiece on a back surface flush with a key operating part when the other terminal party side is the one with only a voice communications function.
CONSTITUTION: The key operating part 3 and a microphone 4 are provided to a device main body 1, and also, the flip part 7 connected to the device main body 1 with a hinge 6 is provided. Also, a monitor 8, a CCD camera 9, and a speaker 10 are provided on the surface of the flip part 7 housed in the device main body 1 when the flip part 7 is closed, and the earpiece on the back surface of the flip part 7 flush with the operating part 3 when the flip part 7 is closed. The telephone can be used as a radio type TV telephone by the speaker 10 or an earphone 12 as keeping a certain distance and observing visually the monitor 8. When the flip part 7 is opened and also, it is used as an ordinary portable telephone by applying the earpiece to the ear when the flip part 7 is closed.

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CLAIMS

[Claim(s)]
[Claim 1]On the surface of a flip part stored in a main device when it has a flip part which equipped a main device with a key operation section and a microphone, and was connected with the aforementioned main device with hinges and the aforementioned flip part is closed, a monitor, When a flip part back surface which serves as a CCD camera the same surface side as a key operation section in a loudspeaker when a flip part is closed is equipped with an ear piece and a flip part is opened, A fixed distance is maintained toward the aforementioned monitor, a CCD camera, and a loudspeaker, A walkie-talkie type TV telephone applies an ear to the aforementioned ear piece and it enabled it to use for it as a usual mobile phone when it was able to use as a radio type TV telephone by loudspeaker telephone or an earphone, and a flip part was closed and the aforementioned monitor was stored in the main device side, recognizing a monitor visually.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]The present invention relates to the portable radiotelephone provided with TV telephone function which can transmit and receive a still picture or an animation, voice informations, etc., such as an image and a character.
[0002]
[Description of the Prior Art]In recent years, the walkie-talkie type TV telephone which can transmit and receive a still picture or an animation, voice informations, etc., such as an image and a character, has come to be commercialized with digitization of wireless communications, such as a digital cellular type telephone and a next-generation cordless telephone (PHP), and advanced features of service.
[0003]Hereinafter, it describes about the conventional walkie-talkie type TV telephone, referring to Drawings. Fig.3 is an outline view showing the composition in the state where the flip part of the conventional walkie-talkie type TV telephone was opened, 2 is the main device in which 1 built in the wireless control circuit in Fig.3, and an antenna which transmits and receives a radio wave. 3 is a key operation section which inputs a telephone number etc., and 4 is a microphone which carries out voice input. 5 is a battery part which supplies a power supply, 6 is a rotatable hinge, and 7 is the flip part connected with the main device 1 by the hinges 6. 8 is a character sent from the other party, such as a telephone number input from the key operation section 3. The liquid crystal display monitor which projects picture information, and 9 are the CCD cameras for sending the picture information of the user of this equipment side to the other party. When connecting to an earphone terminal the loudspeaker to which 10 outputs a receiver sound as a loudspeaker telephone, and 11, 12 is connected to the earphone terminal 11 and it is hard to catch in the surrounding noise, it is an earphone used for a partner's talk not to be heard around. Fig.4 is a perspective view showing the composition in the state where the flip part of the same conventional walkie-talkie type TV telephone was closed.
[0004]About the conventional walkie-talkie type TV telephone constituted as mentioned above, the operation is described below. When transmitting and receiving TV telephone terminal, and a sound and picture information of the other party, the flip part 7 connected with the main device 1 with the hinges 6 is opened, and it rotates and fixes to the position which is easy to recognize visually the liquid crystal display monitor 8 and CCD camera 9, and holds with the liquid crystal display monitor 8 and a fixed distance.
[0005]A power supply is supplied by the battery part 5 with which the main device 1 was equipped when the power supply was turned on, and input the telephone number of an other party terminal, recognizing visually with the liquid crystal display monitor 8 from the key operation section 3 of the main device 1, and next, via control and the wireless circuit of the main device 1, A radio signal is sent from the antenna 2 and calling operation is performed. Transmit [after the wireless circuit combination with the terminal of the other party which comes out] continuously and receive a sound, an image, and an alphabetic signal between terminals through the antenna 2 through a radio signal, Voice response of the voice information received from an other party terminal is carried out from the earphone 12 connected to the loudspeaker 10 or the earphone terminal 11 which operates as a loudspeaker telephone, and an image and text can be received as an image outputted with the liquid crystal display monitor 8. Voice input of the voice information transmitted to an other party terminal is carried out with the microphone 4, the image input of the picture information is carried out to CCD camera 9, and it is transmitted to the other party.
[0006]In the case of the telephone of only the voice communication function in which TV telephone function does not have an other party terminal on the other hand, the liquid crystal display monitor 8 and CCD camera 9 are turned OFF by the same method as the aforementioned operation, and the wireless communication of only a voice information is

performed.
[0007]
[Problem to be solved by the invention]However, by above-mentioned conventional walkie-talkie type TV telephone, when an other party terminal also had TV telephone function, it was satisfactory, but only in the case of the voice communication function, the other party terminal had the problem of being hard to talk over the telephone, by the loudspeaker telephone or the earphone.
[0008]The present invention solves an aforementioned problem and the other party terminal aims at only in the case of a voice communication function, applying an ear to the ear piece part of a main device in the same manner as the usual portable radiotelephone, and providing an available walkie-talkie type TV telephone.
[0009]
[Means for solving problem]The present invention equips a main device with a key operation section and a microphone to achieve the above objects, On the surface of the flip part stored in a main device when it has the flip part connected with the aforementioned main device with hinges and the aforementioned flip part is closed, a monitor, The flip part back surface which serves as a CCD camera the same surface side as a key operation section in a loudspeaker when a flip part is closed is equipped with an ear piece, When a flip part is opened, a fixed distance is maintained toward the aforementioned monitor, a CCD camera, and a loudspeaker, When it can use as a radio type TV telephone by the loudspeaker telephone or an earphone, and a flip part is closed and the aforementioned monitor is stored in the main device side, recognizing a monitor visually, an ear is applied to the aforementioned ear piece and it enables it to use for it as a usual mobile phone.
[0010]
[Function]By the above-mentioned composition, the present invention opens a flip part, when an other party terminal also has TV telephone function, A fixed distance is maintained toward the above-mentioned monitor, a CDD camera, and a loudspeaker, Communication by the image, text, and a voice information can be performed as a wireless TV telephone with a loudspeaker telephone, and only in the case of a voice communication function, a flip part can be closed, an other party terminal can apply an ear piece part to an ear, and it can use as a usual mobile phone.
[0011]
[Working example]Hereinafter, about one Example of the present invention, while referring to Drawings, it describes.
[0012]2 is the main device in which 1 built in the wireless control circuit in Fig.1, and an antenna which transmits and receives a radio wave. 3 is a key operation section which inputs a telephone number etc., and 4 is a microphone which carries out voice input. 5 is a battery part which supplies a power supply, 6 is a rotatable hinge, and 7 is the flip part connected with the main device 1 by the hinges 6. 8 is a character sent from the other party, such as a telephone number input from the key operation section 3. The liquid crystal display monitor which projects picture information, and 9 are the CCD cameras for sending the picture information of the user of this equipment side to the other party. When connecting to an earphone terminal the loudspeaker to which 10 outputs a receiver sound as a loudspeaker telephone, and 11, 12 is connected to the earphone terminal 11 and it is hard to catch in the surrounding noise, it is an earphone used for a partner's talk not to be heard around, and the above is the same as that of a conventional case. Fig.2 is an outline view showing the composition in the state where the flip part of the walkie-talkie type TV telephone was similarly closed, and the ear piece to which 13 outputs a receiver sound at the time only of voice communication, and 14 are segment display parts which display text, such as a telephone number.
[0013]About the walkie-talkie type TV telephone of this example constituted as mentioned above, the operation is described below. When transmitting and receiving TV telephone terminal, and a sound and picture information of the other party, the flip part 7 connected with the main device 1 with the hinges 6 is opened, and it rotates and fixes to the position which is easy to recognize visually the liquid crystal display monitor 8 and CCD camera 9, and holds with the liquid crystal display monitor 8 and a fixed distance. A power supply is supplied by the battery part 5 with which the main device 1 was equipped when the power supply was turned on, and input the telephone number of an other party terminal, recognizing visually with the liquid crystal display monitor 8 from the key operation section 3 of the main device 1, and next, via control and the wireless circuit of the main device 1, A radio signal is sent from the antenna 2 and calling operation is performed.
[0014]Transmit [after the wireless circuit combination with the terminal of the other party which comes out] continuously and receive a sound, an image, and an alphabetic signal through the antenna 2 between terminals through a radio signal, Voice response of the voice information received from an other party terminal is carried out from the earphone 12 connected to the loudspeaker 10 or the earphone terminal 11 which operates as a loudspeaker telephone, and an image and text can be received as an image outputted with the liquid crystal display monitor 8. Voice input of the voice information transmitted to an other party terminal is carried out with the microphone 4, the image input of the picture information is carried out to CCD camera 9, and it is transmitted to the other party.
[0015]Where in the case of the telephone of only the voice communication function in which TV telephone function does not have a terminal of the other party on the other hand, it blockaded the flip part 7 as shown in Fig.2, and the liquid crystal display monitor 8 and CCD camera 9 are turned OFF to carry out transmission and reception of only a voice information, A power supply will be supplied by the battery part 5 with which the main device 1 was equipped if a power supply is turned on, The telephone number of an other party terminal is input recognizing visually by the segment display part 14 from the key operation section 3 of the main device 1, a radio signal is sent from the antenna 2 via control and the wireless circuit of the main device 1, and calling operation is performed.
[0016]An audio signal is continuously transmitted after the wireless circuit combination with the terminal of the other party which comes out and received between terminals through a radio signal, voice response of the voice information received from an other party terminal is carried out, and it can be received from the earphone 12 connected to the ear piece 13 or the earphone terminal 11. Voice input of the voice information transmitted to an other party terminal is carried out with the microphone 4, and it is transmitted to the other party. Therefore, when performing an audio wireless communication, by blockading the not a

telephone call but flip part 7 by the loudspeaker telephone holding a fixed distance, the ear piece 13 can be applied to an ear like the usual portable radiotelephone, and it can talk over the telephone.

[0017]

[Effect of the Invention]As mentioned above, the present invention opens a flip part, when an other party terminal also has TV telephone function, A fixed distance is maintained toward the above-mentioned monitor, a CCD camera, and a loudspeaker, Communication by the image, text, and a voice information can be performed as a wireless TV telephone with a loudspeaker telephone, and only in the case of a voice communication function, a flip part can be closed, an other party terminal can apply an ear piece part to an ear, and it can provide a walkie-talkie type TV telephone available as a usual mobile phone.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
A [FIG. 1] The outline view showing the composition in the state where the flip part of the walkie-talkie type TV telephone in one Example of the present invention was opened
A [FIG. 2] The outline view showing the composition in the state where the flip part of the walkie-talkie type TV telephone was closed
A [FIG. 3] The outline view showing the composition in the state where the flip part of the conventional walkie-talkie type TV telephone was opened
A [FIG. 4] The perspective view showing the composition in the state where the flip part of the walkie-talkie type TV telephone was closed
[Explanations of letters or numerals]
1 Main device
2 Antenna
3 Key operation section
4 Microphone
5 Battery part
6 Hinge
7 Flip part
8 Liquid crystal display monitor
9 CCD camera
10 Loudspeaker
11 Earphone terminal
12 Earphone

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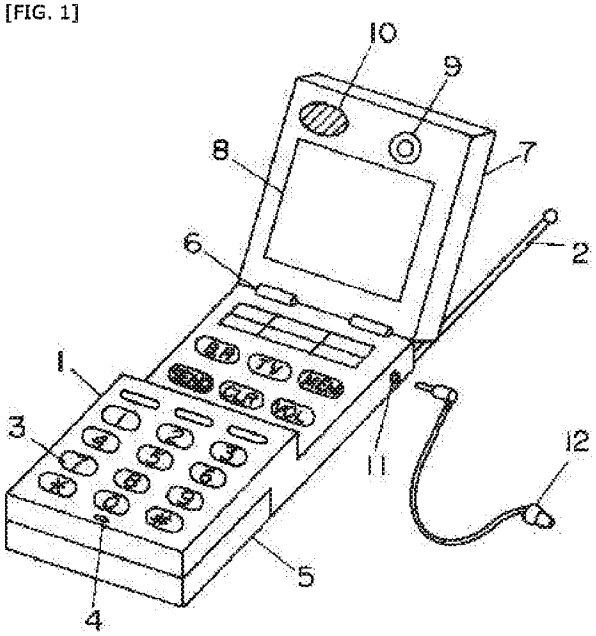
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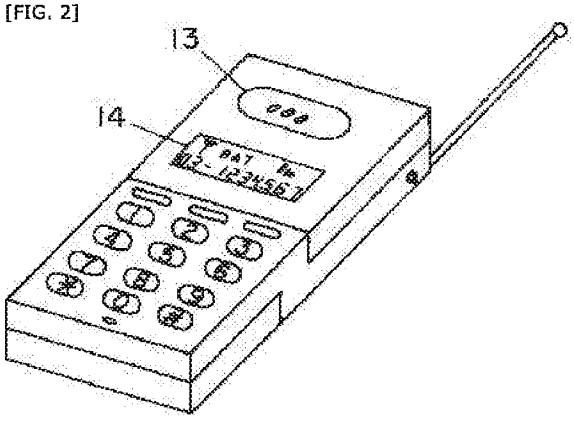
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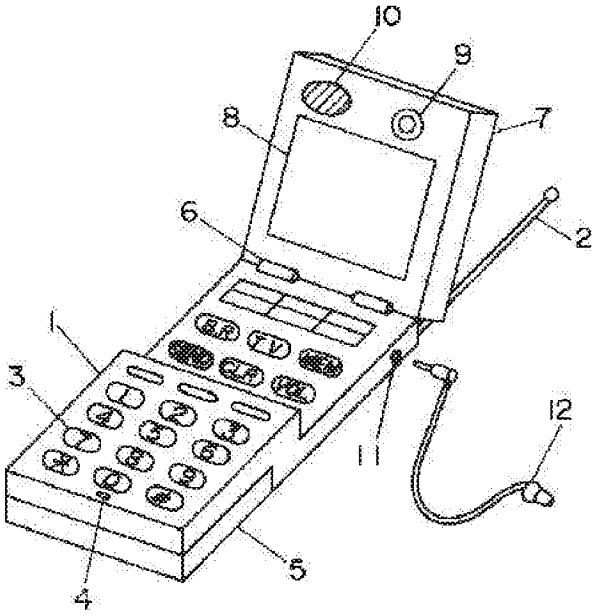
A [FIG. 1]



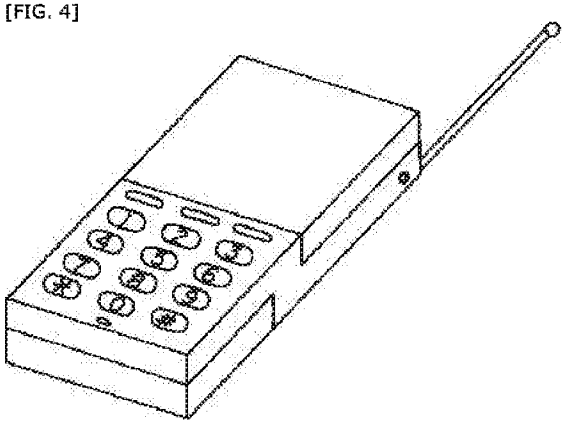
A [FIG. 2]



A [FIG. 3]



A [FIG. 4]



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(74) Agents: **GROENENDAAL, Antonius, W., M.** et al.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

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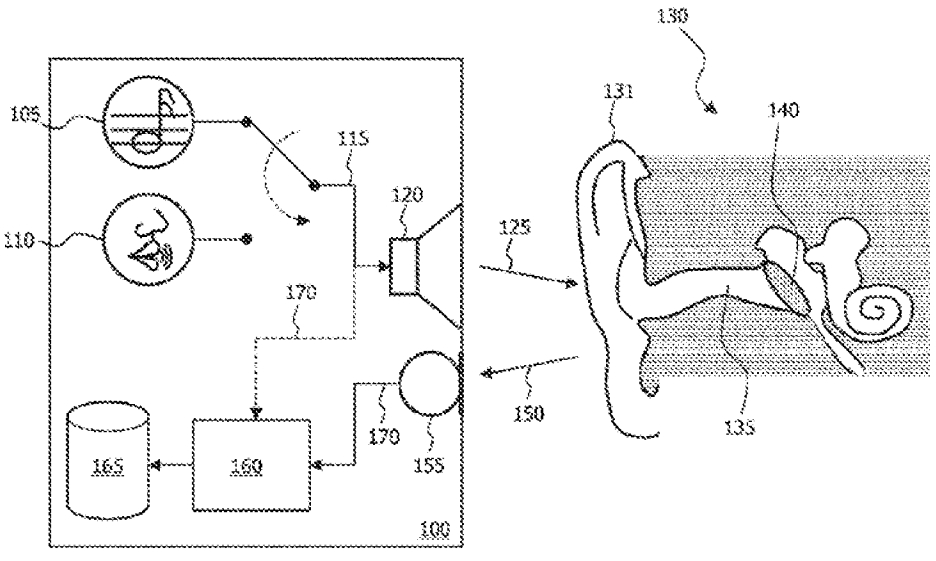
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(54) Title: METHOD AND APPARATUS FOR ACOUSTICAL OUTER EAR CHARACTERIZATION



(57) Abstract: The present invention relates to a method and apparatus for characterizing acoustical properties of an outer ear 130, the method comprising the steps of: transmitting a first acoustic signal 125 towards the outer ear 130, receiving a second acoustic signal 150 from the outer ear 130, and characterizing acoustical properties 165 of the outer ear on the basis of the second acoustic signal 150. The method is characterized in that the first acoustic signal 125 comprises at least one of the following elements: music, and speech. The present invention further relates to a method and apparatus for enrolling, authenticating and identifying a person on the basis of acoustical properties of an outer ear 130.

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Method and apparatus for acoustical outer ear characterization

The invention relates to a method of characterizing acoustical properties of an outer ear, the method comprising the steps of: transmitting a first acoustic signal towards the outer ear, receiving a second acoustic signal from the outer ear, and characterizing acoustical properties of the outer ear on the basis of the second acoustic signal. The invention further relates to an apparatus and a system for characterizing acoustical properties of an outer ear, the apparatus and the system each comprising: transmitting means arranged to transmit a first acoustic signal towards the outer ear, receiving means arranged to receive a second acoustic signal from the outer ear, and characterizing means arranged to characterize the acoustical properties of the outer ear on the basis of the second acoustic signal.

In security applications, as well as in every day life, authentication and identification of persons are of paramount importance. Credit cards, ID cards, passports, and badges are used by many people on a daily basis but are stolen and abused quite frequently. As a result, there is a strong drive to develop reliable biometrics that can be acquired in a preferably non-intrusive and convenient manner. However, certain biometrics such as fingerprints have a disadvantage in that they are left involuntarily by their owners and, as a result, malicious parties have successfully forged fingerprints, e.g. using gummy fingers.

The drive for new biometrics has led to the use of acoustical properties of the outer ear as a biometric. U.S. patent 5,787,187 discloses a system for verifying/recognizing the identity of an individual by characterizing the acoustical properties of the ear canal as a biometric. To this end, a source signal is emitted into the ear canal that comprises e.g. broadband noise, or frequency tones. However, individuals whose outer ear acoustics are being characterized perceive such source signals as intrusive and/or unpleasant.

According to a first aspect of the invention, it is an object to provide a method of acoustical outer ear characterization that is less intrusive for the person being characterized.

This objective is realized in that the method as set forth in the opening paragraph is further characterized in that the first acoustic signal comprises at least one of the

following elements: music, and speech.

The advantage of using music or speech for characterizing the outer ear is that a person being characterized will find the characterization process less intrusive than when being confronted with (white) noise, or tone sequences. The present method has the further advantage that it can be conducted during a conversation, or when a person is listening to a message and/or music. The method is so inconspicuous that characterization can take place without the person being aware of it.

When transmitting the first acoustic signal comprising music and/or speech towards the human outer ear, part of the signal will be reflected by the pinna (the visible part of the outer ear), the ear canal, and the eardrum. A second acoustic signal is captured by using a microphone, which signal comprises part of the reflected signal that in turn comprises information with respect to the outer ear structure. The second acoustic signal is used to characterize acoustical properties of the outer ear.

In a first embodiment, the amplitude of the spectral components present in the second acoustic signal is established in order to characterize acoustical properties. In an alternative embodiment, a transfer function is established on the basis of the frequency domain representation of both the source representation and the received second acoustic signal in order to characterize acoustical properties.

The use of music and/or speech allows the use of low-cost consumer electronics loudspeakers and microphones for characterization.

According to a second aspect of the invention, the method of characterizing acoustical properties of an outer ear can be further enhanced by the addition of noise to the music and/or speech used in the characterization process. The added noise may comprise white or colored noise. Although music and/or speech allow characterization, music and/or speech may not comprise all relevant spectral components in the audible spectrum.

Reliability can be improved by adding noise comprising at least the relevant missing spectral components. Furthermore, by using a relatively low amplitude noise signal, in comparison with that of music and/or speech, the less intrusive nature of music and/or speech can be preserved.

According to a third aspect of the invention, the method of characterizing acoustical properties of an outer ear can be further enhanced by using a particularly elegant method of adding noise. The human auditory system is a very sensitive system that can pick up even minute quantities of noise, provided it is quiet. However, in the presence of music and/or speech, the distinguishing capabilities of the human auditory system are compromised.

By exploiting a technique referred to as spectral and temporal masking, it is possible to add noise to an audio signal without a person noticing. More information related to perceptual coding can be found, inter alia, in "Auditory Perception and the MPEG Audio Standard", by Chris A. Lanciani, published by the Georgia Institute of Technology, August 11, 1995, herein incorporated by reference.

The psycho-acoustic model of the human auditory system is used elaborately in lossy digital audio compression techniques. These techniques exploit, inter alia, the fact that the human ear has difficulty in distinguishing small amplitude frequency components in the presence of a, spectrally proximate, frequency component with a substantially larger amplitude. As a result, it is possible to use a coarser quantization for the smaller components, or discard the smaller components altogether in order to reduce the size of the audio representation.

In the above example, the "compressed" signal is distorted; the quantization errors, and/or discarded frequency components can be considered as noise that is added to the original signal. The present invention suggests adding noise based on the psycho-acoustic model of the human auditory system in order to exploit the temporal and/or spectral masking effect, and not to compress the resulting signal but add inaudible noise in order to shape the frequency spectrum of the signal so as to improve characterization of the outer ear.

Methods according to all of these aspects of the invention can be used in systems for biometric authentication or identification of a user that use acoustical properties of the outer ear as a biometric. Usually, two phases can be distinguished in systems for biometric authentication and identification;

- an enrolment phase during which reference data is acquired, and
- an authentication/identification phase during which

authentication/identification data is acquired and compared with previously enrolled reference data.

During both phases, the acoustical properties of an outer ear are characterized. As a result, the present invention can be used beneficially in methods for biometric enrolment, authentication, and identification that use acoustical properties of the outer ear as a biometric.

According to a further aspect of the invention, it is an object to provide an apparatus for acoustical outer ear characterization that is less intrusive for the person being characterized.

This objective is realized in that the apparatus as set forth in the opening paragraph is further characterized in that the first acoustic signal comprises at least one of the following elements: music, and speech.

In one embodiment, an apparatus according to the present invention comprises a noise generation means that allows the addition of noise to the first acoustic signal comprising music and/or speech. In an alternative embodiment, the noise generation means is used in combination with a noise generation control means that allows the addition of noise based on a psycho-acoustic model of the human auditory system.

The invention further relates to a device for enrolling the acoustical properties of an outer ear of a person that characterizes acoustical properties according to the present invention, as well as to an apparatus for authenticating and an apparatus for identifying a person using acoustical properties characterized according to the present invention.

According to a further aspect of the invention, it is an object to provide a system for acoustical outer ear characterization that is less intrusive for the person being characterized.

This objective is realized in that the system as set forth in the opening paragraph is further characterized in that the first acoustic signal comprises at least one of the following elements: music, and speech.

The present invention further relates to a telecommunication system configured to provide telecommunication services via a network and remotely authenticate a person. The system comprises two terminals, a first terminal associated with a party, and a second terminal operated by a person. The system is arranged in such a way that, according to the present invention, the two terminals jointly characterize the acoustical properties of the outer ear of the person, wherein the characterized acoustical properties are used by an authentication means comprised in the first terminal that matches the characterized acoustical properties of the outer ear of the person with enrolled acoustical ear properties in order to authenticate the person to said party.

These and other aspects of the invention will be further elucidated and described by way of example and with reference to the drawings, in which:

Fig. 1 is a schematic representation of an apparatus according to the first aspect of the present invention for characterizing a human outer ear,

Fig. 2 is a plot depicting the amplitude of the "ear transfer function" over frequency characterized according to the present invention, for three individuals,

Fig. 3 is a schematic representation of an apparatus according to the second aspect of the present invention for characterizing a human outer ear,

Fig. 4 is a schematic representation of an alternative apparatus according to the second aspect of the present invention for characterizing a human outer ear,

Fig. 5 is a plot depicting the amplitude of the "ear transfer function" over frequency characterized according to the present invention, with and without added noise,

Fig. 6 is a schematic representation of an apparatus for authenticating a person based on the third aspect of the present invention for characterizing a human outer ear,

Fig. 7 is a schematic representation of an alternative apparatus for authenticating a person based on the third aspect of the present invention for characterizing a human outer ear,

Fig. 8 is a schematic representation of a system for identifying a person based on the acoustical properties of an outer ear,

Fig. 9 is a schematic representation of a system for remote authentication of a person, using a telecommunication system.

Throughout the drawings, the same reference numerals refer to the same elements, or elements that perform the same function.

Well-known biometric methods for identity verification are based on biometrics such as fingerprints, irises, faces, or speech. Here, measurements are performed in order to obtain biometric data, also known as feature vector data. As a rule, not all biometrics are suitable for all applications. Characteristics such as the price and/or form factor of the required sensors, or the effort involved in deriving characteristics/feature vectors from sensor measurements, can limit the scope of application.

The acoustical properties of the outer ear, in particular the pinna (the outer flap of the ear), the ear canal, and the eardrum, can be measured with little effort, using low-cost loudspeakers and microphones. The shape of the outer ear, such as the folds of the pinna and the length and shape of the ear canal, differs among individuals, as can be observed by visual comparison of the ears of individuals. These differences are even more pronounced for acoustical measurements, and in particular for the transfer function of the outer ear when

characterized, using a loudspeaker close to the ear and a microphone close to or in the ear canal.

When a pre-defined first acoustic signal is transmitted towards the outer ear of a person, the acoustic signal is in part reflected by the outer ear. In parallel, a second acoustic signal is received for characterization. Such a characterization can be used to acquire biometric data for biometric authentication/identification.

In one embodiment, characterization involves transforming the second acoustic signal into the frequency domain and comparing the resultant spectrum with previously enrolled spectra. In a different embodiment, a transfer function is established to characterize the acoustical properties of the outer ear. Such a transfer function can be established in such a way that it is independent of the first acoustic signal and, as a result, can be used to characterize an ear on the basis of different acoustic signals. To establish a transfer function during enrolment that is truly independent of the first acoustic signal, it is relevant to establish the transfer function for all relevant frequency components. Furthermore, in order to be able to reliably authenticate or identify a person, the first acoustic signal used during authentication/identification must provide sufficient information so as to differentiate between individuals.

The ear canal is a resonance system that, together with the pinna, provides rich features. In a coarse approximation, the outer ear is a one-dimensional system that resonates at one quarter of the acoustic wavelength. The resonance is typically around 2500 Hz but varies from person to person. The typical resonance frequencies correspond to typical dimensions of both pinna and ear canal.

The length of the ear canal and the curvature of the pinna have dimensions that can range from millimeters to a few centimeters. To be able to detect these shapes and curvatures, the acoustic probing waves should have proper wavelengths. Assuming that it is possible to resolve structures of the order of one tenth of the wavelength, an acoustic signal ranging from 100 Hz to 15kHz will allow detection of feature sizes up to approximately 2 mm, which seems sufficient for distinguishing most features. Although the range from 100 Hz to 15 kHz may suffice for practical applications, it does not exclude the use of the present invention for other ranges of the audible spectrum ranging from 20 Hz to 22 kHz.

When a fixed pre-determined signal is used as a first acoustic signal during enrolment and identification/authentication, it may suffice to compare the frequency spectrum of the resultant second acoustic signal in order to authenticate and/or identify individuals. To be able to differentiate between different individuals, the first acoustic signal

must have sufficient characteristic features available. Generally, the first acoustic signal does not need to have a flat spectrum in which all frequency components are present to allow successful characterization for authentication/identification.

However, when characterizing a transfer function in order to obtain an input-independent transfer function, all frequency components are relevant. In order to obtain an accurate transfer function, all frequency components must be present. In particular in music and or speech, in which generally not all spectral components are present, noise can be added to complement the spectrum. In this way, the resultant outer ear transfer function can be characterized for all relevant frequency components in the range of 100 Hz to 15 kHz, rather than for a subset. As a result, the transfer function can also be used in combination with other excitation signals.

Fig. 1 depicts an apparatus 100 according to the present invention for characterizing the acoustical characteristics of an outer ear. The apparatus comprises a storage means, such as a hard disk, for storing a digital representation of music 105 and speech 110. Either representation can be used to measure the response, although typically music will have a somewhat broader frequency spectrum than speech.

One of the representations is selected as the source signal 115. The apparatus 100 uses the source signal to generate a first acoustic signal 125. To this end, the apparatus 100 comprises a loudspeaker 120 positioned preferably in the proximity of the ear. The loudspeaker 120 transmits the first acoustic signal 125 towards the outer ear 130, comprising pinna 131, ear canal 135, and eardrum 140. Parts of the first acoustic signal 125 are reflected by the outer ear 130, and a resulting second acoustic signal 150 is received by a microphone 155 fitted close to or in the ear canal 135. The second acoustic signal 150 may also comprise environmental noise that can be measured separately by using a further microphone (not shown), and can be subsequently weighted and subtracted from the output of the microphone 155.

In the embodiment shown in Fig. 1, the characterizing means 160 uses both the selected source signal 115 as well as the microphone output 170 to establish a transfer function characterizing the outer ear 130.

In order to establish this transfer function, the characterizing means 160 transforms the source signal 115, $x(t)$, into a frequency domain representation $X(\omega)$, using a Fast Fourier Transform (FFT). Use of other time domain-to-frequency domain transformations, including Discrete Fourier Transforms can also be envisaged. The

microphone output 170, $r(t)$, is also transformed, resulting in $R(\omega)$. Subsequently, a transfer function is established:

$$H(\omega) = R(\omega)/X(\omega)$$

This transfer function is an approximation of the actual transfer function and can be represented as a cascade of:

- the transfer function of the loudspeaker ($H_{lsp}(\omega)$),
- the transfer function of the outer ear ($H_{ear}(\omega)$),
- the transfer function of the microphone ($H_{mic}(\omega)$).

$$H(\omega) = H_{lsp}(\omega) \cdot H_{ear}(\omega) \cdot H_{mic}(\omega)$$

Although this transfer function also includes the transfer functions of both loudspeaker 120 and microphone 155, these can be chosen within predefined specifications leaving the transfer function of the ear as the characteristic part.

The resulting transfer function ($H(\omega)$) is a complex entity. In a preferred embodiment, the characterizing means 160 discards delay and phase shift information and uses the amplitude of the transfer function as acoustical properties 165. The delay and phase shift information, and thereby some differentiating information, will be lost by using the amplitude of the transfer function. However, it is expected that this will result in a gain of robustness by reducing intra-class variation. The acoustical properties 165 can be used as a biometric feature vector in a method of authentication and identification.

Although the apparatus depicted in Fig. 1 comprises both the loudspeaker 120 and the microphone 155, it is possible to partition the apparatus into two modules that can be separated during use, for example, an apparatus comprising a first module in the form of a wireless headset comprising both the loudspeaker 120 and the microphone 144, and a second module comprising a handheld device wherein the two modules are arranged to communicate with each other by means of a wireless communication protocol such as Bluetooth using wireless communication means.

Fig. 2 depicts a set of transfer functions $|H(\omega)|$ 180,185,190, as established for three individuals characterized by using one piece of music. Fig. 2 is illustrative of the wealth of features present in the transfer functions. Each transfer function 180,185,190 shows characteristic peaks where a particular transfer function differs considerably from the other

transfer functions, thereby providing sufficient opportunity to differentiate between these three persons.

Fig. 3 depicts an apparatus 200 according to the second aspect of the present invention for characterizing a human outer ear 130.

The apparatus 200 comprises a storage means, such as a memory comprising two representations of an audio signal, one comprising speech 110 and another comprising music 105. One of these representations is selected as a source signal; the selected source signal 115. The apparatus further comprises a noise generator 220, which is arranged to generate noise that can be added to the selected source signal 115. The resulting signal is a noisy selected source signal 225 that is used by the apparatus 200 to generate a first acoustic signal 125. In order to generate the first acoustic signal, the apparatus 200 comprises a loudspeaker 120.

In one embodiment, the added noise is white noise that effectively increases the background noise of the selected source signal 115 in a uniform manner. In an alternative embodiment, the noise comprises colored noise with spectral components in the range of 100 Hz to 15 kHz, which are limited, or no spectral components in the selected source signal spectrum.

In parallel with the transmission of the first acoustic signal, the microphone 155 receives a second acoustic signal 150. The microphone output 170 is sent to the characterizing means 245. The characterizing means 245 uses the microphone output 170 to characterize a transfer function which, at least in part, is based on the acoustical properties of the outer ear 130. In this embodiment, the acoustical properties are based on the noisy version of the selected source signal 225 and the output of the microphone 155.

Although it is possible to add noise to the selected audio representation 115, it is also possible to perform this addition in the analog (electric), or even in the acoustic domain. Fig. 4 depicts an apparatus 300 in which the noise generator 220 is arranged as a source for a separate loudspeaker. Here, the first acoustic signal is effectively added in the acoustic domain by superposition of the signals 315 and 310.

An apparatus for characterizing acoustical properties of an outer ear such as depicted in Figs. 3 and 4 resembles an apparatus for enrolment of acoustical properties of an outer ear of a person. Both characterize acoustical properties. However, in the case of enrolment, it is important to do so in a reliable manner so as to facilitate a robust authentication or identification. Typically, an apparatus for enrolment of acoustical properties will perform a series of characterizations, using a series of first acoustic signals.

Subsequently, the results of the characterization process will be combined in order to obtain a more reliable characterization.

Fig. 5 is a plot depicting the amplitude of two transfer functions over frequency characterized according to the present invention. The first transfer function 580 is established while using music by means of an apparatus as shown in Fig. 1, whereas the second transfer function 590 was characterized while using music with added noise by means of an apparatus as shown in Fig. 3. This plot illustrates that by enhancing the first acoustic signal, by adding noise, the resulting transfer function will also be enhanced. This particular plot shows that the transfer function is emphasized for large parts of the spectrum, and in addition is "smoothed" over the entire audible spectrum.

The inventors have found that the application of a lossy audio compression algorithm is a particularly elegant method of adding noise to a music and/or speech signal. Lossy audio compression algorithms are typically based on a psycho-acoustic model of the human auditory system. As the name suggests, lossy compression involves discarding information comprised in the original audio signal. The discarded information can also be considered as a noise signal added to the original audio content. As a result, a lossy compressed audio file, such as a file encoded by means of well-known audio compression standards such as MPEG audio layer 2 or 3, AAC, ATRAC, or WMA, may comprise large quantities of additional noise, albeit encoded in an inaudible fashion. In fact, the higher the compression ratio used during encoding, the larger the amount of additional noise. Consequently, when a lossy compressed audio signal is used for characterization, the added noise may benefit the characterization process.

Although lossy compressed audio already provides additional noise, a further improvement is possible. Fig. 6 depicts an apparatus 500 for authenticating a person by using previously enrolled acoustical properties. The apparatus 500 comprises various components also found in Fig. 3. The apparatus 500 further comprises a noise generator control means 505 that analyzes the selected representation 115, and, based on a psycho-acoustic model of the human auditory system, determines the amount of noise that can be added, as well as the frequency band in which it has to be added to the selected representation 115 without causing audible distortions in the first acoustic signal 125.

Apparatus 500 uses the same psycho-acoustic model of the human auditory system as is used in lossy digital audio compression, but the goal is different. The goal of a system applying lossy digital audio compression is to efficiently use a constrained number of bits to encode the audio signal while minimizing the perceived distortion. As a result, the

lossy audio compression algorithm will focus on the reduction of the number of frequency components that need to be encoded.

In contrast, the present invention aims to add as much noise as possible to the first acoustic signal in order to optimize detection while minimizing the perceived distortion. A method according to the present invention does not have the bit-rate constraint found in a lossy audio compression algorithm. As a result, the present invention has more freedom to add noise to the selected source signal. For example, it is typically advantageous for a method according to the present invention to add frequency components to the selected source signal where there are none present. In contrast, such an addition would clash with the bit-rate constraint in a lossy audio compression algorithm. The present invention can exploit this additional freedom and optimize detection in an even more efficient fashion than a lossy audio compression algorithm can.

The apparatus 500 comprises a delay line 501 to allow temporal analysis of the selected representation 115 by the noise generator control means 505. The noise generator control means 505 sends a control signal to the noise generator 220 in order to control both amplitude and frequency characteristics of the noise generator output. In doing so, apparatus 500 can add noise in a hardly perceptible manner, exploiting both temporal and spectral masking. The noise generated by the noise generator 220 is added to the delayed selected representation.

The apparatus 500 uses the resultant noisy audio representation 510 to generate a first acoustic signal 125 sent to the outer ear 130 by means of a loudspeaker 120. In parallel, a second acoustic signal 150 is acquired by means of a microphone 155. The microphone output is sent to a characterizing means 525. The characterizing means 525 establishes a transfer function based on the noisy audio representation 510 and the output from the microphone 155. This transfer function can be used as, or in an alternative embodiment as a basis for, a feature vector 530. The resulting feature vector 530 is subsequently offered to the authentication means 540.

The authentication means 540 uses an alleged identity 545, for example, entered by the person being authenticated, using a keyboard, or read from a badge reader. The alleged identity 545 is used to retrieve enrolled acoustical properties from a database 535 of enrolled acoustical properties. The retrieved acoustical properties are subsequently matched with those of the resulting feature vector 530. Provided a sufficient match is found within a pre-determined range, the authentication is said to be successful. It should be noted

that an authentication decision may be either a hard decision or a soft decision. The use of soft decisions is particularly beneficial in multi-modal biometric authentication systems.

To further improve the performance of the authentication system, well-known techniques such as Fischer Linear Discriminant Analysis (LDA) can be applied to characterize the most differentiating frequency components. To improve performance in a system applying Fischer LDA, the system for authenticating or identifying a person can emphasize those spectral components in the first acoustic signal that result in the most differentiating frequency components. Subsequently, the noise control generator means 505 will have to be configured so as to add as much signal energy as possible to these particular frequency components in the first acoustic signal that result in the most differentiating frequency components.

The apparatus 500 depicted in Fig. 6 represents an apparatus for biometric authentication, whose general structure is not unlike that of an apparatus for biometric identification. However, there is one main difference between these devices. In an apparatus for identification, a biometric is characterized and matched with, potentially, all entries in the reference database. In contrast, an apparatus for authentication typically only matches the established feature vector with the reference data associated with the alleged identity.

Although the use of lossy audio compression in a characterization method may not result in optimal characterization, it does present a substantial improvement over a system that does not apply noise insertion. Fig. 7 depicts an alternative apparatus 595 for authenticating a person, using previously enrolled acoustical properties. In the apparatus 595, the delay line 501, the noise generator control means 505, the noise generator 220, and the adder found in apparatus 500 (Fig. 6) have been replaced by alternative means that perform a similar function.

In the apparatus 595, the selected source signal 115 is sent to a lossy audio compression encoder 591. This encoder comprises a processor executing a lossy audio compression algorithm, or parts of such an algorithm as described below. The lossy compressed audio signal 592, output by the lossy audio compression encoder 591, is sent to a lossy audio compression decoder 593. The decoder 593 comprises a processor for executing the accompanying audio decompression algorithm, or parts thereof. The combination of both the lossy encoding and subsequent decoding results in a noisy audio representation 510 with minimal audible distortion.

A typical lossy audio compression encoder comprises three stages:

1. A transformation stage

The input signal is transformed.

2. A quantization stage

Signal analysis and quantization are handled in this stage. As a result, this stage is the primary cause of the loss of information (added noise).

3. An encoding stage

Conventional entropy encoding techniques are used to generate a more concise representation of the quantized data.

The accompanying lossy audio compression decoder typically comprises stages that effectively mirror the encoder stages:

1. A decoding stage

The encoded data is decoded by using conventional entropy decoding techniques.

2. A reconstruction stage

An approximation of the transformed representation is reconstructed by means of the decoded data.

3. A transformation stage

The transformed representation is transformed back into a signal resembling the original input signal.

In the present embodiment, the encoder and the decoder are placed back-to-back. This allows further optimization of the encoder and decoder. One important optimization is the removal of the encoding and decoding stages. Further optimizations are possible, depending on the actual algorithm applied. The resultant audio processing module 594 will perform the same function but will do so in a more efficient manner.

Fig. 8 depicts a system 600 according to the present invention. The system comprises an apparatus 605 for enrolment of acoustical properties of a person's outer ear. The apparatus 605 is used to characterize the acoustical properties of an outer ear 601, using a first acoustic signal 602 comprising music and/or speech. The apparatus 605 receives a second acoustic signal 603 and uses this to characterize acoustical properties related to the outer ear 601 that are subsequently stored in a database 610.

The system further includes an apparatus 625 for identification of a person, using acoustical properties of an outer ear. When a person is present at the apparatus 625 that needs to be identified, the apparatus 625 supplies a first acoustic signal 622 comprising music and/or speech. The first acoustic signal 622 is transmitted towards the outer ear 621of the person being identified. The apparatus 625 receives a second signal 623 and uses this to

characterize acoustical properties of the outer ear 621. The characterized acoustical properties are subsequently matched with enrolled acoustical properties from the database 610. When the difference is within a predetermined threshold, a match is found and the identity is established as being the identity associated with the database entry.

To match acoustical properties, data is sent from the database 610 to the apparatus 625 via a network 615. This network may be a GSM network, a UMTS network, a wireless LAN, a proprietary network, or even the Internet. To prevent excessive data transfers, the database may be distributed, or alternatively, the matching process may be centralized at one or multiple sites in the network.

Although the apparatus 605 and the apparatus 625 may be dedicated devices, the present invention can also be incorporated in existing or future consumer electronics devices such as mobile phones, DECT phones, regular phones, or other devices such as portable audio and/or video players that comprise earphones, or headphones.

Fig. 9 depicts a telecommunication system 700 configured to provide telecommunication services via a network and allow remote authentication of a person, using acoustical properties of an outer ear. The depicted system comprises at least two terminals; the first terminal 701 is the terminal that performs the actual authentication, the second terminal 702 in turn establishes the acoustical properties of the person 705 who is being authenticated. Although the depicted first terminal 701 is structurally similar to the second terminal 702, this is not necessary. In an alternative embodiment, the first terminal 701 may be e.g. a computer system operated by a service provider arranged to automatically answer orders placed by telephone.

The actual authentication process is distributed through both terminals. The first terminal 701 provides a representation 720 of an audio signal comprising music and/or speech. This representation 720 can be pre-recorded or created on-the-fly by the first terminal 701, e.g. by sampling the voice of the operator 703 of the first terminal 701. The representation 720 is subsequently transmitted to the second terminal 702 via a network 725. In the second terminal, noise is added to the incoming signal according to the present invention. This noisy representation is converted into a first acoustic signal 730 by the second terminal 702, using a loudspeaker 120.

The second terminal 702 further receives a second acoustic signal 735. The second acoustic signal 735 comprises reflected parts of the first acoustic signal 730. These parts are reflected by an outer ear 706 of the person 705 operating the second terminal 702. The signal registered by the microphone 155 is used together with the noisy representation in

the characterizing means 770 to derive characterized acoustical properties 750. The characterized acoustical properties 750 are transmitted to the first terminal 701 via the network 725.

The first terminal 701 comprises an authentication means 755. The authentication means 755 obtains an alleged identity 545. The alleged identity 545 may be e.g. communicated by the person being authenticated to the first terminal, or may be obtained by using a card reader. Using the alleged identity 545, the authentication means obtains enrolled acoustical properties associated with the alleged identity 545 from the database 760. Subsequently, the authentication means 755 matches the characterized acoustical properties 750 with these enrolled acoustical properties. The person operating the second terminal 702 is authenticated when a sufficient match is found with the enrolled acoustical properties associated with the alleged identity 545, otherwise authentication fails.

The network used in system 725 may be a GPS network, a UMTS network, a 802.11 wireless LAN, a proprietary network, or a TCP/IP network. The system 700 can be used to remotely authenticate persons, e.g. to grant them access to services on a network, to content available through the network, or it may be used to authorize transactions, e.g. in order to allow electronic banking.

Although the system 700 depicted in Fig. 9 is partitioned in an efficient manner, it is possible to distribute functionality from the second terminal 702 to the first terminal 701. This is relevant when there is limited control of the integrity of the second terminal 702. In this scenario, it is interesting to move the characterizing means from the second terminal 702 to the first terminal 701. However, although certain networks such as a TCP/IP network allow transparent data transmission, other networks such as GSM networks may not be transparent for audio signals. As a result, re-distribution of functionality may not always be feasible.

Apart from the above-mentioned embodiments, the present invention can also be applied in consumer electronics devices such as audio and/or video playback devices utilizing headphones, or earphones. Here, the present invention can be used to identify a user and customize e.g. equalizer settings, or program offers based on the user identity.

Alternatively, a mobile phone, or an alternative device comprising earphones or headphones may be assigned exclusively to one or more particular users. In doing so, the present invention would allow an efficient theft-deterrent/abuse-prevention system for said consumer electronics device.

The present invention can allow the authentication of users with or without knowledge of said users, e.g. for allowing automatic priority scheduling in a telephone queue.

It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims.

In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. Use of the verb "comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. Use of the article "a" or "an" preceding an element or step does not exclude the presence of a plurality of such elements or steps.

The invention can be implemented by means of hardware comprising several distinct elements, and by means of a suitably programmed computer. In the device claim enumerating several means, several of these means can be embodied by one and the same item of hardware. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

CLAIMS:

1. A method of characterizing acoustical properties of an outer ear (130), the method comprising the steps of:

- transmitting a first acoustic signal (125) towards the outer ear (130),
- receiving a second acoustic signal (150) from the outer ear (130), and
- characterizing acoustical properties (165) of the outer ear on the basis of the second acoustic signal (150),

characterized in that the first acoustic signal (125) comprises at least one of the following elements:

- music, and
- speech.

2. The method of claim 1, characterized in that the method further comprises a step of transmitting an acoustic noise signal (315) towards the outer ear (130).

3. The method of claim 1, characterized in that the first acoustic signal (125) is based on a representation of an audio signal, the representation comprising one of the following:

- an electromagnetic representation of an audio signal,
- an optical representation of an audio signal,
- an electrical representation of an audio signal, and
- a digital representation of an audio signal.

4. The method of claim 3, characterized in that the digital representation is a lossy compressed audio signal (592).

5. The method of claim 3, characterized in that the method further comprises a step of processing the representation of the audio signal before converting the representation into an acoustic signal.

6. The method of claim 5, characterized in that the processing step comprises the addition of noise to the representation of the audio signal.

7. The method of claim 5, characterized in that the processing step comprises the addition of noise to the representation of the audio signal, the noise formed using a psycho-acoustic model of the human auditory system in order to reduce perceptual disturbance as a result of the added noise.

8. The method of claim 1, characterized in that the step of characterizing (160) the acoustical properties of the outer ear (130) involves a frequency domain analysis of the second acoustic signal (150).

9. The method of claim 8, characterized in that the step of characterizing (160) the acoustical properties of the outer ear (130) involves characterizing a transfer function of the acoustical properties of the outer ear (130).

10. A method of enrolling the acoustical properties of an outer ear (130) of a person, characterized in that it incorporates the method of claim 1 for characterizing the acoustical properties of the outer ear of the person being enrolled.

11. A method of authenticating a person using previously enrolled acoustical properties (535) of an outer ear (130), characterized in that it incorporates the method of claim 1 for characterizing (525) the acoustical properties (530) of the outer ear (130) of the person being authenticated.

12. A method of identifying a person using previously enrolled acoustical properties (610) of an outer ear (601), characterized in that it incorporates the method of claim 1 for characterizing the acoustical properties of the outer ear (621) of the person being identified.

13. An apparatus (100,200,300,500) for characterizing acoustical properties of an outer ear (130), the apparatus comprising:

- transmitting means (120) arranged to transmit a first acoustic signal (125) towards the outer ear (130),

- receiving means (155) arranged to receive a second acoustic signal (150) from the outer ear (130), and
- characterizing means (160) arranged to characterize the acoustical properties (165) of the outer ear (130) on the basis of the second acoustic signal (150),

characterized in that the first acoustic signal (125) comprises at least one of the following elements:

- music, and
- speech.

14. The apparatus (100,200,300,500) for enrolment of acoustical properties of an outer ear (130) of a person, characterized in that it incorporates the apparatus of claim 13 for characterizing the acoustical properties (165) of the outer ear (130) of the person being enrolled.

15. An apparatus for authenticating and/or identifying a person, using previously enrolled acoustical properties (535) of an outer ear, characterized in that it incorporates the apparatus (100,200,300,500) of claim 13 for characterizing the acoustical properties (165,250,330,530) of the outer ear (130) of the person being authenticated.

16. The apparatus of claim 13, characterized in that it comprises two modules that can be separated, wherein a first module comprises:

- the transmitting means (120),
- the receiving means (155), and
- a first communication means arranged to communicate with a second module,

and wherein the first module can be separated from the second module, the second module comprising:

- the characterizing means (160), and
- the second communication means arranged to communicate with the first module.

17. A telecommunication system (700) configured to provide telecommunication services via a network (725), the network (725) comprising:

- a first terminal (701), associated with a party, comprising an authentication means (755),

- a second terminal (702) operated by a person (705), and
- both terminals connected by a network (725),

wherein the first terminal (701) and the second terminal (702) are arranged to execute the steps of the method of claim 1 for characterizing the acoustical properties of the outer ear of the person, and wherein the authentication means (755) in the first terminal is arranged to remotely authenticate the person (705), using the characterized acoustical properties (750), an alleged identity (545), and a database (760) comprising enrolled acoustical properties.

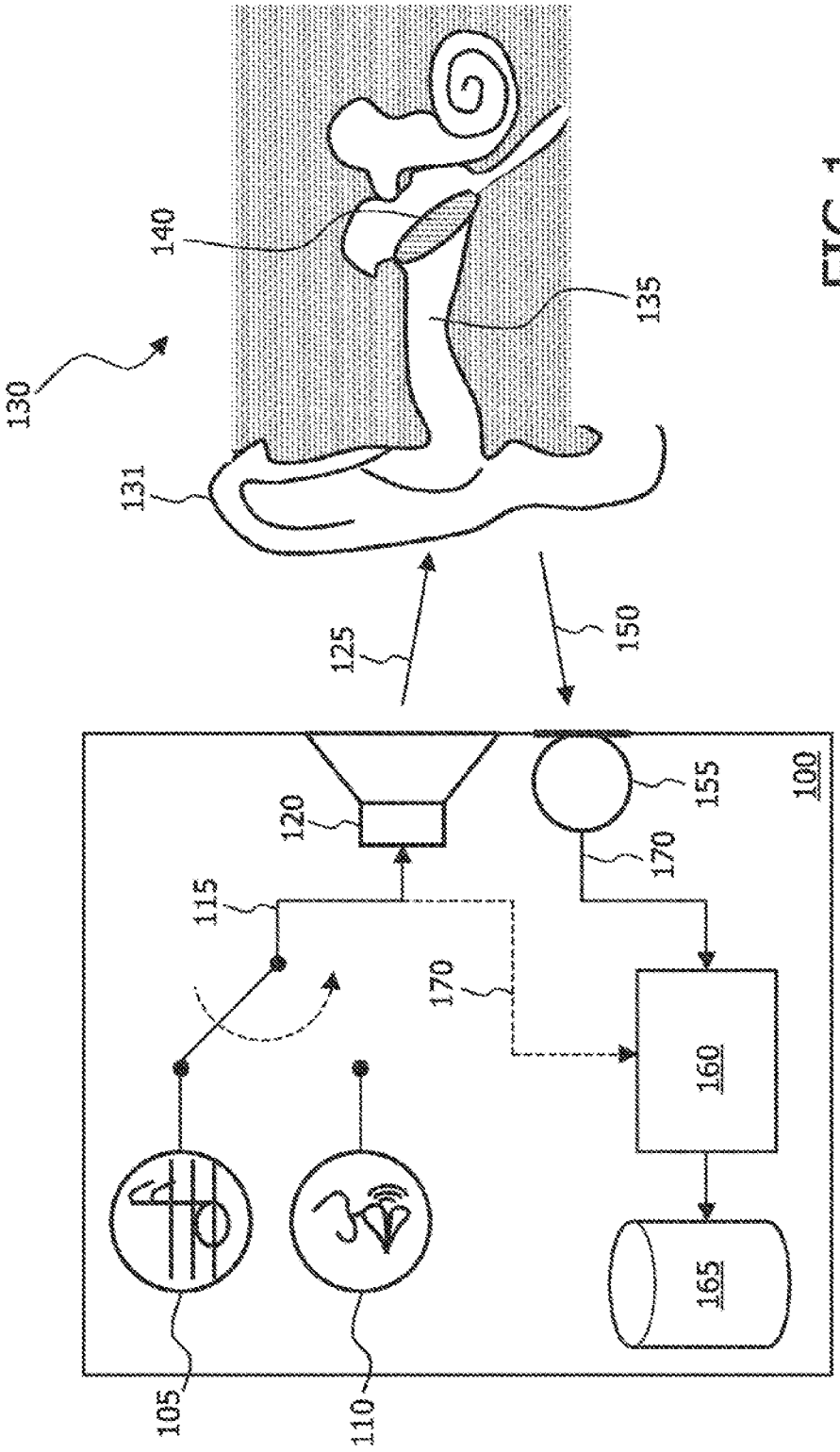


FIG.1

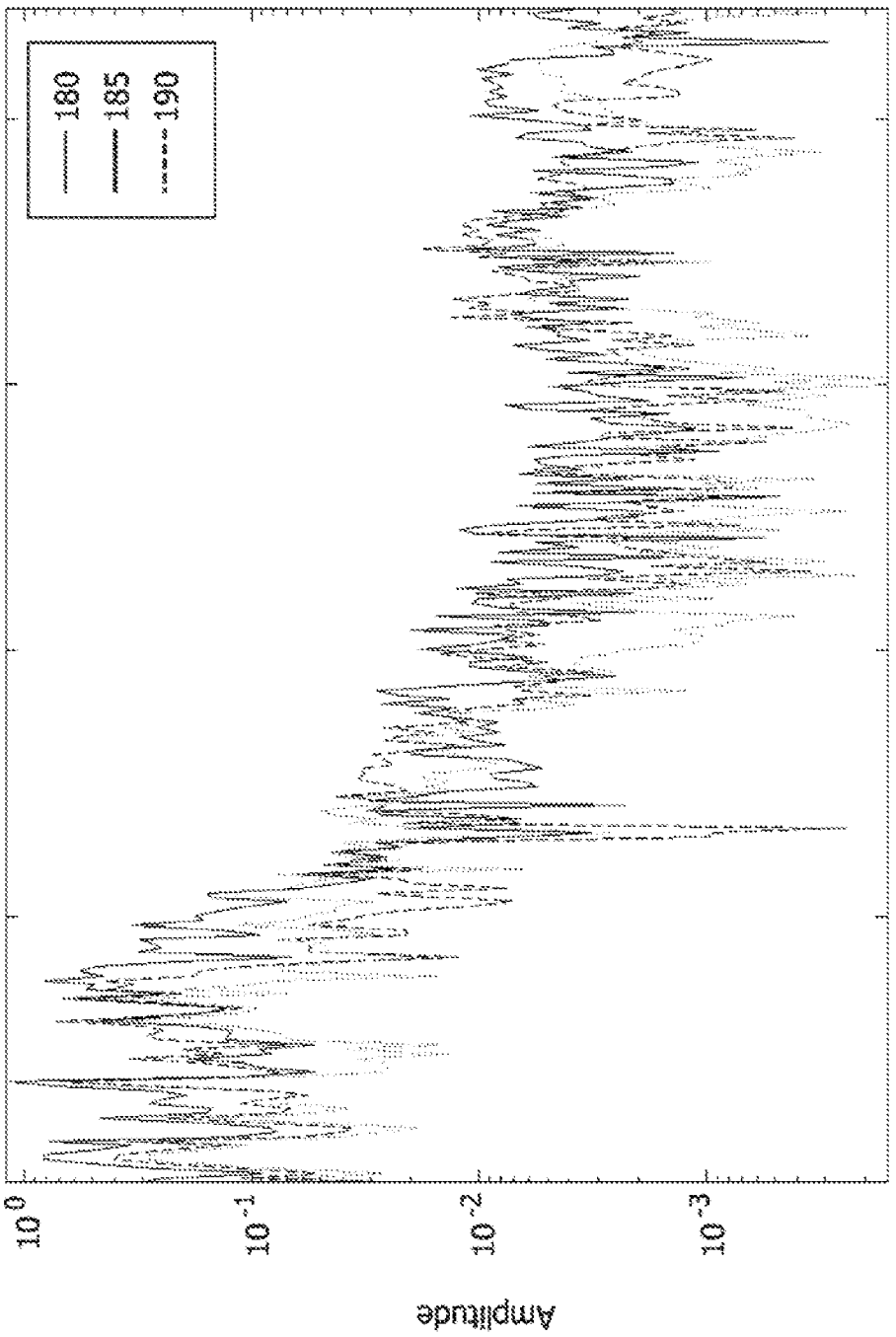

180
185
190
Amplitude
10^{0}
10^{-1}
10^{-2}
10^{-3}
00.511.52
x10 4
Frequency(Hz)

FIG.2

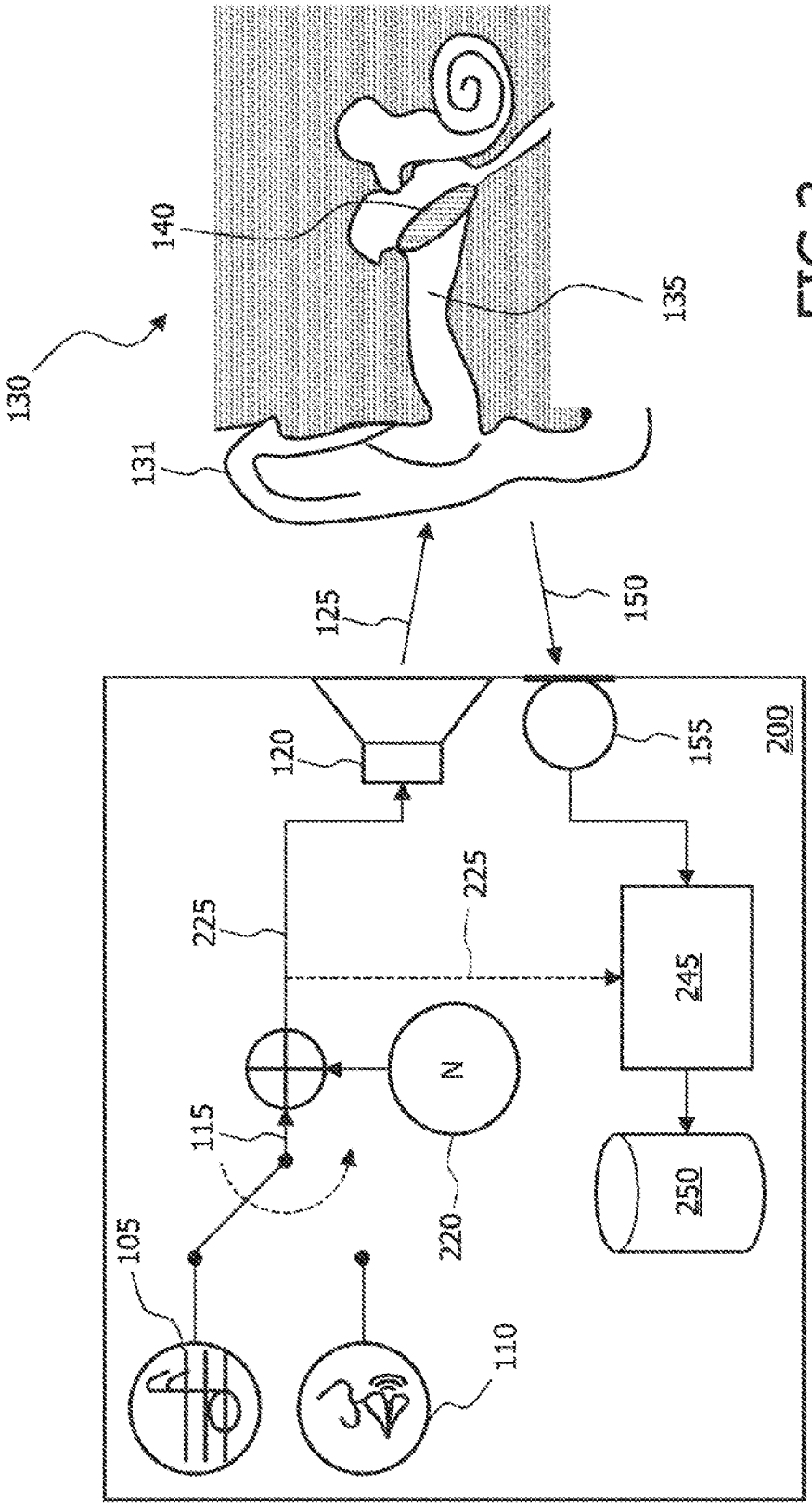

130
131
140
135
125
150
120
155
200
225
225
245
N
115
105
220
250
110

FIG.3

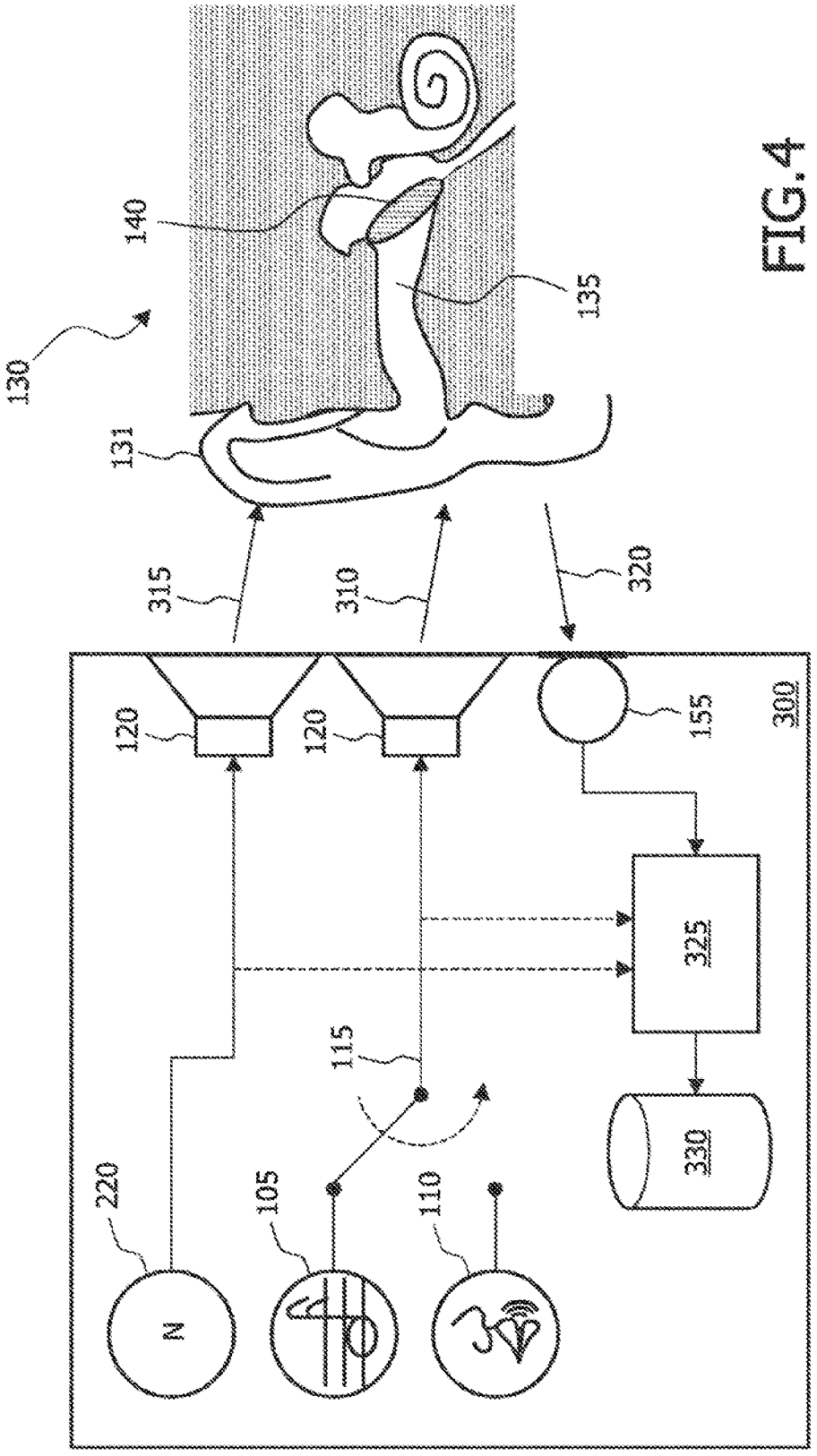

130
131
140
135
315
310
320
120
120
155
300
325
330
115
220
105
110
N

FIG.4

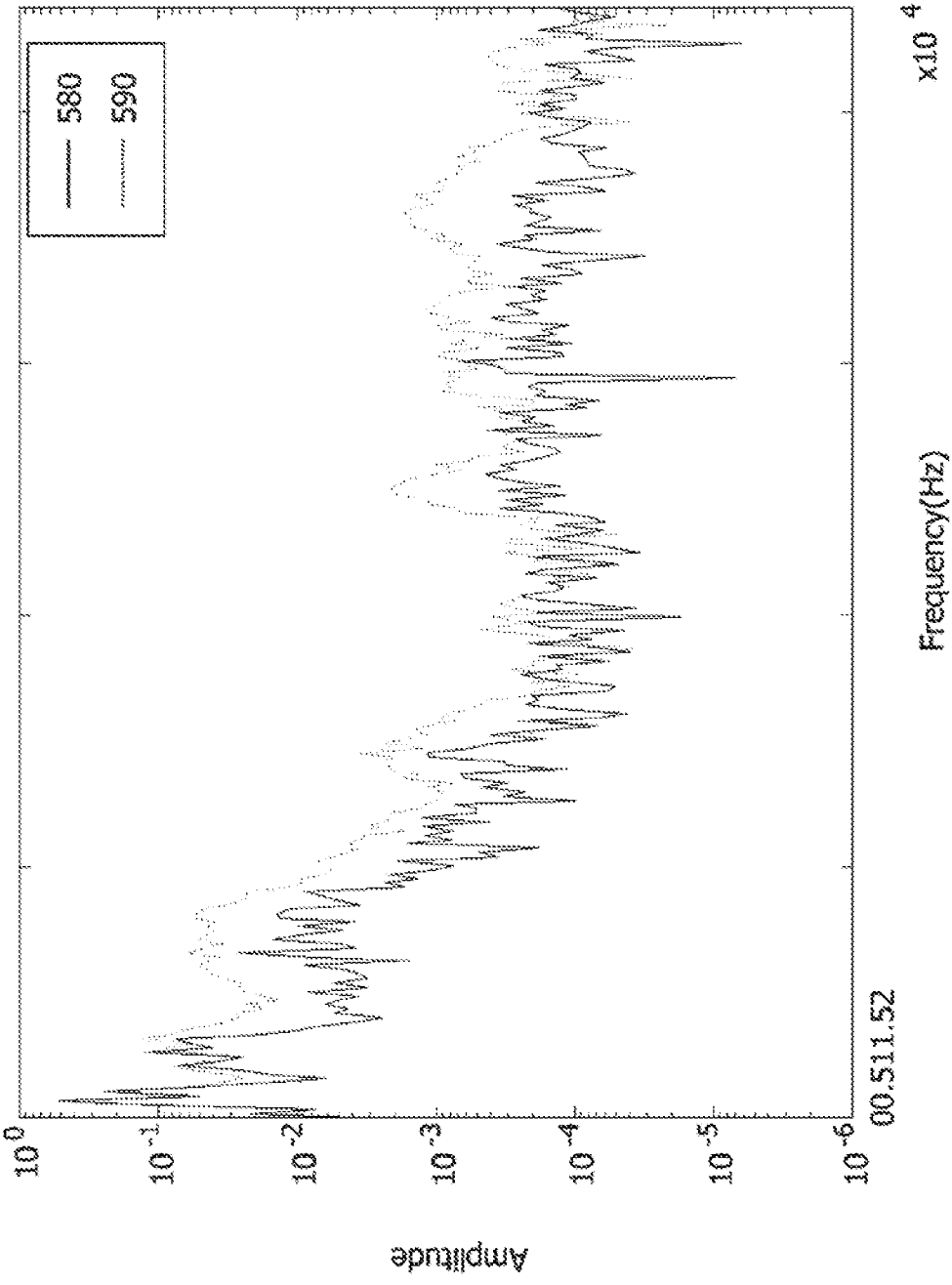

580
590
Amplitude
Frequency(Hz)
x10^4
00.511.52
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6

FIG.5

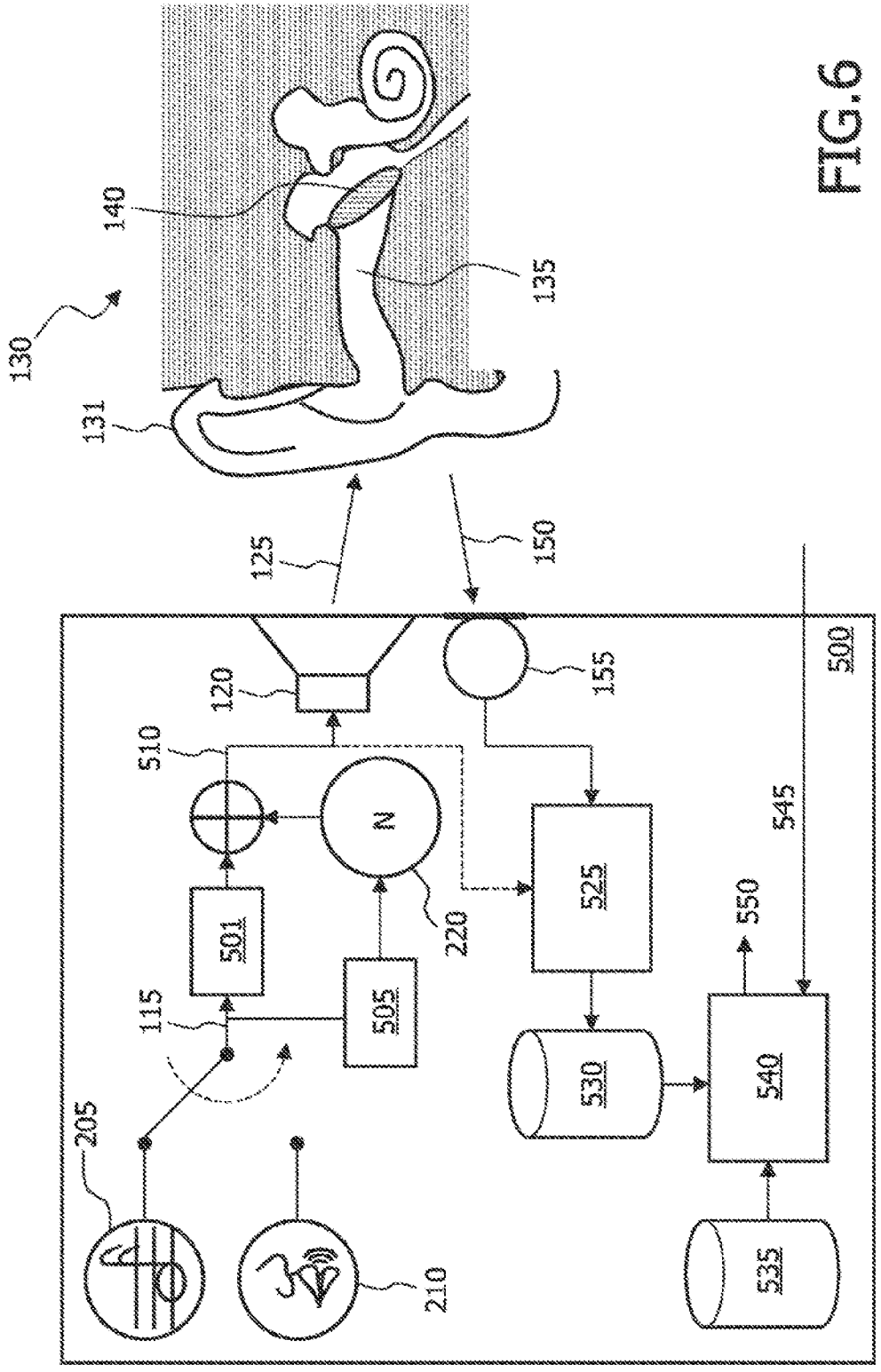

130
131
140
135
125
150
120
155
500
510
N
545
525
501
220
550
505
115
530
540
205
210
535

FIG.6

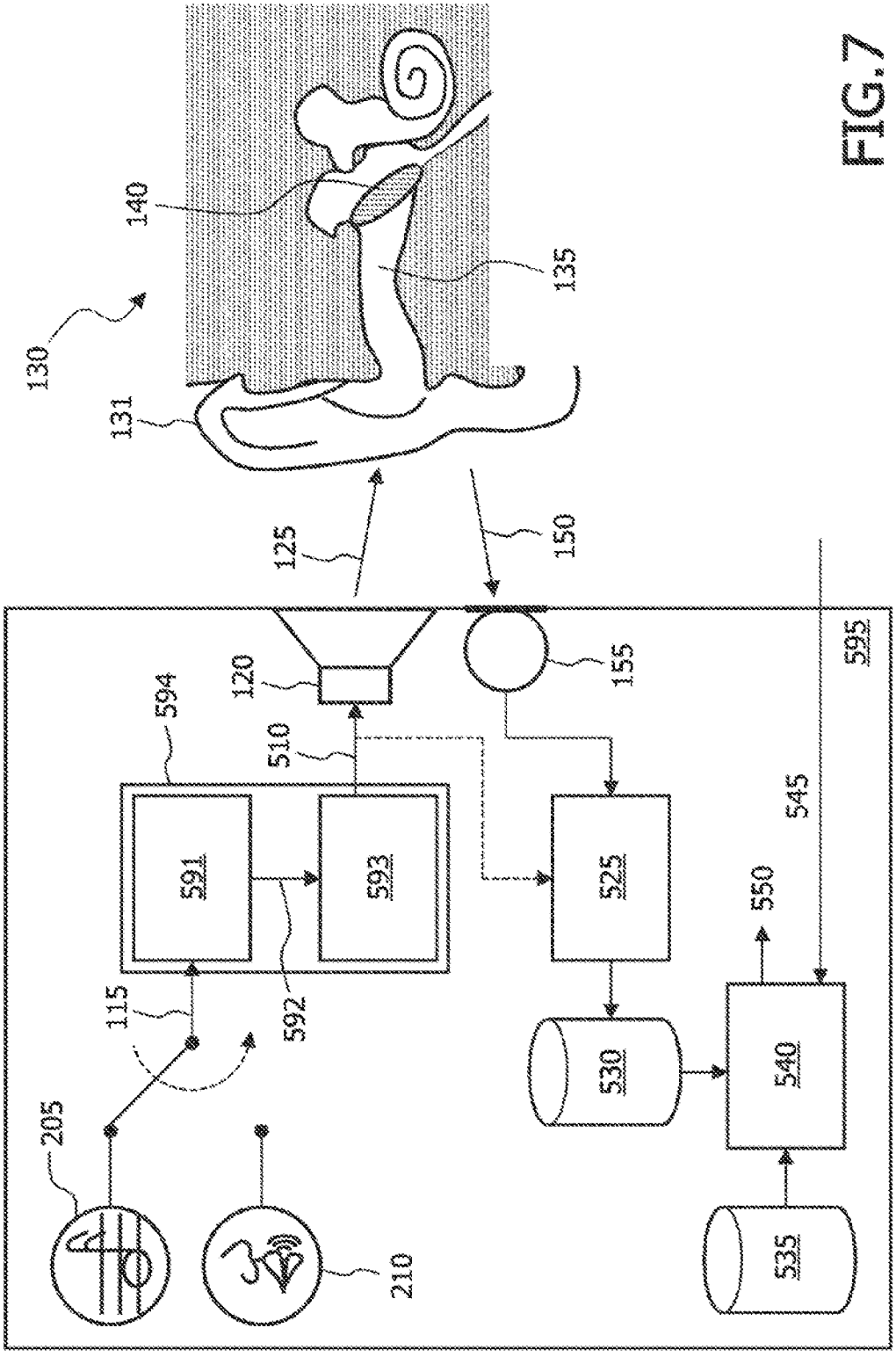

140
135
130
131
125
150
595
120
155
594
510
591
593
525
545
550
115
592
530
540
205
210
535

FIG.7

FIG.8

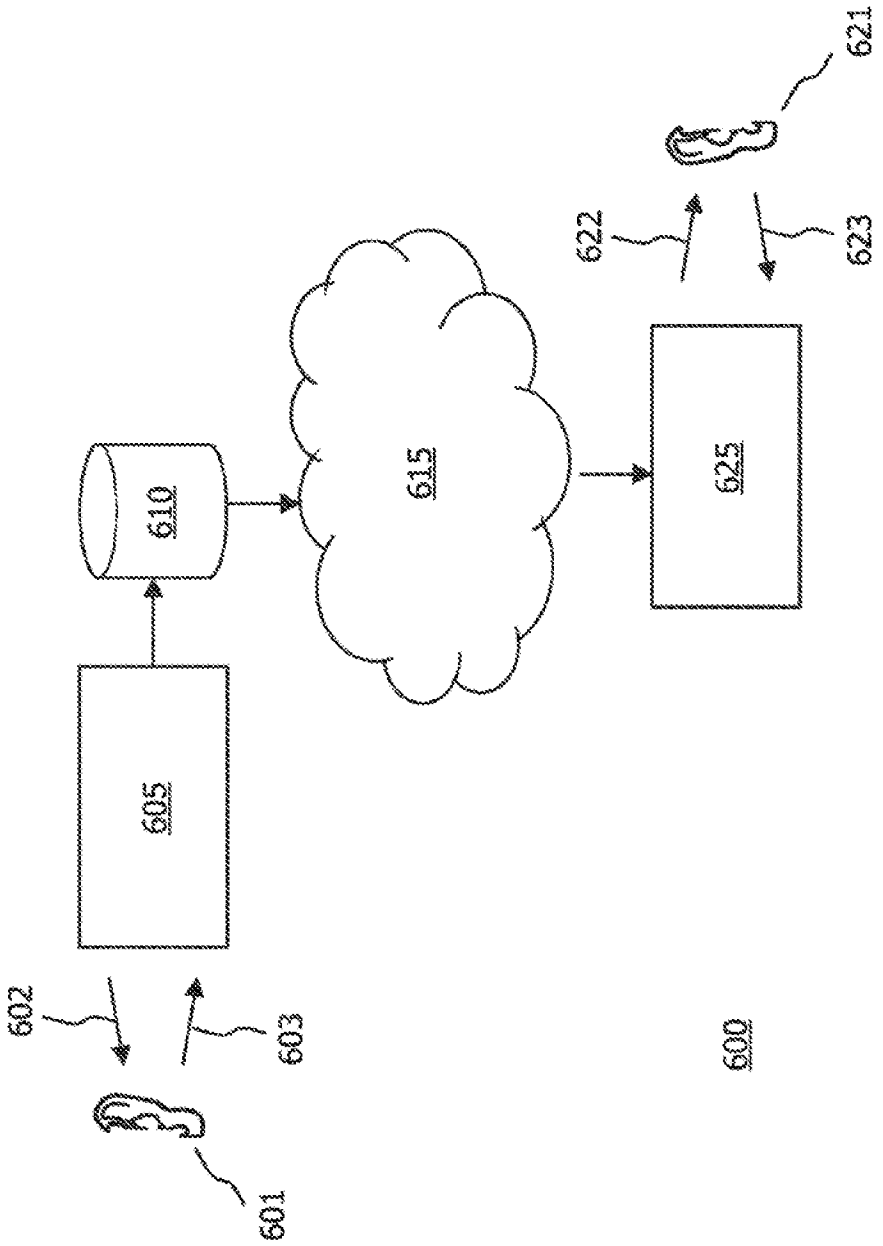
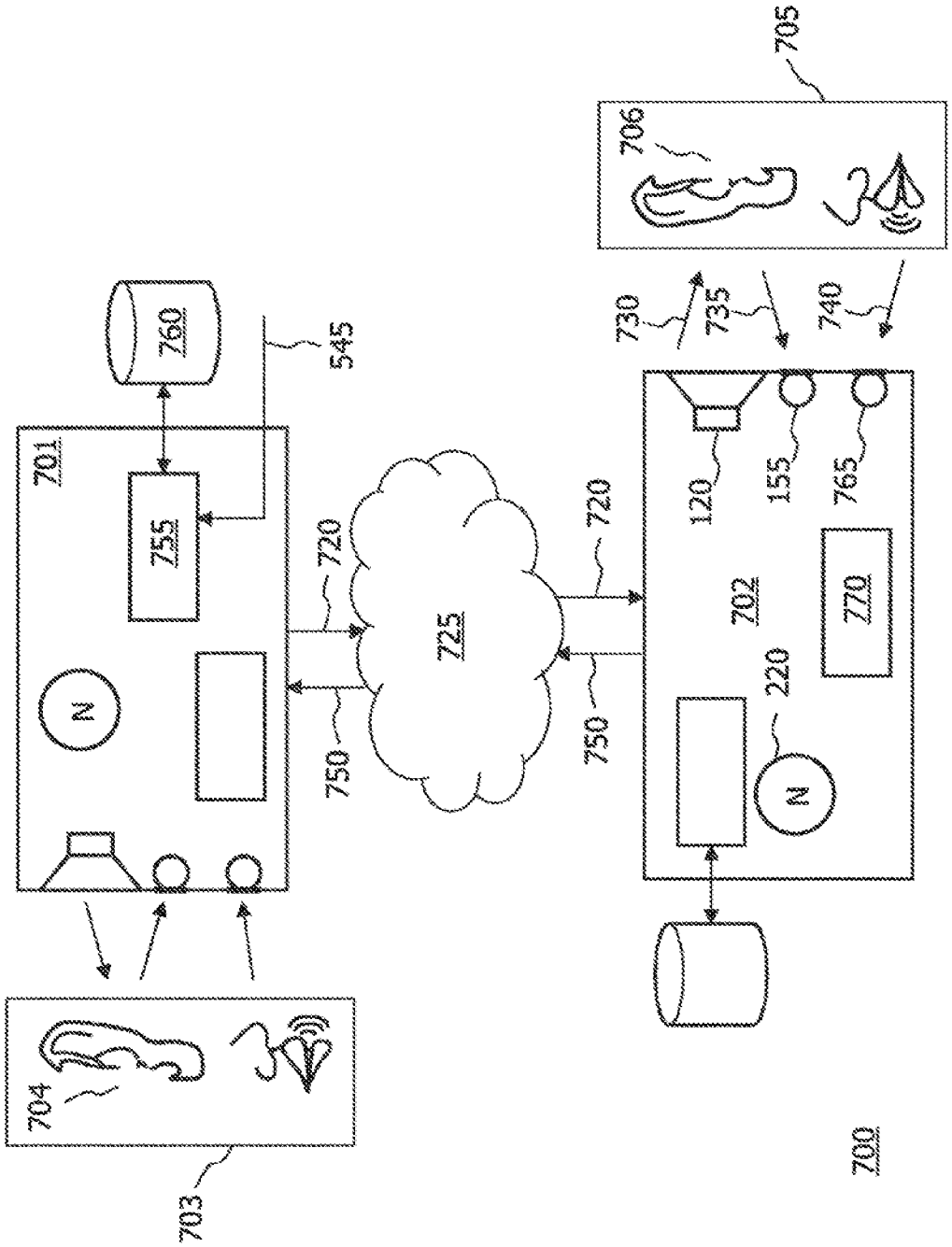


FIG.9


705
706
730
735
740
760
545
701
755
720
725
720
120
155
765
702
770
220
750
750
704
703
700

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(74) Agents: **GROENENDAAL, Antonius, W., M.** et al.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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

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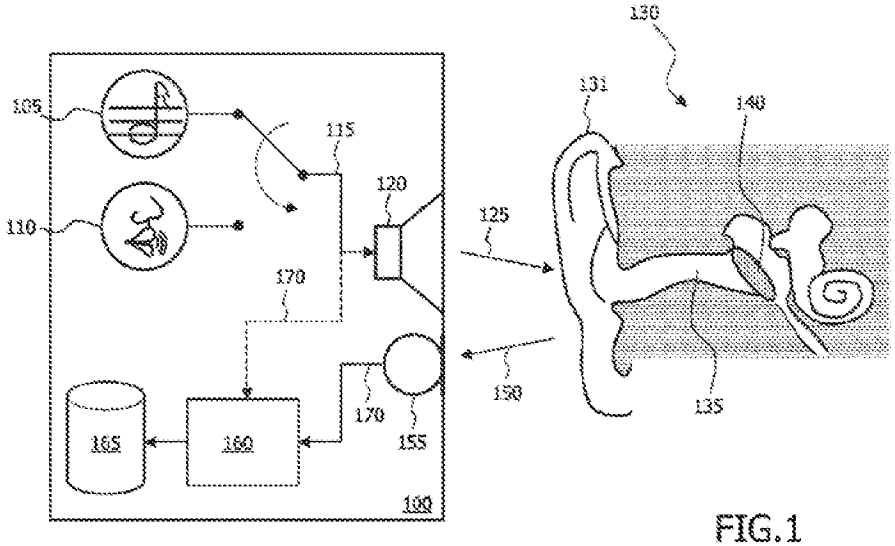


FIG.1

(57) Abstract: The present invention relates to a method and apparatus for characterizing acoustical properties of an outer ear 130, the method comprising the steps of: transmitting a first acoustic signal 125 towards the outer ear 130, receiving a second acoustic signal 150 from the outer ear 130, and characterizing acoustical properties 165 of the outer ear on the basis of the second acoustic signal 150. The method is characterized in that the first acoustic signal 125 comprises at least one of the following elements: music, and speech. The present invention further relates to a method and apparatus for enrolling, authenticating and identifying a person on the basis of acoustical properties of an outer ear 130.

WO 2007/034371 A3

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2006/053252

A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B G07C G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	GB 2 375 205 A (ORANGE PERSONAL COMM SERV LTD [GB]) 6 November 2002 (2002-11-06) page 12, line 4 - page 14, line 8; claims	1,10-13
A	US 5 787 187 A (BOUCHARD ANN MARIE [US] ET AL) 28 July 1998 (1998-07-28) cited in the application column 5, line 61 - column 6, line 35	1-17

-/--

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search	Date of mailing of the international search report
18 September 2008	06/10/2008

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Manschot, Jan

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2006/053252

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	TONH M AKKERMANS ET AL: "Acoustic Ear Recognition" ADVANCES IN BIOMETRICS LECTURE NOTES IN COMPUTER SCIENCE;;LNCS, SPRINGER, BERLIN, DE, vol. 3832, 9 December 2005 (2005-12-09), pages 697-705, XP019026949 ISBN: 978-3-540-31111-9 the whole document	1-17

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2006/053252

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
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			US	2004215968 A1	28-10-2004
US 5787187	A	28-07-1998	NONE		

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(71) Applicant *(for all designated States except US)*: **PERSONICS HOLDINGS INC.** [US/US]; 5100 Town Center Circle Tower II, Suite 510, Boca Raton, Florida 33486 (US).

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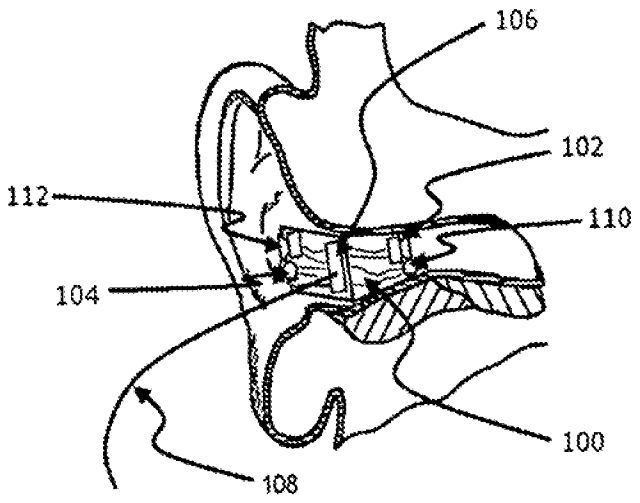
(74) Agents: **KURTZ, Richard, E.** et al.; Greenberg Traurig, LLP, 1750 Tysons Blvd., Suite 1200, Mclean, Virginia 22102 (US).

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Published:
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- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(54) Title: METHOD AND DEVICE FOR SOUND DETECTION AND AUDIO CONTROL



(57) Abstract: At least one exemplary embodiment is directed to a listening device (100) can include a receiver (102) and means for directing a sound produced by the receiver into an ear of the user, a microphone (104) and means for mounting the microphone so as to receive the sound in an environment , detecting means for detecting an auditory signal in the sound received by the microphone, and alerting means for alerting the user to the presence of the auditory signal, whereby the user's personal safety is enhanced due to the user being alerted to the presence of the auditory signal, which otherwise may be unnoticed by the user due to loud sound level created at the ear of the user by the receiver.

WO 2008/103925 A1

METHOD AND DEVICE FOR SOUND DETECTION AND AUDIO CONTROL

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This Application is a Non-Provisional and claims the priority benefit of Provisional Application No. 60/891,220 filed on February 22, 2007, the entire disclosure of which is incorporated herein by reference.

FIELD

[0002] The present invention generally relates to a device that monitors sounds directed to an ear, and more particularly, though not exclusively, to an earpiece and method of operating an earpiece for warning sound detection and audio control.

BACKGROUND

[0003] The human auditory system has been increasingly stressed to tolerate high noise levels it had hitherto been unexposed. Recently, human knowledge of the causes of hearing damage have been researched intensively, and models for predicting hearing loss developed and verified with empirical data from decades of scientific research. And yet it can be strongly argued that the danger of permanent hearing damage is more present in our daily lives than ever, and that sound levels from personal audio systems in particular (e.g., from portable audio devices), live sound events, and the urban environment are a ubiquitous threat to healthy auditory functioning across the global population. Music reproduction levels and urban noise are antagonistic; we play our personal audio devices louder to hear over the traffic noise. And use of personal audio devices is rapidly increasing, especially in the younger generation who are suffering permanent hearing damage at increasingly younger ages.

[0004] Noise is a constant in industrialized societies, given the ubiquity of external sound intrusions, such as people talking on their cell phones, blaring music in health

clubs, or the constant hum of HVAC systems in schools and office buildings. To combat the undesired cacophony, consumers are arming themselves with portable audio playback devices to drown out intrusive noise. The majority of devices providing the consumer with audio content do so using insert (or in-ear) earbuds, which deliver sound directly to the ear canal, generating levels sufficient to perceptually mask background noise even though the earbuds provide little to no ambient sound isolation. With earbuds, personal audio reproduction levels can reach in excess of 100 dB; enough to exceed recommended daily sound exposure levels in less than a minute and to cause permanent acoustic trauma. Furthermore, rising population densities have continually increased sound levels in society. According to research, 40% of the European community is continuously exposed to transportation noise of 55 dBA and 20% are exposed to greater than 65 dBA. This level of 65 dBA is considered by the World Health Organization to be intrusive or annoying, and as mentioned, can lead to users of personal audio devices increasing reproduction level to compensate for ambient noise.

[0005] Noise exposure can generate auditory fatigue, possibly comprising a person's listening abilities. On a daily basis, people are exposed to various environmental sounds and noises within their environment, such as the sounds from traffic, construction, and industry. Some of the sounds in the environment may correspond to warnings, such as those associated with an alarm or siren. A person that can hear the warning sounds can generally react in time to avoid danger. In contrast, a person that cannot adequately hear the warning sounds, or whose hearing faculties have been compromised due to auditory fatigue, may be susceptible to danger.

[0006] Environmental noise can mask warning sounds and impair a person's judgment. Moreover, when people wear headphones to listen to music, or engage in a call using a telephone, they can effectively impair their auditory judgment and their ability to discriminate between sounds. With such devices, the person is immersed in the audio experience and generally less likely to hear warning sounds within their environment. In some cases, the user may even turn up the volume to hear their personal audio over environmental noises. This can put the user in a compromising situation since they may not be aware of warning sounds in their environment. It also

puts them at high sound exposure risk which can potentially cause long term hearing damage.

[0007] A need therefore exists for enhancing the user's ability to hear warning sounds in the environment and control audio without compromising hearing.

SUMMARY

[0008] At least one exemplary embodiments in accordance with the present invention provide a method and device for warning sound detection and audio control.

[0009] At least one exemplary embodiment is directed to a listening device (e.g., personal listening device) which can include a) a receiver and means for directing a sound produced by the receiver (e.g., into an ear of a user), b) a microphone and means for mounting the microphone so as to receive the sound in an environment (e.g., an environment surrounding a user), c) detecting means for detecting an auditory signal (e.g., a danger signal) in the sound received by the microphone, and d) alerting means for alerting the user to the presence of the auditory signal detected by the detecting meansauditory signal.

[0010] The alerting means can comprise a controllable electronic valve arranged to shut off the receiver upon detection of the auditory signal by the detecting means, whereby enabling the user to hear the auditory signal. The detecting means can comprise a) first means for detecting whether the volume of the sound received by the microphone is more than a predetermined level, b) second means for detecting whether the spectral pattern of the sound received by the microphone is characteristic of the auditory signal, c) third means for detecting whether the temporal pattern of the sound received by the microphone is characteristic of the auditory signal, d) fourth means for detecting whether sound received by the microphone is approaching to or receding from the user, and e) fifth means for combining the outputs of the first, second, third, and fourth means. The predetermined level can be set to various levels, for example at least to approximately 65 dB.

[0011] The second means can comprise a) means for detecting whether the signal-to-noise ratio is more than approximately 13 dB in at least one one-third-octave-wide frequency band, b) means for detecting whether the signal-to-noise ratio is more than a chosen threshold value (e.g., approximately 10 dB) in at least one one-octave-wide frequency band, and c) means for detecting whether the signal-to-noise ratio is more than a chosen threshold (e.g., approximately 15 dB), all enjoined by the logical OR operator. The third means can comprise a periodicity detector and pitch detector arranged to activate upon detection of a sound with chosen period ranges (e.g., approximately between 0.5 and 4 Hz) and chosen pitch (e.g., approximately between 500 and 1000 Hz), respectively. The fourth means can be arranged to operate by analyzing sound level over time and by analyzing Doppler shifts in the sound spectrum.

[0012] In at least a second exemplary embodiment, a listening device can include a) a receiver and means for directing a sound produced by the receiver into an ear of the user, b) a microphone and means for mounting the microphone so as to receive the sound in an environment (e.g., surrounding a user), c) recognition means for recognizing predetermined environmental sounds, and d) action means for performing predetermined actions upon recognition of the environmental sounds.

[0013] The recognition means can comprise a) first means for computing a sound signature of an environmental sound consisting of a vector of numerical values identifying said environmental sound, b) second means for storing a plurality of said sound signatures, and c) third means for comparing the sound signature of said environmental sound with said plurality of sound signatures stored by said second means and for determining a best-matching sound signature. The environmental sounds can be recognized reliably and predetermined actions can be taken upon such recognition. The vector of numerical values can comprise at least one among total power of the environmental sound, powers of the environmental sound in predetermined frequency bands, mel-frequency cepstral coefficients of the environmental sound, a pitch of the environmental sound, a bandwidth of the environmental sound, and a brightness of the environmental sound.

[0014] The third means can be arranged to operate using distance between the sound signatures, using support vector machine (SVM) classifier, using neural

network classifier, or using mixture of Gaussians classifier. Fourth means can direct the sound signature produced by first means into the sound signature storage provided by second means, whereby the personal listening device is accorded an ability to learn, recognize, and act upon recognition of new sound signatures for sounds of interest to the particular user of the device.

[0015] Localization means can determine at least one among a location, direction and distance of the environmental sound with respect to the user. The localization means can be arranged to operate using one or more acoustic cues selected from the group comprising a) level (intensity) differences between the signals received at left and right ears, b) phase differences between the signals received at left and right ears, c) level (intensity) variation over time for the signals received at left and right ears, and d) phase variation over time for the signals received at left and right ears.

[0016] The action means can comprise one or more means selected from the group comprising a) first means of selectively amplifying the environmental sound recognized by the recognition means, b) second means of selectively attenuating the environmental sound recognized by the recognition means, c) third means of alerting the user to the environmental sound recognized by the recognition means by reciting a textual label pre-associated with the environmental sound to the user by means of text-to-speech synthesizer, d) fourth means of alerting the user to the environmental sound recognized by the recognition means by rendering a specific sound pre-associated with the environmental sound to the user, e) fifth means of alerting the user to the environmental sound recognized by the recognition means by reciting information indicative of how far and in which direction the environmental sound is located, f) sixth means of alerting the user to the environmental sound recognized by the recognition means by discontinuing the playback of any audio content being played over the personal listening device, and g) seventh means of associating an indicator of which particular action or actions, from the list above, should be executed upon detection of the environmental sound.

[0017] In a third exemplary embodiment, a method for constructing a audio listening device can include a) providing a receiver and means for directing a sound produced by the receiver, b) providing a microphone and means for mounting the microphone so as to receive the sound in an environment surrounding the user, c) providing

detecting means for detecting an auditory signal in the sound received by the microphone, and d) providing alerting means for alerting the user to the presence of the auditory signal detected by the detecting means. The user's personal safety can be enhanced due to the user being alerted to a presence of the auditory signal, which otherwise may be unnoticed by the user due to a loud sound level created at the ear of the user by the receiver.

[0018] The alerting means can be a controllable electronic valve arranged to shut off the receiver upon detection of the auditory signal by the detecting means, whereby enabling the user to hear the auditory signal. The detecting means can include a) first means for detecting whether the volume of the sound received by the microphone is more than a predetermined level, b) second means for detecting whether the spectral pattern of the sound received by the microphone is characteristic of the auditory signal, c) third means for detecting whether the temporal pattern of the sound received by the microphone is characteristic of the auditory signal, d) fourth means for detecting whether sound received by the microphone is approaching to or receding from the user, and e) fifth means for combining the outputs of the first, second, third, and fourth means.

[0019] In a fourth exemplary embodiment, a method for constructing a audio listening device can include the steps of a) providing a receiver and means for directing a sound produced by the receiver into an ear of the user, b) providing a microphone and means for mounting the microphone so as to receive the sound in an environment surrounding the user, c) providing recognition means for recognizing predetermined environmental sounds, and d) providing action means for performing predetermined actions upon recognition of the environmental sounds.

[0020] The recognition means can include a) first means for computing a sound signature of the environmental sound consisting of a vector of numerical values identifying the environmental sound, b) second means for storing a plurality of the sound signatures, and c) third means for comparing the sound signature of the environmental sound with the plurality of sound signatures stored by the second means and for determining the best-matching sound signature. In at least one exemplary embodiment when environmental sounds are recognized, predetermined actions can be taken upon such recognition.

[0021] The vector of numerical values can include total power of the environmental sound, powers of the environmental sound in predetermined frequency bands, mel-frequency cepstral coefficients of the environmental sound, a pitch of the environmental sound, a bandwidth of the environmental sound, and a brightness of the environmental sound. The third means can be arranged to operate using distance between the sound signatures, for example, using support vector machine (SVM) classifier, using neural network classifier, or using mixture of Gaussians classifier. Fourth means can direct the sound signature produced by first means into the sound signature storage provided by second means, whereby the personal listening device is accorded an ability to learn, recognize, and act upon recognition of new sound signatures for sounds of interest to a particular user of the device.

[0022] Localization means can determine at least one among a location, direction, and distance of the environmental sound with respect to the user. The localization means can be arranged to operate using one or more acoustic cues selected from the group comprising: a) level (intensity) differences between the signals received at left and right ears, b) phase differences between the signals received at left and right ears, c) level (intensity) variation over time for the signals received at left and right ears, and d) phase variation over time for the signals received at left and right ears.

[0023] In a fifth exemplary embodiment, a method for acute sound detection and reproduction (e.g., for use with an earpiece) can include measuring an external ambient sound level in an ear canal, monitoring a change in the external ambient sound level for detecting an acute sound, determining whether a sound source producing the acute sound is approaching or departing, and reproducing the acute sound within the ear canal responsive to the detecting.

[0024] The user's listening acuity in relation to sounds of interest to the user can be enhanced by the listening device by means of amplifying those sounds of interest. A user's listening experience, can be enhanced by the listening device by means of attenuating the interfering sounds. The user's situation awareness can be enhanced by reciting to him/her the textual label associated with and the location of the environmental sound. The user's personal safety can be enhanced by alerting him/her to specific acoustic signals such as, but not limited to, words in multiple languages indicative of emergency situation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. 1 is a pictorial diagram of a listening device constructed in accordance with an exemplary embodiment;

[0026] FIG. 2 is a block diagram of the listening device in accordance with an exemplary embodiment;

[0027] FIG. 3 is a block diagram of an electronic signal processing unit of a listening device constructed in accordance with an exemplary embodiment;

[0028] FIG. 4 is a block diagram of a volume detecting unit as shown in FIG. 3 in accordance with an exemplary embodiment;

[0029] FIG. 5 is a block diagram of a spectral pattern detecting unit as shown in FIG. 3 in accordance with an exemplary embodiment;

[0030] FIG. 6 is a block diagram of a temporal pattern detecting unit as shown in FIG. 3 in accordance with an exemplary embodiment;

[0031] FIG. 7 is a block diagram of a localization unit as shown in FIG. 3 in accordance with an exemplary embodiment;

[0032] FIG. 8 is a block diagram of a relevance detecting unit as shown in FIG. 3 in accordance with an exemplary embodiment;

[0033] FIG. 9 is a block diagram of a sound signature extracting unit as shown in FIG. 3 in accordance with an exemplary embodiment;

[0034] FIG. 10 is a block diagram of a sound signature recognition unit as shown in FIG. 3 in accordance with an exemplary embodiment; and

[0035] FIG. 11 is a block diagram of a sound control unit as shown in FIG. 3 in accordance with an exemplary embodiment.

FIG. 1: Listening device

100 sound-attenuating earplug

102 ear-canal loudspeaker receiver

104 ambient-sound microphone

106 electronic signal processing unit

108 connection to the audio playback device

110 ear-canal microphone

112 external loudspeaker receiver

FIG. 2: Block Diagram

102 Ear Canal Receiver (ECR)

104 Ambient Sound Microphone (ASM)

106 Processor

110 Ear Canal Microphone (ECM)

122 Analog to Digital Converter (ADC)

124 Analog to Digital Converter (ADC)

126 Digital to Analog Converter (DAC)

128 Memory

130 Audio Interface

132 Transceiver

134 Location Unit

136 Power Supply

FIG. 3: Processor

150 ambient sound input terminal

152 amplifier (AMP)

154 low-pass filter (LPF)

156 analog-to-digital converter (ADC)

158 volume detecting unit (VDU)

160 spectral pattern detecting unit (SPDU)

162 temporal pattern detecting unit (TPDU)

164 localization unit (LU)

166 relevance detection unit (RDU)

168 sound signature extracting unit (SSEU)

170 training mode selector

172 sound signature comparing unit (SSCU)

174 sound signature storage (SSS)

176 sound class selector
178 sound control unit (SCU)
180 playback sound input terminal
182 operation mode selector
184 sound replacement switch
186 ear-canal loudspeaker output terminal

FIG. 4: Volume Detecting Unit (VDU)
200 digitized input signal terminal
202 Fourier transform unit
204 signal power computation unit
206 power comparator
208 output terminal

FIG. 5: Spectral Pattern Detecting Unit (SPDU)
250 digitized input signal terminal
252 Fourier transform unit
254 third-octave signal bandpass filterbank
256 third-octave signal power computation unit
258 octave signal bandpass filterbank
260 octave signal power computation unit
262 total signal power computation unit
264 noise spectrum accumulator
266 third-octave noise bandpass filterbank
268 third-octave noise power computation unit
270 octave noise bandpass filterbank
272 octave noise power computation unit
274 total noise power computation unit
276 third-octave power comparator
278 octave power comparator
280 total power comparator
282 logic unit

284 "operation-enable" terminal

286 output terminal

FIG. 6: Temporal Pattern Detecting Unit (TPDU)

300 digitized input signal terminal

302 Fourier transform unit

304 spectrum accumulation unit

306 two-dimensional Fourier transform unit

308 periodicity detector

310 periodicity comparator

312 pitch detection unit

314 pitch comparator

316 logic unit

318 "operation-enable" terminal

320 output terminal

FIG. 7: Localization Unit (LU)

350 digitized input signal terminal

352 Fourier transform unit

354 signal power computation unit

356 accumulator-comparator

358 pitch detector

360 harmonics extractor

362 Doppler shift detector

364 logic unit

366 "operation-enable" terminal

368 output terminal

FIG. 8: Relevance Detecting Unit (RDU)

400 spectral pattern information terminal

402 temporal pattern information terminal

404 sound direction information terminal

406 logic unit
408 output terminal

FIG. 9: Sound Signature Extracting Unit (SSEU)
450 digitized input signal terminal
452 pre-emphasis filter
454 signal windowing operation (splitter)
456 Fourier transform unit
458 bandpass filterbank
460 triangular filterbank
462 discrete cosine transform unit
464 pitch detector
466 brightness detector
468 bandwidth detector
470 a set of numerical outputs

FIG. 10: Sound Signature Recognition Unit (SSRU)
500 incoming sound signature terminal
502 sound signature difference computation unit
504 sound signature storage connector terminal
506 minimum distance finding unit
508 threshold unit
510 output terminal

FIG. 11: Sound Control Unit (SCU)
550 ambient sound input terminal
552 playback sound input terminal
554 Fourier transform unit
556 ambient sound gating unit
558 selective attenuation unit
560 selective amplification unit
562 inverse Fourier transform unit

564 playback sound gating unit
566 sound signature information terminal
568 danger signal presence information terminal
570 operation mode terminal
572 sound replacement enable terminal
574 logic unit
576 replacement sound playback unit
578 text-to-speech synthesizer
580 summation unit
582 ear-canal loudspeaker output terminal

DETAILED DESCRIPTION

[0036] The following description of at least one exemplary embodiment is merely illustrative in nature and is in no way intended to limit the invention, its application, or uses.

[0037] Processes, techniques, apparatus, and materials as known by one of ordinary skill in the relevant art may not be discussed in detail but are intended to be part of the enabling description where appropriate, for example the fabrication and use of transducers.

[0038] In all of the examples illustrated and discussed herein, any specific values, for example the sound pressure level change, should be interpreted to be illustrative only and non-limiting. Thus, other examples of the exemplary embodiments could have different values.

[0039] Note that similar reference numerals and letters refer to similar items in the following figures, and thus once an item is defined in one figure, it may not be discussed for following figures.

[0040] Note that herein when referring to correcting or preventing an error or damage (*e.g.*, hearing damage), a reduction of the damage or error and/or a correction of the damage or error are intended.

[0041] Note that discussions herein refer to an earpiece, however exemplary embodiments are not limited to devices for the ear, for example a device in accordance with at least one exemplary embodiment can be a stand alone unit.

[0042] At least one exemplary embodiment of the invention is directed to an earpiece for ambient sound monitoring and warning detection. Reference is made to **FIG. 1** in which an earpiece device, generally indicated as earpiece 100, is constructed and operates in accordance with at least one exemplary embodiment of the invention. As illustrated, earpiece 100 depicts an electro-acoustical assembly for an in-the-ear acoustic assembly, as it would typically be placed in the ear canal of a user. The earpiece 100 can be an in the ear earpiece, behind the ear earpiece, receiver in the ear, open-fit device, or any other suitable earpiece type. The earpiece 100 can be partially or fully occluded in the ear canal, and is suitable for use with users having healthy or abnormal auditory functioning.

[0043] Earpiece 100 includes an Ambient Sound Microphone (ASM) 104 to capture ambient sound, an Ear Canal Receiver (ECR) 102 to deliver audio to the ear canal, and an Ear Canal Microphone (ECM) 110 to assess a sound exposure level within the ear canal. The earpiece 100 can partially or fully occlude the ear canal to provide various degrees of acoustic isolation. The assembly is designed to be inserted into the user's ear canal, and to form an acoustic seal with the walls of the ear canal at a location between the entrance to the ear canal and the tympanic membrane (or ear drum). Such a seal is typically achieved by means of a soft and compliant housing of assembly. Such a seal creates a closed cavity of approximately 5cc between the in-ear assembly and the tympanic membrane. As a result of this seal, the ECR (speaker) 102 is able to generate a full range bass response when reproducing sounds for the user. This seal also serves to significantly reduce the sound pressure level at the user's eardrum resulting from the sound field at the entrance to the ear canal. This seal is also a basis for a sound isolating performance of the electro-acoustic assembly.

[0044] Note that in at least one exemplary embodiment a stand alone system (e.g., not an earpiece) can be used to detect sounds that a listener in a noisy environment can't. Thus, in at least one exemplary embodiment a stand alone device can detect

a sound and notify a user or save the occurrence in a database, without sealing the ear canal of a user.

[0045] Located adjacent to the ECR 102, is the ECM 110, which is acoustically coupled to the (closed) ear canal cavity. One of its functions is that of measuring the sound pressure level in the ear canal cavity as a part of testing the hearing acuity of the user as well as confirming the integrity of the acoustic seal and the working condition of the earpiece 100. In one arrangement, the ASM 104 can be housed in the ear seal to monitor sound pressure at the entrance to the occluded or partially occluded ear canal. All transducers shown can receive or transmit audio signals to a processor 106 that undertakes audio signal processing and provides a transceiver for audio via the wired or wireless communication path 108.

[0046] Briefly, the earpiece 100 can actively monitor a sound pressure level both inside and outside an ear canal and enhance spatial and timbral sound quality while maintaining supervision to ensure safes sound reproduction levels. The earpiece 100 in various embodiments can conduct listening tests, filter sounds in the environment, monitor warning sounds in the environment, present notification based on identified warning sounds, maintain constant audio content to ambient sound levels, and filter sound in accordance with a Personalized Hearing Level (PHL).

[0047] The earpiece 100 can generate an Ear Canal Transfer Function (ECTF) to model the ear canal using ECR 102 and ECM 110, as well as an Outer Ear Canal Transfer function (OETF) using ASM 104. For instance, the ECR can deliver an impulse within the ear canal and generate the ECTF via cross correlation of the impulse with the impulse response of the ear canal. The earpiece 100 can also determine a sealing profile with the user's ear to compensate for any leakage. It also includes a Sound Pressure Level Dosimeter to estimate sound exposure and recovery times. This permits the earpiece 100 to safely administer and monitor sound exposure to the ear. Additionally, an external loudspeaker 112 can be placed on the outer (environment-facing) surface of the earpiece 100 for performing other functions of the headphone, such as monitoring of sound exposure and ear health conditions, headphone equalization, headphone fit testing, noise reduction, and customization.

[0048] Referring to **FIG. 2**, a block diagram 120 of the earpiece 100 in accordance with an exemplary embodiment is shown. As illustrated, the earpiece 100 can include

the processor 106 operatively coupled to the ASM 104, ECR 102, and ECM 110 via one or more Analog to Digital Converters (ADC) 122 and 124 and Digital to Analog Converters (DAC) 126. The processor 106 can utilize computing technologies such as a microprocessor, Application Specific Integrated Chip (ASIC), and/or digital signal processor (DSP) with associated storage memory 208 such a Flash, ROM, RAM, SRAM, DRAM or other like technologies for controlling operations of the earpiece device 100. The processor 106 can also include a clock to record a time stamp.

[0049] The earpiece 100 can measure ambient sounds in the environment received at the ASM 104. Ambient sounds correspond to sounds within the environment such as the sound of traffic noise, street noise, conversation babble, or any other acoustic sound. Ambient sounds can also correspond to industrial sounds present in an industrial setting, such as, factory noise, lifting vehicles, automobiles, an robots to name a few.

[0050] Although the earpiece 100 when inserted in the ear can partially occlude the ear canal, the earpiece 100 may not completely attenuate the ambient sound. The passive aspect of the physical earpiece 100, due to the mechanical and sealing properties, can provide upwards of a 22dB noise reduction. However, portions of ambient sounds higher than the noise reduction level can still pass through the earpiece 100 into the ear canal thereby producing residual sounds. For instance, high energy low frequency sounds may not be completely attenuated. Accordingly, residual sound may be resident in the ear canal and measured by the ECM 130.

[0051] The memory 128 can also store program instructions for execution on the processor 106 as well as captured audio processing data. For instance, memory 128 can be off-chip and external to the processor 106, and include a data buffer to temporarily capture the ambient sound and the internal sound, and a storage memory to save from the data buffer the recent portion of the history in a compressed format responsive to a directive by the processor. It should also be noted that the data buffer can in one configuration reside on the processor 106 to provide high speed data access. The storage memory can be non-volatile memory such as SRAM to store captured or compressed audio data.

[0052] The earpiece 100 can include an audio interface 130 operatively coupled to the processor 106 to receive audio content, for example from a media player or cell phone, and deliver the audio content to the processor 106. The processor 106 responsive to detecting events can adjust the audio content delivered to the ear canal. For instance, the processor 106 can lower a volume of the audio content responsive to detecting an event for transmitting the sound to the ear canal. The processor 106 by way of the ECM 110 can also actively monitor the sound exposure level inside the ear canal and adjust the audio to within a safe and subjectively optimized listening level range.

[0053] The earpiece 100 can further include a transceiver 132 that can support singly or in combination any number of wireless access technologies including without limitation Bluetooth™, Wireless Fidelity (WiFi), Worldwide Interoperability for Microwave Access (WiMAX), and/or other short or long range communication protocols. The transceiver 132 can also provide support for dynamic downloading over-the-air to the earpiece 100. It should be noted also that next generation access technologies can also be applied to the present disclosure.

[0054] The location receiver 134 can utilize common technology such as a common GPS (Global Positioning System) receiver that can intercept satellite signals and therefrom determine a location fix of the earpiece 100.

[0055] The power supply 136 can utilize common power management technologies such as replaceable batteries, supply regulation technologies, and charging system technologies for supplying energy to the components of the earpiece 100 and to facilitate portable applications. A motor (not shown) can be a single supply motor driver coupled to the power supply 136 to improve sensory input via haptic vibration. As an example, the processor 106 can direct the motor to vibrate responsive to an action, such as a detection of a warning sound or an incoming voice call.

[0056] The earpiece 100 can further represent a single operational device or a family of devices configured in a master-slave arrangement, for example, a mobile device and an earpiece. In the latter embodiment, the components of the earpiece 100 can be reused in different form factors for the master and slave devices.

[0057] The signal processing unit **106** is an electronic component that can operate in accordance with the block diagram 300 shown in FIG. 3. Referring now to **FIG. 3**,

a structural scheme of the processing done within the signal processing unit is shown. Specifically, the input part of the processing consists of a terminal **150** onto which the signal arriving from the microphone **104** is connected; the amplifier **152** can amplify the microphone signal; the low-pass filter **154** can suppress aliasing effects during digitization of the following step; and the analog-to-digital (ADC) converter **156,** can convert the sound wave into the digital format for further processing.

[0058] The digitized ambient sound is fed to two circuits depicted in FIG. 3. The top circuit (comprised of units **158**, **160**, **162**, **164**, and **166**) performs recognition of auditory signals per specifications set in ISO 7731, "Ergonomics – Danger signals for public and work areas – Auditory signals", second edition dated 2003-11-01. The bottom circuit (comprised of units **168**, **170**, **172**, **174**, and **176**) detects by means of sound signature comparison other signals of interest to the system. Briefly, embodiments for the detailed structure of blocks **158**, **160**, **162**, **164**, **166**, **168**, **172**, and **178** are presented ahead in FIGS. 4 through 11, respectively.

[0059] Specifically, the output of the analog-to-digital converter **156** can be connected to the volume detector unit (VDU) **158**, to the spectral pattern detecting unit (SPDU) **160**, to the temporal pattern detecting unit (TPDU) **162**, and to the localization unit (LU) **164**. The volume detector 158 determines whether the detected signal power is above a power threshold, for example, given in ISO 7731. If this condition is satisfied, the volume detector outputs the "true" flag. The output of the volume detector **158** is connected, in parallel, to the "operation-enable" inputs of the spectral pattern detecting unit **160**, to the temporal pattern detecting unit **162**, and to the localization unit **164**. Thus, unit **160**, **162**, and **164** do not operate until and unless the volume detector **158** detects the signal of sufficient power. The spectral pattern detecting unit **160** determines whether the spectral properties of the signal, such as power in octave or third-octave bands, for example, to conform to the ISO 7731 standard. The temporal pattern detecting unit **162** determines whether the temporal properties of the signal, such as pulsation rate, for example, to conform to the ISO 7731 standard. The localization unit **164** determines whether the signal appears approaching or receding. Outputs of the units **160**, **162**, and **164** are connected to the relevance detecting unit **166**, which detects whether the signal is

indeed a non-receding danger signal and therefore warrants an action. Output of the relevance detecting unit **166** is connected to the sound control unit **180**, which is described later in this section.

[0060] The output of the analog-to-digital converter **156** is also connected to the sound signature extracting unit (SSEU) **168**. It is used to extract the digital vector of the features of the ambient sound received via terminal **150**. These features are said to comprise the ``sound signature''. The sound signature storage (SSS) **174** stores the digital signatures for the plurality of the sounds that are of interest to the system. Also, with each signature, an indicator of the class of sound having three possible values (``alert word'', ``desired sound'', or ``undesired sound'') and optional sound replacement information for the signal is stored. Sound replacement information consists of either the alternative sound (to be rendered to the user) or the textual label (to be recited to the user) when the sound of interest is detected in the environment. A learning-mode switch **170** is used to direct the extracted sound signature to the storage **174** for recording, thereby enabling the system to learn sound signatures for signals of relevance to the user. A sound class switch **176** is used along with the switch **170** in the learning mode to let the system know the intention of the user as to whether the signal being taught to the system is an alert word, is a desirable sound, or is an undesirable sound.

[0061] If switch **170** is not pressed, the output of the sound signature extractor unit **168** is connected to the sound signature comparing unit (SSCU) **172**, which also has as an input the signature storage **174** with signatures for all sounds of relevance. The output of the signature comparing unit **172** consists of the four-valued flag indicating the recognition result (no signal detected, alert word detected, desired signal detected, or undesired signal detected), of an optional sound replacement information for the signal, and of a list of a particular frequency bands which are occupied by the sound if one is detected. It is connected to the sound control unit **178**.

[0062] The output of the analog-to-digital converter **156** is also connected to the sound control unit **178**. The sound control unit (SCU) **178** also receives the detection results from the auditory signals detection circuit (output of the unit **166**) and from the desired/undesired signals detection circuit (output of the unit **172**). The playback

sound input terminal **180** is connected to the sound control unit **178**. The user-selectable switch **182** selects the mode of operation for the sound control unit. Possible modes of operation are transparency, amplification, attenuation, and playback. Another user-selectable switch **184** is used to turn on sound replacement mode. The recognition results from outputs of unit **166** and of unit **172** together with the positions of switches **182** and **184** determine the action or actions to be done by the sound control unit **178**. The possible actions are: mute the audio playback; selectively amplify the ambient sound in the given frequency bands; selectively attenuate the ambient sound in the given frequency bands; replace the sound according to the sound replacement information associated with it (i.e., by rendering the associated replacement sound or applying text-to-speech conversion to the associated textual label); and announce the location of the detected sound (such as "left, 20 feet") via text-to-speech conversion.

[0063] In the foregoing, a brief description of the earpiece 100 and it's operation is presented with respect to FIGS. 1-3 in accordance with embodiments of the invention. Ambient sound is acquired by the microphone **104** (see FIG. 1) and enters the electronic control unit via the terminal **150** (see FIG. 3). The signal is amplified by amplifier **152**, is low-passed by a low-pass filter **154** with the cut-off of half the discretized frequency to avoid aliasing, and is converted to the digital form via the analog-to-digital converter **156**. It is then sent to two independently operating circuits (top and bottom parts of FIG. 3) designed to recognize specifically auditory signals and all other signals of interest, respectively.

[0064] In the top circuit (150-166), the signal is processed for detection of auditory signals (such as ambulance or fire truck siren). The signal is analyzed in the manner similar to how humans are detecting the presence of danger signals in the environment. The signal is subject to several consecutive tests considering its power, its spectral and temporal characteristics, and its motion direction, if any. Specifically, the signal is first submitted to the volume detecting unit **158**. It determines whether the volume of the signal and the signal-to-noise ratio are sufficiently high to warrant an action, by comparing those characteristics with thresholds, for example, set forth in ISO 7731. If the signal is determined to be sufficiently loud, it is passed along to the output of the volume detecting unit **158** and is sent, in parallel, to three units for

further determining the compliance, for example, with ISO 7731 and the relevance of the signal.

[0065] The signal is analyzed by the spectral pattern detecting unit **160** for determining if the signal has high power in one or more narrow frequency bands, suggesting a siren-type or horn-type signal. The signal is also analyzed by the temporal pattern detecting unit **162** for determining if the signal has periodic pulsations in power or in spectral peak position, which is also characteristic of auditory signals. Both of these units output a flag indicating whether patterns characteristic for auditory signals are detected. The signal is also analyzed by the localization unit **164** for determining via Doppler shift analysis and via signal power analysis over time whether the signal is approaching or receding. Unit **164** also outputs a binary value indicative of the result of analysis. Outputs of units **160**, **162**, and **164** are sent to the relevance detecting unit **166**. It makes a decision of whether the auditory signal is present and whether is it relevant to the user (e.g., receding signal is not relevant). If the signal is deemed to be relevant, a command is sent to the sound control unit directing it to mute the audio playback and to switch to the transparency mode to allow the user of the system to hear the danger signal, which can otherwise be obscured by music playback. This concludes the discussion of the operation of the top circuit of FIG. 3 (units **158**, **160**, **162**, **164**, and **166**).

[0066] The bottom circuit of FIG 3 (units **168**, **170**, **172**, **174**, and **176**) performs detection of sounds by means of sound signature comparison. Sounds of interest to the system are divided into three broad classes: alert words, desired sounds, and undesired sounds. Example of alert words are words like "fire", "police", "traffic accident", and similar in multiple languages. When an alert word is detected, the playback is stopped and a word itself or the sound replacement information associated with it (such as alert signal or translation of the word) is rendered to the user, depending on the position of switch **184**. Examples of a desired sound may be a name of the user, footsteps sound, gun cock sound, or a sound of bicycle bell. A reaction for the desired sound is its amplification and/or announcement of such sound being detected. Undesired sounds may include a sound of a train whistle or train bells announcing the train arrival at the station or the sound of dentist drill in the dentist's office. The reaction to the undesired sound is its attenuation so that the

interference caused by it is kept minimal. The system is also accorded with the ability to train itself with the new sounds of interest to the particular user (e.g., a person who wants not to skip the weather forecast on TV can tune his system to the characteristic music happening at the start of forecast and make this sound desired).

[0067] Specifically, for the signature-based sound recognition, the input sound to the system is sent to the unit **168**, which computes the numeric vector comprising the sound signature of the ambient sound. Under normal mode of operation (the training mode switch **170** is not pressed), the numeric sound signature is sent to the sound signature comparing unit **172**. Unit **172** compares it to the sound signatures stored in the sound signature storage **174**. Unit **174** stores the sound signatures for sound of interest together with the sound class indicator (``alert word'', ``desired sound'', or ``undesired sound'') and with optional sound replacement information for each signature. Unit **174** may be pre-programmed with sound signatures most suitable for average user (e.g., has several alert words stored in most common languages). In addition, sound pertinent to certain user profile (such as sound of bicycle bell for joggers) can be pre-stored or downloaded later on a per-user basis, and the system can learn additional sounds of interest to the particular user by using the learning mode selectable by the switch **170**. Unit **172** finds, from all signatures stored in the storage **174**, the sound signature that is the most similar to the incoming sound signature. It also computes the degree of certainty of the decision that the sound found in the storage is actually present in the ambient signal. If the degree of certainty is more than a set threshold, the sound corresponding to the best-matching sound signature is deemed to be present in the environment and the unit **172** outputs the information associated with the sound (sound class, sound replacement information if any, and the list of frequency bands occupied by the detected sound).

[0068] Under ``learning'' mode of operation (switch **170** is pressed), the sound signature of the ambient sound is sent to unit **174** for storage for later use. In this way, the system learns additional ``sounds of interest'' for the particular user of the system. When exposing the system to the ``sound of interest'', the user also uses the switch **176** to tell the system whether the sound being taught is an ``alert word'' and should cause stop of the music playback when encountered, is ``desirable'' and should be amplified when encountered, or is ``undesirable'' and should be

attenuated when encountered. This information is stored in the indicator associated with each sound signature in storage **174**.

[0069] Referring to **FIG. 4**, a block diagram for an exemplary embodiment of the volume detecting unit 158 is shown. The volume detecting unit includes an input terminal **200** for input of the digitized ambient audio signal frame. The terminal **200** is connected to the Fourier transform unit **202**, which computes the spectrum of the frame of the signal. The output of the Fourier transform unit **202** is connected to the signal power computation unit **204**. The output of the signal power computation unit **204** is connected to the power threshold unit **206**. The output of unit **206** is connected to the output terminal **208** of the volume detecting unit.

[0070] The volume detecting unit 158 is involved in recognition of auditory signals. There are several constraints imposed on auditory signals in ISO 7731 international standard. The volume detecting unit verifies first of those constraints – specifically, that the signal power is more than the absolute threshold of 65 dB. The volume detecting unit operates as follows.

[0071] The frame of the digitized input sound arrives via terminal **200**. The Fourier transform unit **202** obtains the spectrum of the frame and passes it on to the power computation unit **204**, which computes the power of the signal in dB. The computed value of power is transmitted to the power comparator **206**, which outputs "true" if the signal power is more than a pre-determined value of 65 dB and "false" otherwise. The output of the power comparator **206** is finally sent to the output terminal **208**. If the signal sent is "true", it means that sufficiently high-volume signal is presented in the environment. The signal enables operation of three other units (spectral pattern detection unit, temporal pattern detection unit, and localization unit) to analyze the signal further as to whether the signal is an auditory signal or not.

[0072] Referring to **FIG. 5**, a block diagram of the spectral pattern detecting unit 160 according to one embodiment is shown. The spectral pattern detecting unit ˙60 is responsible for detecting the specific spectral patterns prescribed for auditory signals, for example by ISO 7731 standard. The terminal **250** serves as the input for the audio signal. The input terminal **250** is connected to the Fourier transform unit **252**, which computes the spectrum of the incoming sound frame.

[0073] The output of the unit **252** is connected to the third-octave signal bandpass filterbank **254** containing one-third-octave-wide filters spanning the signal frequency range. The output of the filterbank **254** is connected to the third-octave signal power computation unit **256**. The output of the unit **252** is also connected to the octave signal bandpass filterbank **258** containing octave-wide filters spanning the signal frequency range. The output of the filterbank **254** is connected to the octave signal power computation unit **260**. The output of the unit **252** is also connected to the total signal power computation unit **262**.

[0074] The output of the unit **252** is also connected to the noise spectrum accumulation unit **264**. The output of the noise spectrum accumulation unit **264** is connected to the third-octave noise bandpass filterbank **266** containing one-third-octave-wide filters spanning the signal frequency range. The output of the filterbank **266** is connected to the third-octave signal power computation unit **268**. The output of the unit **264** is also connected to the octave noise bandpass filterbank **270** containing octave-wide filters spanning the signal frequency range. The output of the filterbank **270** is connected to the third-octave signal power computation unit **272**. The output of the unit **264** is also connected to the total noise power computation unit **274**.

[0075] The outputs of the third-octave signal power computation unit **256** and of the third-octave noise power computation unit **268** are connected to the third-octave power comparator **276**. The outputs of the octave signal power computation unit **260** and of the third-octave noise power computation unit **272** are connected to the octave power comparator **278**. The outputs of the total signal power computation unit **262** and of the total noise power computation unit **274** are connected to the total power comparator **280**.The outputs of the comparators **276**, **278**, and **280** are connected to the logic unit **282**. The "operation-enable" terminal **284** is also connected to the logic unit **282**. The logic unit operates according to the rules described in the next section. The output terminal **286** of the spectral pattern detecting unit is connected to the output of the logic unit signaling the detection of the spectral pattern characteristic of an auditory signal.

[0076] In the foregoing, a brief description of the operation of the spectral pattern detecting unit 160 is provided. The input signal arrives into the spectral pattern

detecting unit via input terminal **250**. The signal is subject to the Fourier transform in the unit **252**, generating the spectrum of the signal frame. The spectrum of the signal is then sent to the filter-bank **254** and subsequently to the power computation unit **256**, which outputs the list of signal power in third-octave frequency bands spanning the signal frequency range. The spectrum of the signal is also sent to the filter-bank **258** and subsequently to the power computation unit **260**, which outputs the list of signal power in octave frequency bands spanning the signal frequency range. The spectrum of the signal is also sent to the total power computation unit **262**, which outputs the total power of the signal in the entire frequency range.

[0077] For the purposes of estimating the environmental noise level, the spectrum of the signal is also sent to the noise power accumulation unit **264**. The noise power accumulation unit **264** accepts the spectrum of the sound and computes the running estimate of the average spectrum power over a time window of 1 minute. This running estimate is deemed to be the noise power spectrum and is used in several other units of the volume detector for computing the signal-to-noise ratio of the detected signal.

[0078] The noise spectrum (from the output of unit **264**) is subject to the same computations as the signal spectrum. Specifically, the noise spectrum is sent to the filter-bank **266** and subsequently to the power computation unit **268**, which outputs the list of noise power in third-octave frequency bands spanning the signal frequency range. The noise spectrum is also sent to the filter-bank **270** and subsequently to the power computation unit **272**, which outputs the list of noise power in octave frequency bands spanning the signal frequency range. The noise spectrum is also sent to the total noise power computation unit **274**, which outputs the total noise power.

[0079] The computed third-octave power of the signal (output by unit **256**) and third-octave power of the noise (output by unit **268**) is sent to the third-octave power comparator **276**. The comparator **276** operates according to the following rule. The comparator **276** outputs "true" if in at least one third-octave band the signal level is more than the effective masked threshold (computed from the noise power) by at least 13 dB. One set of rules for computing effective masked threshold are established in ISO 7731.

[0080] The computed octave power of the signal (output by unit **260**) and octave power of the noise (output by unit **272**) is sent to the octave power comparator **278**. The comparator **278** operates according to the following rule. The comparator **278** outputs "true" if in at least one octave band the signal level is more than the effective masked threshold (computed from the noise power) by at least 10 dB. One set of rules for computing effective masked threshold are established in ISO 7731.

[0081] The computed total power of the signal (output by unit **262**) and total power of the noise (output by unit **274**) is sent to the total power comparator **280**. The comparator **280** operates according to the following rule. The comparator **280** outputs "true" is the signal level is more than the noise level by at least 15 dB.

[0082] The outputs of the comparators **276**, **278**, and **280** are sent to the logic unit **282**. The logic unit **282** also accepts input from "operation-enable" terminal **284**. The logic unit **282** operates according to the following rules:

a) If the "operation-enable" input **284** is "false", the output of the unit **282** is "false".

b) If the "operation-enable" input **284** is "true" and the input from at least one of the comparators **276**, **278**, and **280** is "true", the output of the unit **282** is "true".

c) Otherwise, the output of the unit **282** is "false".

[0083] The "operation-enable" terminal can also be used to disable operation of the spectral pattern detecting unit altogether by e.g. putting the semiconductor components comprising the unit into low-power-consumption ("sleep") mode so as to conserve power for unattached operations.

[0084] The output of the unit **282** is sent to the output terminal **286** to signal to the further circuits whether the environmental signal exhibit spectral properties characteristic of danger signals, for example, in accordance with ISO 7731.

[0085] Referring to **FIG. 6**, a block diagram of the temporal pattern detecting unit 162 according to one embodiment is shown. The temporal pattern detecting unit 162 is responsible for detecting the specific temporal patterns prescribed for auditory signals, for example, by ISO 7731 standard. The terminal **300** serves as the input for

the audio signal. The input terminal **300** is connected to the Fourier transform unit **302**, which computes the spectrum of the incoming sound frame. The output of the Fourier transform unit **302** is connected to the spectrum accumulation unit **304**, which keeps a first-in, first-out queue of spectra of recently seen frames. The output of the spectrum accumulation unit is connected to the two-dimensional Fourier transform unit **306**. The output of the Fourier transform unit **306** is connected to the periodicity detector **308**, which output is connected to the periodicity comparator **310**. The output of the periodicity comparator **310** is submitted to the logic unit **316**.

[0086] The output of the Fourier transform unit **302** is also connected to the pitch detector **312**. The output of the pitch detector **312** is connected to the pitch comparator **314**. The output of the pitch comparator **314** is also submitted to the logic unit **316**. The logic unit **316** accepts inputs from the periodicity comparator **310**, from the pitch comparator **314**, and from the "operation-enable" input terminal **318**. The logic unit **316** operates in accordance with the rules fully described in the next section. The output of the logic unit is connected to the output terminal **320** of the temporal pattern detecting unit.

[0087] In the foregoing, a brief description of the operation of the temporal pattern detecting unit 162 is provided. The digitized frame of the ambient sound arrives into the temporal pattern detecting unit via terminal **300**. The signal is converted to the frequency domain in the Fourier transform unit **302**. The spectrum of the sound is sent from the Fourier transform unit **302** to the spectrum accumulator **304**. The spectrum accumulator **304** keeps a number of recently received spectrums in the first-in, first-out (queue-type) data structure so that at any given moment of time the spectrum accumulator holds most recently seen spectrums for the last 4 seconds. The spectrum accumulator outputs then in the two-dimensional format as an array where the spectrums are placed in rows of two-dimensional array. This array can be thought of as an image with brightness of the pixel being the power of the spectrum at given time and frequency, X-axis being the frequency, and Y-axis being the time. Two-dimensional Fourier transform on such image would reveal the periodicity of image structure. Thus, the array of most recently seen spectrums is send out of the spectrum accumulator **304** to the two-dimensional Fourier transform unit **306**, which (by definition of the two-dimensional Fourier transform) produces as the output the

two-dimensional array of Fourier transform coefficients. This array is submitted to the periodicity detector **308**, which searches for the pronounced peak(s) in it. If the ratio of peak magnitude to the average magnitude over the array of two-dimensional Fourier transform coefficients is higher than a set threshold, then the frequency location of the highest peak detected is sent to the periodicity comparator **310**. The periodicity comparator **310** ensures that the frequency of periodicity is in agreement with pulsation/sweep frequency prescribed for auditory signals, for example in ISO 7731 standard, that is specifically is between 0.5 and 4 Hz. If that is the case, the periodicity comparator **310** outputs "true". Otherwise, or if there is no output at the output of the periodicity detector **308**, the periodicity comparator **310** outputs "false".

[0088] The spectrum of the sound is also sent from the Fourier transform unit **302** to the pitch detector **312**, which is a device well-known to one skilled in art. The pitch detector **312** executes numeric pitch detection algorithm and outputs the pitch frequency of the signal to the pitch comparator **314**. The pitch comparator **314** verifies that the pitch of the signal is in agreement with the pitch prescribed for auditory signals, for example in ISO 7731 standard, that is specifically is between 500 and 1000 Hz. If that is the case, the pitch comparator **314** outputs "true". Otherwise, or if the pitch detector **312** determines that the signal is pitchless, the pitch comparator **314** outputs "false".

[0089] The outputs of the comparators **310** and **314** are sent to the logic unit **316**. The logic unit **316** also accepts input from "operation-enable" terminal **318**. The logic unit **316** operates according to the following rules:

a) If all three inputs are "true", the output of the unit **316** is "true".
b) Otherwise, the output of the unit **316** is "false".

[0090] In accordance with these rules, the "false" signal on "operation-enable" terminal inhibits output for the temporal pattern detecting unit. The "operation-enable" terminal can also be used to disable operation of the temporal pattern detecting unit altogether by e.g. putting the semiconductor components comprising the unit into low-power-consumption ("sleep") mode so as to conserve power for unattached operations. If the "operation-enable" terminal is "true", the output of the logic control

unit is "true" if and only if both the periodicity and the pitch of the ambient auditory signal conform, for example, to the ISO 7731 standard.

[0091] The output of the unit **316** is sent to the output terminal **320** to signal to the further circuits whether the environmental signal exhibit temporal properties characteristic of danger signals, for example, in accordance with ISO 7731.

[0092] Referring to **FIG. 7**, a block diagram of the localization unit 164 according to one embodiment is shown. The input for the localization unit is a terminal **350** (digitized input signal terminal). It is connected to the Fourier transform unit **352**. The output of the Fourier transform unit **352** is connected to the signal power computation unit **354**. The output of the power computation unit **354** is connected to the accumulator-comparator **356**, which evaluates whether the volume of the detected signal is increasing or decreasing over time. The output of the accumulator-comparator is connected to the logic unit **364**.

[0093] The output of the Fourier transform unit **352** is also connected, in parallel, to the pitch detector **358** and to the harmonics extractor **360**. The output of both blocks **358** and **360** is connected to the Doppler shift detector **362**. The Doppler shift detector **362** determines whether the signal is approaching or receding via comparison between the extracted pitch value and the frequencies of harmonics in the sound. The output of the Doppler shift detector is also connected to the logic unit **364**.

[0094] The logic unit **364** is processing the outputs of the accumulator-comparator **356** and of the Doppler shift detector **362** according to the operation rules fully described in the following subsection. The "operation-enable" terminal **366** is also connected to the logic unit. The output of the logic unit is applied to the terminal **368** indicating whether the signal is approaching or receding for later use in the relevance detection unit.

[0095] In the foregoing, a brief description of the operation of the location unit 164 is provided. The input for the localization unit is the terminal **350**. The digitized frame of the input signal arrives via the terminal **350** and is converted to the frequency-domain representation in the Fourier transform unit **352**. The spectrum of the frame is then submitted to the power computation unit **354**. The output is the power of the detected signal of interest. It is then send to the accumulator-comparator unit **356**.

[0096] The unit **356** operates by storing the values of the signal power for a number of recently seen signal frames. Upon the availability of the new value for the signal power, the unit **356** compares it with the stored values to determine if a consistent trend of increasing or decreasing signal power is observed. The unit **356** outputs "false" if the signal's power is decreasing over time, suggesting a receding sound, and "true" otherwise.

[0097] The spectrum of the signal frame is also submitted to the pitch detector **358** and to the harmonics extractor **360**. The pitch detector **358** is a device well-known to one skilled in art. It executes a numeric algorithm to detect a pitch of the incoming signal and outputs the detected pitch. The harmonics extractor **360** detects the presence of peaks in the spectrum of the sound and outputs their frequencies. Outputs of units **358** and **360** are sent to the Doppler shift detector **362**. It is well known from physics that a harmonic sound subject to Doppler shift loses the harmonistic property, as the fundamental frequency and all the harmonics shift by the same number of Hz and the frequencies of harmonics are no longer integer multiplicatives of the fundamental frequency. As such, if the sound is approaching (receding), the frequencies of harmonics are consistently lower (higher, correspondingly) than the integer multiplicatives of a pitch. The Doppler shift detector **362** detects whether the sound appears to be receding according to these rules and outputs "true" if it indeed appears to be receding. Otherwise, it outputs "false".

[0098] The logic unit **364** takes inputs from the accumulator-comparator **358**, from the Doppler shift detector **362**, and from the "operation-enable" terminal **366** and outputs, to the terminal **368**, a single Boolean value according to logical "AND" rule as follows: the output is "true" if and only if all three inputs are "true". As such, if the "operation-enable" terminal is "false" (i.e., no signal of sufficient power is detected in the environment), the output of the unit is forced to be "false". The "operation-enable" terminal can also be used to disable operation of the localization unit altogether by e.g. putting the semiconductor components comprising the unit into low-power-consumption ("sleep") mode so as to conserve power for unattached operations. When "operation-enable" terminal is "true", a sound deemed to be receding by at least one method (volume over time or Doppler shift) is deemed to be receding by the whole unit ("false" at the terminal **368**) so that no system's reaction is necessary.

Otherwise, the sound is either stationary or approaching ("true" at the terminal **368**), and a reaction such as audio playback muting or amplification of the detected sound may be necessary. The output of the localization unit is sent to the relevance detecting unit 166.

[0099] Referring to **FIG. 8**, a block diagram of the relevance detecting unit 166 according to one embodiment is shown. The relevance detecting unit 166 is a logic unit **406** that can include three input terminals (**400**, **402**, and **404**) and one output terminal **408**. Input terminal **400** is connected to the logic unit **406** and provides Boolean value to the logic unit indicating whether the spectral pattern of the detected signal matches the characteristics of auditory signals. Input terminal **402** is connected to the logic unit **406** and provides Boolean value to the logic unit indicating whether the temporal pattern of the detected signal matches the characteristics of auditory signals. Input terminal **404** is connected to the logic unit **406** and provides Boolean value to the logic unit whether the signal appears approaching ("true") or receding ("false"). The logic unit **406** executes a numeric algorithm based on the unit's inputs and generates a Boolean value at the output of the logic unit **406**, which is connected to the output terminal **408** of the relevance detecting unit. The specific algorithm describing operations of the relevance detecting unit is specified below.

[00100] The relevance detecting unit 166 determines whether the auditory signal possibly detected in the environment is relevant and to signal its occurrence to the sound control unit. To accomplish that, the relevance detecting unit 166 accepts information about spectral characteristics of the signal via terminal **400** from the spectral pattern detecting unit, about temporal characteristics of the signal via terminal **402** from the temporal pattern detecting unit, and about the estimated sound source direction (towards the listener or away from the listener) via terminal **404** from the localization unit. The relevance detecting unit also implicitly receives information about the volume of the signal, as the volume detecting unit enables operations of the spectral pattern detecting unit, of the temporal pattern detecting unit, and of the localization unit if and only if the signal volume matches criteria for auditory signal; as such, if the volume of signal is low, there will be no inputs to the relevance detecting unit. The logic unit **406** is responsible for determining whether the detected sound is

relevant based on sound's volume, spectral and temporal properties, and direction. The output of unit **406** is determined according to the following rules:

a) If input at the terminal **404** is "false", the output is "false".

b) If input at the terminal **404** is "true" and input at the terminal **400** is "true", then the output is "true".

c) If input at the terminal **404** is "true" and input at the terminal **402** is "true", then the output is "true".

d) Otherwise, the output is "false".

[00101] Thus, environmental signals are deemed relevant danger signals if they are not receding and satisfy at least one out of two (spectral pattern and temporal pattern) criteria characteristic of auditory signals. The output of the unit **406** is passed to the output terminal **408** of the relevance detecting unit to signal to the signal control unit whether the auditory signal is presented in the environment warranting interruption of music playback for safety of the listener.

[00102] Referring to **FIG. 9**, a block diagram of the sound signature extracting unit 168 according to one embodiment is shown. The sound signature extracting unit 168 processes the incoming sound in order to extract salient features used for identifying sounds of interest such as alert words, desirable sounds, and undesirable sounds. The exact features being extracted can vary. The preferred embodiment of the unit uses a combination of perceptual and cepstral features. The former include total signal power, bandwidth power for several frequency bands, pitch frequency, brightness, and bandwidth. The latter are comprised of mel-frequency cepstral coefficients (MFCCs).

[00103] The sound signature extracting unit 168 is comprised of the terminal **450** for the input of the digitized signal, connected to the pre-emphasis filter **452**, which in turn is connected to the splitter **454** programmed to perform windowing operation. The frame of the signal appearing at the output of the splitter **454** is passed to the Fourier transform operation **456**. The output of the Fourier transform is connected, in parallel, to two filterbanks (bandpass filterbank **458** and triangular filterbank **460**) and to signal parameter detectors (pitch detector **464**, brightness detector **466**, and

bandwidth detector **468**). Bandpass filterbank **458** is a device commonly used in electronics and in engineering and is known to one skilled in the art. The outputs **470a** of the filterbank **458** contain the numerical values of the total signal power and of the signal power in several frequency bands. They form a part of the sound signature.

[00104] The filterbank **460** and the discrete cosine transformation algorithm **462** together compute the MFCCs of the signal frame. As dictated by standard MFCC computation algorithm well-known to one skilled in the art, filters in the triangular filterbank **460** have triangular shape of the passing window and the output of the triangular filterbank **460** is subjected to the discrete cosine transformation (DCT) **462**. The outputs **470b** of the DCT contain the numerical values for MFCCs and also form a part of the sound signature.

[00105] The output of the splitter is also connected to a pitch detector **464** employing a numeric algorithm for computing the pitch of the signal frame. The numeric output **470c** of the pitch detector is also a part of the sound signature.

[00106] The output of the splitter is also connected to the brightness detector **466** employing a numeric algorithm to compute the brightness of the signal frame. Brightness is computed in accordance with its common definition as the centroid of the spectrum. The numeric output **470d** of the brightness detector is also a part of the sound signature.

[00107] The output of the splitter is also connected to the bandwidth detector **468** employing a numeric algorithm to compute the bandwidth of the signal frame. Bandwidth is computed in accordance with its common definition as the second momentum of the spectrum. The numeric output **470e** of the bandwidth detector is also a part of the sound signature.

[00108] The output **470** of the sound signature extracting unit thus constitute a vector of several numerical values ("sound signature") combined, in the described case, from the total signal power, signal power in several frequency bands, mel-frequency cepstral coefficients computed from the signal, and the signal pitch, brightness, and bandwidth.

[00109] In the foregoing, a brief description of the operation of the sound signature extracting unit 168 is provided. The sound signature extracting unit 168 accepts a

digitized input signal via the input terminal **450**. The signal is then subject to the pre-emphasis filtering done by the filter **452** with pre-emphasis parameter 0.96. Pre-emphasized signal is then split into overlapping frames of fixed size, and each frame is windowed by a Hamming window in the splitter **454**. Each frame is then subjected to the Fourier transform operation in the block **456**, resulting in the spectrum of the frame at the output of the block **456**. The spectrum is submitted to the bandpass filterbank **458**, which computes using simple summation over frequencies the total power of the signal and the power of the signal in several frequency bands and outputs the total and the band-wise powers to output terminals **470a**.

[00110] The spectrum of the frame is also submitted to the blocks **460** and **462**, which together compute mel-frequency cepstral coefficients of the signal frame. Block **460** filters the spectrum with triangular-shaped bandpass filters arranged on the mel-frequency scale and produces an ordered list of signal powers at the outputs of the filters. Block **462** performs the DCT of this list as if it were the signal. The DCT outputs constitute the mel-frequency cepstral coefficients and are sent to the output terminals **470b**.

[00111] The spectrum of the frame is also submitted to the pitch detector **464**. The detector executes a numeric pitch detection algorithm to determine whether the pitch is present in the signal and what is it. The pitch detector outputs the pitch value (or a pre-determined constant, such as 0 or –1, in case no pitch is detected) to the output terminal **470c**. The spectrum of the frame is also submitted to the brightness detector **466**. The detector executes a numeric algorithm to compute the centroid of the spectrum and outputs the computed value to the output terminal **470d**.The spectrum of the frame is also submitted to the bandwidth detector **468**. The detector executes a numeric algorithm to compute the second momentum of the spectrum (the power-weighted average of the squared difference between spectrum components and spectrum centroid) and outputs the computed value to the output terminal **470e**.

[00112] Briefly, the sound signature extracting unit 168 accepts the digitized input signal via the terminal **450**. As follows from FIG. 3, in the final system it is connected to the output of analog-to-digital converter **156** of FIG. 3. The sound signature extracting unit 168 executes several algorithms named above, computes the numeric signature of the sound, and outputs it to the terminals **470a**, **470b**, **470c**, **470d**, and

470e. These terminals comprise the set of output terminals **470**. The sound signature thus is produced and is sent either to the sound signature storage or to the sound signature comparing unit depending on whether the system is currently in learning mode or in operation mode, respectively.

[00113] Referring to **FIG. 9**, a block diagram of the sound signature comparing unit 172 according to one embodiment is shown. The input terminal **500** is connected to the sound signature difference computation unit **502**. The sound signature storage connector terminal **504** is also connected to the unit **502**. Output of the unit **502** is connected to the minimum distance finding unit **506**, which is connected in turn to the thresholding unit **508**. The output of the thresholding unit is fed to the output terminal **510**.

[00114] The sound signature comparing unit 172 performs a recognition of the ambient sound by comparing its signature extracted by the unit **158** of FIG. 3 with signatures of all sound known to the system stored in the signature storage **160** of FIG. 3. Accordingly, the sound signature comparing unit accepts the sound signature of the ambient sound via the terminal **500** and has access to the sound signatures of all sounds stored in the system via terminal **504**. Input from the terminal **500** is transmitted to the difference computation unit **502**.

[00115] The term "distance between signatures" is herein defined to mean the numeric measure of dissimilarity between two sound signatures, computed using some numeric algorithm. The exact choice of algorithm is not critical for providing the system with behavior in accordance with the current patent application. The simplest choice of such algorithm would be to compute normalized Euclidian or Mahalabonis distance between two sound signatures, which are nothing but two numeric vectors. More advanced algorithms can be applied such as multi-dimensional sound signature classification with support vector machines or with neural networks. However, those require auxiliary data structures computed and stored in the signature storage unit together with actual sound signatures in order to achieve reasonable processing speed. In addition, those data structures will have to be updated every time a new sound of interest is taught to the system and is stored in the signature storage unit. It will inevitably be a balancing act between computational

speed, memory requirements, and update complexity of various algorithms in choosing the one for implementation.

[00116] The unit **502** executes such algorithm to compute a set of distances between the sound signature obtained via terminal **500** and all sound signatures in the sound signature storage accessed via connector **504**. The result of the computation is sent to the minimum distance finding unit **506**. The unit **506** accepts the set of distances from the current ambient sound to all sounds of interest to the system and selects the numerically minimal distance from the set. The value of the minimal distance, along with the class of the signal (alert word, desirable, or undesirable), with the optional sound replacement information for the signal, and with the list of the frequency bands occupied by the detected signal, is sent to the thresholding unit **508**, which compares the distance with a predetermined threshold. If the distance is less than a threshold, a decision is made that the sound is recognized and a flag indicative of such decision is sent to the output terminal **510** along with the class of the signal, with the optional sound replacement information for the signal, and with the list of frequency bands of the detected signal. If the distance is more than a threshold, a decision is made that no sounds of interest are present in the environment and a flag indicative of such decision is sent to the terminal **510**.

[00117] Referring to **FIG. 10**, a block diagram of the sound control unit 178 according to one embodiment is shown. The sound control 178 unit has two terminals for sound input. The ambient sound terminal **550** is connected to the Fourier transform unit **554**. The output of the Fourier transform unit is connected to the ambient sound gating unit **556**. Gating is controlled by output **B** of the logic unit **574**. The output of the gating unit is connected to the selective attenuation unit **558**. Activation of the selective attenuation unit is controlled by output **C** of the logic unit **574**. The output of the selective attenuation unit is connected to the selective amplification unit **560** similarly controlled by output **D** of the logic unit **574**. The output of the selective amplification unit is connected to the inverse Fourier transform unit **562**. Output of the unit **562** is connected to the first input of the four-input summation unit **580**. The playback sound terminal **552** is connected to the playback sound gating unit **564**, controlled by the output **A** of the logic unit **574**. Output of the unit **564** is connected to the second input of the four-input summation unit **580**.

[00118] The sound control unit also has two terminals for input of information pertaining to the detection of signals of interest to the system (terminal **566**) and specifically of auditory signals (terminal **568**). Via terminal **566**, information comprised of the class of the detected signal of interest, of its optional sound replacement information, and of frequencies occupied by the signal of interest arrives. Terminal **566** is connected to selective attenuation and amplification units **558** and **560**, to the replacement sound playback unit **576**, to the text-to-speech synthesizer **578**, and to the logic unit **574**. Terminal **568** is connected only to the logic unit **574** to allow for action-taking when auditory signal is detected.

[00119] The logic unit **574** is actually responsible for the control of the sound. It has four inputs and five outputs. Four inputs are: the already described terminals **566** and **568**; the operation mode switch terminal **570** via which the user of the system sets the current mode of operation; and the sound replacement enable terminal **572** via which the user of the system enables or disables sound replacement mode for sounds that have associated sound replacement information. Five outputs of the logic unit **574** are named **A**, **B**, **C**, **D**, and **E** in drawing for ease of reference and are connected to the playback sound gating unit **564**, to the ambient sound gating unit **556**, to the selective attenuation unit **558**, to the selective amplification unit **560**, and to both the replacement sound playback unit **576** and the text-to-speech converter **578**, respectively. The logic unit operates in accordance with the rules described in the next section.

[00120] The replacement sound playback unit **576** is used to render to the user the replacement sound associated with the detected environmental sound. Terminal **566** is connected to the connected to the replacement sound playback unit **576** for transmission of the sound replacement information, which may include the replacement sound associated with the detected sound. If no replacement sound is associated with the detected sound, the replacement sound playback unit **576** does not produce any output. The output **E** of the logic unit **574** is also connected to the replacement sound playback unit **576** for enabling/disabling its operation. The output of the replacement sound playback unit **576** is connected to the third input of the four-input summation unit **580**.

[00121] The TTS converter **578** is used to announce the occurrence of sounds of interest in the environment. Terminal **566** is connected to the TTS converter **578** for transmission of the sound replacement information, which may include the textual label of the sound. If no textual label is associated with detected sound, the TTS converter **578** does not produce any output. The output **E** of the logic unit **574** is also connected to the TTS converter **578** for enabling/disabling its operation. The output of the TTS converter **578** is connected to the fourth input of the four-input summation unit **580**.

[00122] The summation unit **580** sums up the outputs of the inverse Fourier transform unit **562**, of the playback sound gating unit **564**, of the replacement sound playback unit **576**, and of the TTS converter **578** and is connected to the output terminal **582** for the in-ear loudspeaker.

[00123] In the foregoing, a brief description of the operation of the sound control unit 178 is provided. The sound control unit executes actions based on the recognized sounds of interest to the system. Depending on the current mode of operation, set by two switches connected to the terminals **570** and **572**, the action can be different.

[00124] Via the terminal **566**, the information about recognized sound of interest arrives when such sound occurs. The information includes the class of sound (alert word, desirable sound, or undesirable sound), optional sound replacement information associated with the detected sound, and the list of particular frequency bands occupied by the detected sound. Via the terminal **568**, the information of whether the relevant auditory signal is detected arrives. In logic unit **574**, reaction to auditory signals takes precedence over any reaction to the other signals of interest.

[00125] Via the terminal **550**, ambient sound arrives. It is then subject to the Fourier transform in the unit **554** and can be turned on or off with ambient sound gating unit **556** controlled by the output **B** of the logic unit **574**. It can be further selectively attenuated by unit **558** or amplified by unit **560** at frequencies specified in the information transmitted via terminal **566**. Activation of the units **558** and **560** is controlled by outputs **C** and **D** of the logic unit **574**, respectively. The ambient sound is then subject to inverse Fourier transform done by unit **562** in order to convert the signal back to the time domain and is passed to the output terminal **582** and thus to the user of the system via summation unit **580**.

[00126] Via the terminal **552**, playback sound arrives. It can be turned on or off with playback sound gating unit **564** controlled by output **A** of the logic unit **574**. It is then passed to the output terminal **582** and thus to the user of the system via summation unit **580**.

[00127] The sound replacement capability is based on replacement sound playback unit **576** and TTS converter **578**. Activation of the sound replacement capability is controlled by the output **E** of the logic unit **574**. When sound replacement mode is active, if sound replacement information contains the replacement sound (the textual label) associated with detected sound, the replacement sound playback unit **576** (the TTS converter **578**) activates and renders the replacement sound associated with (translates to speech the textual label, respectively) associated with the detected environmental sound arriving via sound signature information terminal **566**. Outputs of the replacement sound playback unit **576** and of the TTS converter **578** are passed to the output terminal **582** and thus to the user of the system via summation unit **580**. In addition, when sound replacement mode is active, the original detected sound is attenuated by the selective attenuation unit **558** so that the original sound is not heard by the user and only the replacement sound or textual recitation is heard.

[00128] The logic unit **574** controls six units (**564**, **556**, **558**, **560**, **576**, and **578**) with five outputs named **A**, **B**, **C**, **D**, and **E**, respectively. Unit **564** passes through the playback signal only if output **A** of the unit **564** is "true". Unit **556** passes through the ambient signal only if output **B** of the unit **564** is "true". Unit **558** selectively attenuates the frequencies defined in the information arriving via the terminal **566** only if output **C** of the unit **574** is "true". Unit **560** selectively amplifies the frequencies defined in the information arriving via the terminal **566** only if output **D** of the unit **574** is "true". Unit **576** performs rendering of the replacement sound contained in the information arriving via the terminal **566** only if output **E** of the unit **574** is "true". Unit **578** performs TTS conversion of the textual label contained in the information arriving via the terminal **566** only if output **E** of the unit **574** is "true".

[00129] The system's mode of operation is selected by the user via the switch connected to the terminal **570**. Four modes of operation are possible: transparency, amplification, attenuation, and playback. In addition, the user may enable sound replacement mode (SRM) via the switch connected to the terminal **572**. For each

possible combination of switches **570** and **572**, the rules of operation for the logic unit **574** are listed below as values of outputs **A**, **B**, **C**, **D**, and **E**, respectively, abbreviated to five letters with **T** meaning "true" and **F** meaning "false".

Mode: Transparency, SRM Disabled
Recognized Auditory signal: Unit **574** output: **FTFFF**
Recognized Alert Word: Unit **574** output: **FTFFF**
Recognized Desirable Sound: Unit **574** output: **FTFFF**
Recognized Undesirable Sound: Unit **574** output: **FTFFF**
No Signal Of Interest Recognized: Unit **574** output: **FTFFF**

Mode: Transparency, SRM Enabled
Recognized Auditory signal: Unit **574** output: **FTFFF**
Recognized Alert Word: Unit **574** output: **FTTFT**
Recognized Desirable Sound: Unit **574** output: **FTTFT**
Recognized Undesirable Sound: Unit **574** output: **FTFFF**
No Signal Of Interest Recognized: Unit **574** output: **FTFFF**

Mode: Amplification, SRM Disabled
Recognized Auditory signal: Unit **574** output: **FTFFF**
Recognized Alert Word: Unit **574** output: **FTFFF**
Recognized Desirable Sound: Unit **574** output: **FTFTF**
Recognized Undesirable Sound: Unit **574** output: **FTFFF**
No Signal Of Interest Recognized: Unit **574** output: **FTFFF**

Mode: Amplification, SRM Enabled
Recognized Auditory signal: Unit **574** output: **FTFFF**
Recognized Alert Word: Unit **574** output: **FTFFF**
Recognized Desirable Sound: Unit **574** output: **FTTFT**
Recognized Undesirable Sound: Unit **574** output: **FTFFF**
No Signal Of Interest Recognized: Unit **574** output: **FTFFF**

Mode: Attenuation, SRM Disabled or Enabled
Recognized Auditory signal: Unit **574** output: **FTFFF**
Recognized Alert Word: Unit **574** output: **FTFFF**
Recognized Desirable Sound: Unit **574** output: **FTFFF**
Recognized Undesirable Sound: Unit **574** output: **FTTFF**
No Signal Of Interest Recognized: Unit **574** output: **FTFFF**

Mode: Playback, SRM Disabled
Recognized Auditory signal: Unit **574** output: **FTFFF**
Recognized Alert Word: Unit **574** output: **FTFTF**
Recognized Desirable Sound: Unit **574** output: **TTFTF**
Recognized Undesirable Sound: Unit **574** output: **TFFFF**
No Signal Of Interest Recognized: Unit **574** output: **TFFFF**

Mode: Playback, SRM Enabled
Recognized Auditory signal: Unit **574** output: **FTFFF**
Recognized Alert Word: Unit **574** output: **FTTFT**
Recognized Desirable Sound: Unit **574** output: **TTTFT**
Recognized Undesirable Sound: Unit **574** output: **TFFFF**
No Signal Of Interest Recognized: Unit **574** output: **TFFFF**

[00130] As can be seen from the tables above, the auditory signal takes priority and the system interrupts sound playback and goes to the state equivalent to the transparency mode if danger signal is recognized. Several other actions detailed in the table are also taken to react to alert words with possible textual announcement, to amplify desired sounds, and to eliminate undesired sounds based on the current operation mode. In transparency mode, the system does not take any action at all as the person just hears outside world as he/she would hear it without headphones, and if sound replacement mode is active, the detection of alert word or of a desirable sound triggers attenuation of that sound and rendering of the replacement sound instead.

[00131] One of the advantages of the presented invention is the convenient automatic shutdown of audio content playback if an auditory signal is detected in the environment. Another advantage is reduction of unnecessary/unwanted/harmful sounds. For example, in the dentist's office the constant noise of the dentist drill inhibits communication between the doctor and the patient and contributes to the noise-induced hearing loss common to the occupation of dentist. Both of these problems can be solved if a sound of dentist drill is filtered out with the present listening device.

[00132] Yet another advantage is localization and amplification of sounds of interest to the wearer with optional interruption of playback upon detection of such sounds, thereby improving the situation awareness and listening acuity of the user. The listening system may be implemented in several modifications to suit various needs and fall into various price ranges, such as the system having only the ability to recognize basic danger signals (car horn, ambulance siren, etc.) and disable audio playback upon such detection; the system having additional ability to recognize and localize sounds of interest and perform amplification, attenuation, TTS conversion, and sound replacement, with some basic sounds pre-programmed into the system; and fully customizable system having expanded sound storage and sound recognition capabilities (e.g., recognizing alert words in many languages), ability to download sound signatures for specific sounds of interest to the particular user (such as bike bell for joggers), and ability to learn new sounds of interest by playing such sound to the system in the training mode and assigning appropriate action to the learned sound.

[00133] In one embodiment, the system can be employed in an automobile audio scenario. It is relatively common occurrence for the driver of the car to play loud music in the car, thereby hindering his/her ability to hear sounds of emergency vehicles and car horns of other cars. The described system can be modified to use in such scenario by automatically shutting down the playback of music if/when such emergency sound is detected.

[00134] Another specific application is use of the system in the search and rescue tasks. Currently, firefighters countrywide use PASS (Personal Alert Safety System) apparatus. PASS is typically a small box mounted on the belt of the wearer and is

configured to emit a loud tone when a person wearing such it remains motionless for a pre-determined period of time, suggesting that he is unconscious, is stuck in or under debris, has fallen to the floor, etc. Another firefighter using the personal listening device described herein tuned to the alert produced by PASS and set to amplification and localization mode can use the information provided by the device, such as direction and distance to the source, to find the disabled firefighter by literally moving so as the reported direction to the source decreases.

[00135] In another embodiment, a personal listening device incorporating aspects of the disclosed invention can be worn throughout the day by the person and provide comfortable and safe listening experience. The personal listening device can also include capabilities for monitoring of the sound exposure for the purposes of hearing loss prevention; for wireless integration with communication devices (e.g., for notification of incoming e-mail); for frequency response normalization according to the user's ear anatomy and personal preferences; etc.

[00136] While a specific embodiment has been illustrated above containing many specificities and implementation details, these should not be construed as limiting the scope of the invention but as merely providing illustrations as to how to build and operate presently preferred embodiment. Numerous modifications and departures from the exact description above are possible without departing from the nature and the essence of the invention. For example, different sound recognition and classification algorithms may be used; the signal processing may be done in the unit external to the headphones (e.g., located on the belt of the wearer); different circuitry may be used to discern auditory signals; etc. Thus the scope of this invention should be determined by the appended claims and their legal equivalents, rather than by the examples given.

CLAIMS

What is claimed is,

1. A listening device, comprising:

a) means for directing a sound produced by a receiver into an ear;

b) means for mounting a microphone so as to receive the sound in an environment;

c) detecting means for detecting an auditory signal in the sound received by said microphone; and

d) alerting means for alerting said user to the presence of said auditory signal detected by said detecting means.

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2. The listening device of Claim 1 wherein said alerting means comprises a controllable electronic valve arranged to shut off the said receiver upon detection of said auditory signal by said detecting means.

3. The listening device of Claim 1 wherein said detecting means comprises:

a) first means for detecting whether the volume of the sound received by said microphone is more than a predetermined level;

b) second means for detecting whether the spectral pattern of the sound received by said microphone is characteristic of said auditory signal;

c) third means for detecting whether the temporal pattern of the sound received by said microphone is characteristic of said auditory signal,

d) fourth means for detecting whether sound received by said microphone is approaching to or receding from the device; and

e) fifth means for combining the outputs of said first, second, third, and fourth means.

4. The listening device of Claim 3 wherein said predetermined level is set at least to about 65 dB.

5. The listening device of Claim 3 wherein said second means consist of:

a) means for detecting whether the signal-to-noise ratio is more than about 13 dB in at least one one-third-octave-wide frequency band;

b) means for detecting whether the signal-to-noise ratio is more than about 10 dB in at least one one-octave-wide frequency band; and

c) means for detecting whether the signal-to-noise ratio is more than about 15 dB, all enjoined by the logical OR operator.

6. The listening device of Claim 3 wherein said third means comprises periodicity detector and pitch detector arranged to activate upon detection of a sound with period between about 0.5 and about 4 Hz and pitch between about 500 and about 1000 Hz, respectively.

7. The listening device of Claim 3 wherein said fourth means is arranged to operate by analyzing sound level over time and by analyzing Doppler shifts in the sound spectrum.

8. A listening device , comprising:

a) means for directing a sound produced by a receiver into an ear of a user;

b) means for mounting a microphone so as to receive the sound in an environment surrounding said user;

c) recognition means for recognizing predetermined environmental sounds; and

d) action means for performing predetermined actions upon recognition of said environmental sounds.

9. The listening device of Claim 8 wherein said recognition means comprise:

a) first means for computing a sound signature of an environmental sound consisting of a vector of numerical values identifying said environmental sound;

b) second means for storing a plurality of said sound signatures; and

c) third means for comparing the sound signature of said environmental sound with said plurality of sound signatures stored by said second means, where the means for comparing determines a best-matching sound signature.

10. The listening device of Claim 9 wherein said vector of numerical values comprises at least one among total power of said environmental sound, powers of said environmental sound in predetermined frequency bands, mel-frequency cepstral coefficients of said environmental sound, a pitch of said environmental sound, a bandwidth of said environmental sound, and a brightness of said environmental sound.

11. The listening device of Claim 9 wherein said third means is arranged to operate using distance between said plurality of sound signatures, using support vector machine (SVM) classifier, using neural network classifier, or using mixture of Gaussians classifier.

12. The listening device of Claim 9, further including fourth means for directing said sound signature produced by first means into the sound signature storage provided by second means.

13. The listening device of Claim 8, further including localization means for determining at least one among a location, direction and distance of said environmental sound with respect to said user.

14. The listening device of Claim 13 wherein said localization means is arranged to operate using one or more acoustic cues selected from the group comprising:

a) level (intensity) differences between the signals received at left and right ears;

b) phase differences between the signals received at left and right ears;

c) level (intensity) variation over time for the signals received at left and right ears; and

d) phase variation over time for the signals received at left and right ears.

15. The listening device of Claim 8 wherein said action means comprise one or more means selected from the group comprising:

a) first means of selectively amplifying said environmental sound recognized by said recognition means;

b) second means of selectively attenuating said environmental sound recognized by said recognition means;

c) third means of alerting said user to said environmental sound recognized by said recognition means by reciting a textual label pre-associated with said environmental sound to said user by means of text-to-speech synthesizer;

d) fourth means of alerting said user to said environmental sound recognized by said recognition means by rendering a specific sound pre-associated with said environmental sound to said user;

e) fifth means of alerting said user to said environmental sound recognized by said recognition means by reciting information indicative of how far and in which direction said environmental sound is located;

f) sixth means of alerting said user to said environmental sound recognized by said recognition means by discontinuing the playback of any audio content being played over said listening device; and

g) seventh means of associating an indicator of which particular action or actions, from the list above, can be executed upon detection of said environmental sound.

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16. A method for constructing a audio listening device, comprising:

a) providing means for directing a sound produced by a receiver into an ear of said user;

b) providing means for mounting a microphone so as to receive the sound in an environment surrounding said user;

c) providing detecting means for detecting an auditory signal in the sound received by said microphone; and

d) providing alerting means for alerting said user to the presence of said auditory signal detected by said detecting means.

17. The method of Claim 16 wherein said alerting means comprises a controllable electronic valve arranged to shut off the said receiver upon detection of said auditory signal by said detecting means.

18. The method of Claim 16 wherein said detecting means comprises:

a) first means for detecting whether the volume of the sound received by said microphone is more than a predetermined level;

b) second means for detecting whether the spectral pattern of the sound received by said microphone is characteristic of said auditory signal;

c) third means for detecting whether the temporal pattern of the sound received by said microphone is characteristic of said auditory signal;

d) fourth means for detecting whether sound received by said microphone is approaching to or receding from said user; and

e) fifth means for combining the outputs of said first, second, third, and fourth means.

19. A method for constructing an audio listening device, comprising:

a) providing a receiver and means for directing a sound produced by said receiver into an ear of said user;

b) providing means for mounting a microphone so as to receive the sound in an environment ;

c) providing recognition means for recognizing predetermined environmental sounds; and

d) providing action means for performing predetermined actions upon recognition of said environmental sounds.

20. The method of Claim 19 wherein said recognition means comprise:

a) first means for computing a sound signature of said environmental sound consisting of a vector of numerical values identifying said environmental sound;

b) second means for storing a plurality of said sound signatures; and

c) third means for comparing the sound signature of said environmental sound with said plurality of sound signatures stored by said second means and for determining the best-matching sound signature.

21. The method of Claim 20 wherein said vector of numerical values comprises total power of said environmental sound, powers of said environmental sound in predetermined frequency bands, mel-frequency cepstral coefficients of said environmental sound, a pitch of said environmental sound, a bandwidth of said environmental sound, and a brightness of said environmental sound.

22. The method of Claim 20 wherein said third means is arranged to operate using distance between said sound signatures, using support vector machine (SVM) classifier, using neural network classifier, or using mixture of Gaussians classifier.

23. The method of Claim 20, further including fourth means for directing said sound signature produced by first means into the sound signature storage provided by second means, whereby the listening device can query the sound signature storage to recognize, and act upon recognition of new sound signatures.

24. The method of Claim 19, further including localization means for determining at least one among a location, direction, and distance of said environmental sound with respect to said user,

wherein said localization means is arranged to operate using one or more acoustic cues selected from the group comprising:

a) level (intensity) differences between the signals received at left and right ears;

b) phase differences between the signals received at left and right ears;

c) level (intensity) variation over time for the signals received at left and right ears; and

d) phase variation over time for the signals received at left and right ears.

25. A method for acute sound detection and reproduction, the method comprising:

measuring an external ambient sound level in an ear canal at least partially occluded by an earpiece;

monitoring a change in the external ambient sound level for detecting a sound;

determining whether a sound source producing the sound is approaching or departing; and

reproducing the sound within the ear canal responsive to detecting the sound based on the step of determining.

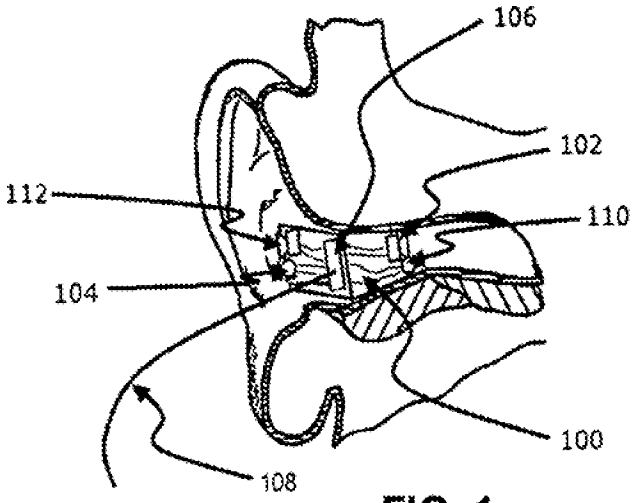

106
102
112
110
104
100
108

FIG. 1

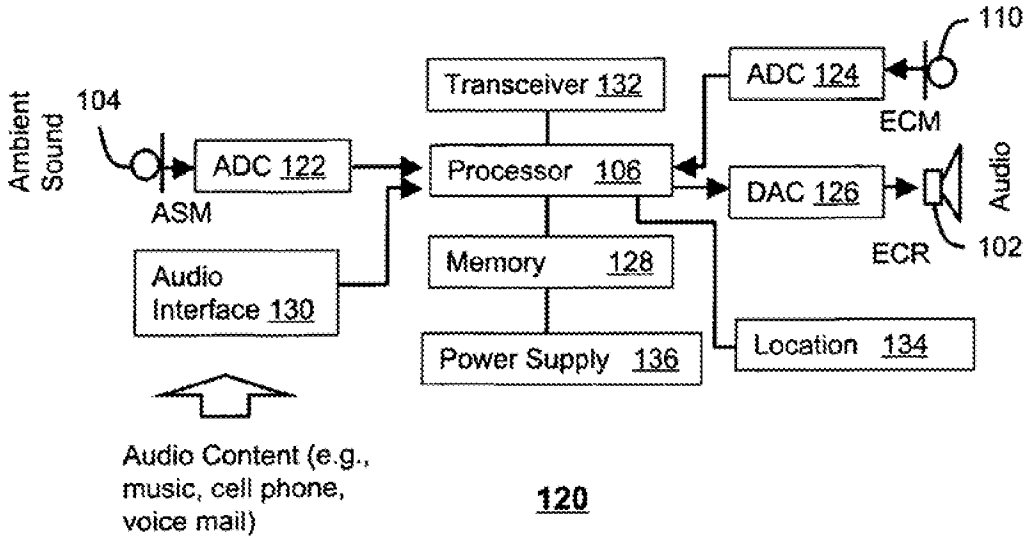
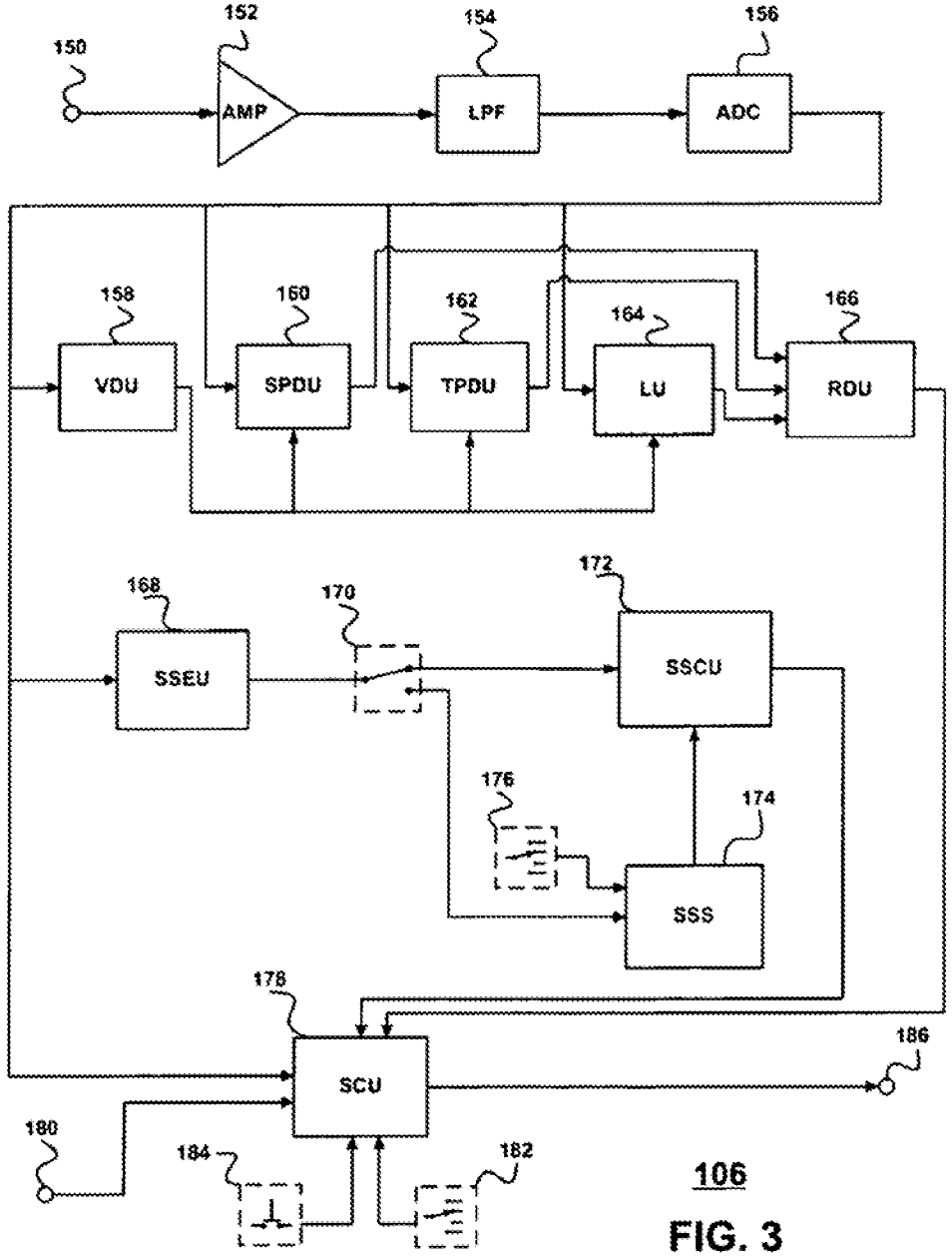
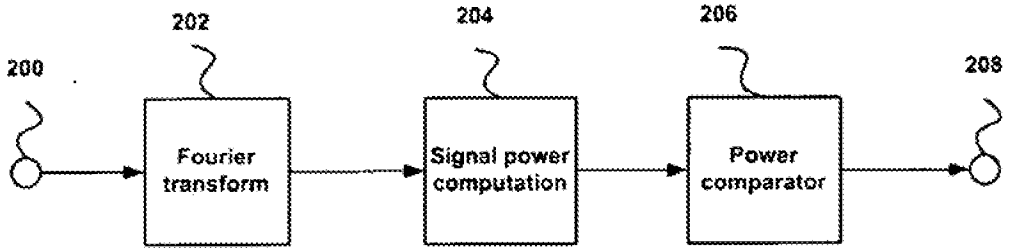

110
Transceiver 132
ADC 124
ECM
Ambient Sound
104
ADC 122
ASM
Processor 106
DAC 126
Audio
Memory 128
ECR
102
Audio Interface 130
Power Supply 136
Location 134
Audio Content (e.g., music, cell phone, voice mail)
120

FIG. 2


150
152
AMP
154
LPF
156
ADC
158
VDU
160
SPDU
162
TPDU
164
LU
166
RDU
168
SSEU
170
172
SSCU
174
176
SSS
178
SCU
180
182
184
186

106

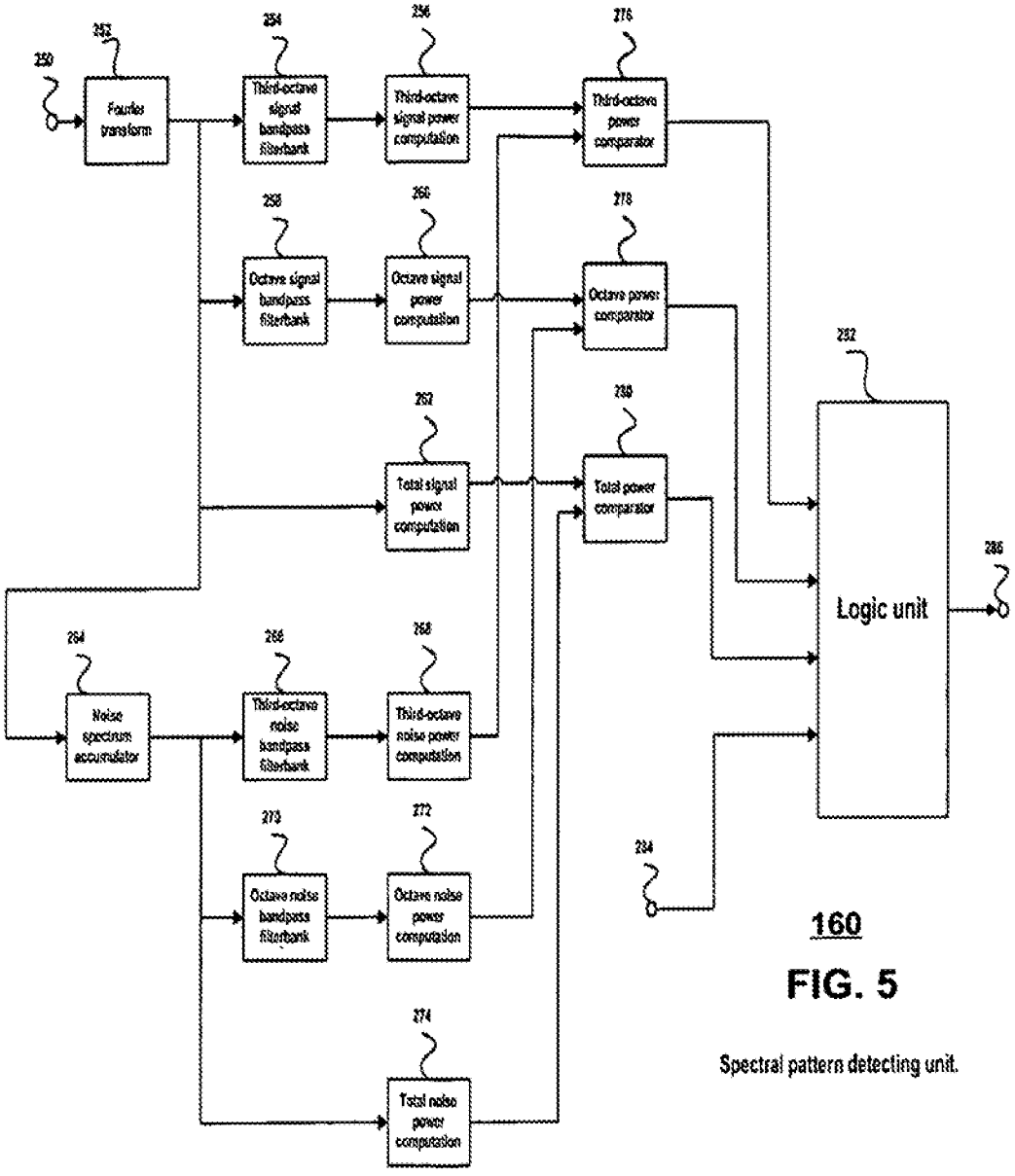
FIG. 3



Volume Detecting Unit

158

FIG. 4



160

FIG. 5

Spectral pattern detecting unit.

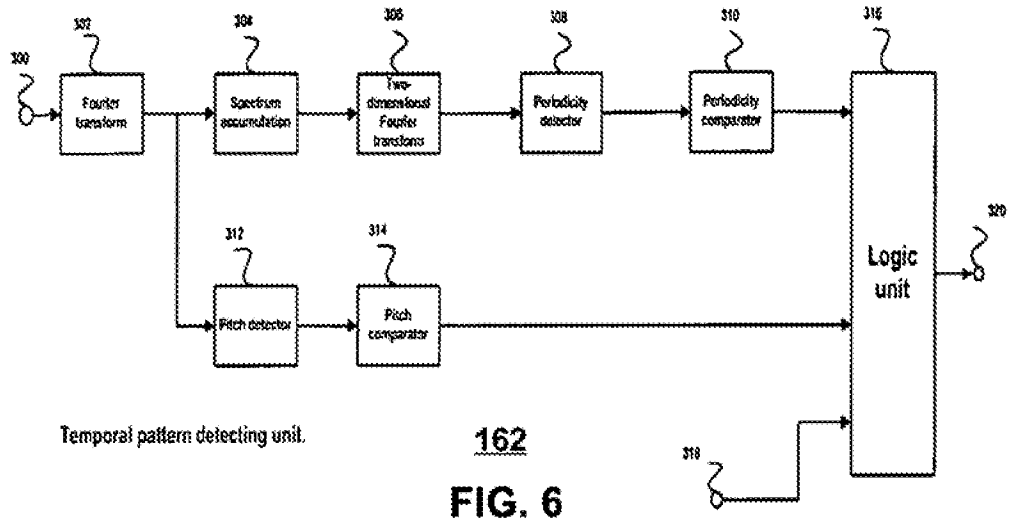

300
302
Fourier transform
304
Spectrum accumulation
306
Two-dimensional Fourier transform
308
Periodicity detector
310
Periodicity comparator
316
Logic unit
320
312
Pitch detector
314
Pitch comparator
318
Temporal pattern detecting unit.
162

FIG. 6

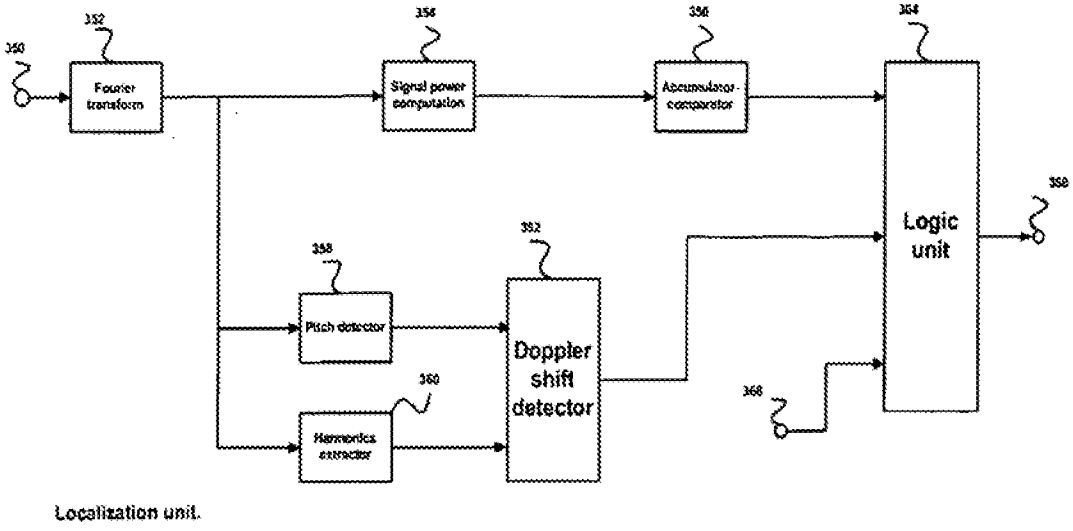
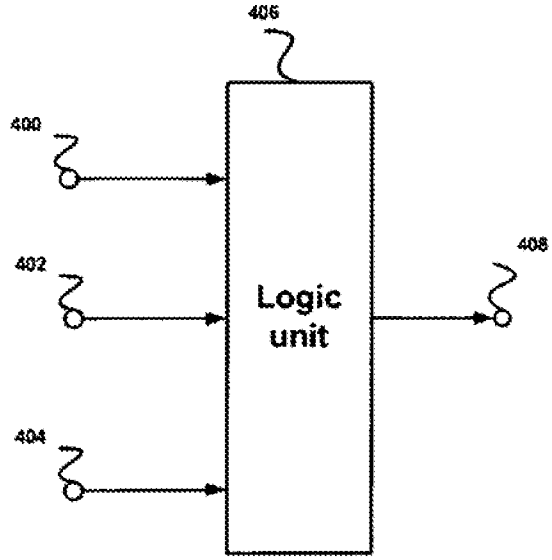

350
352
Fourier transform
356
Signal power computation
358
Accumulator comparator
364
Logic unit
368
358
Pitch detector
362
Doppler shift detector
360
Harmonics extractor
Localization unit.
164

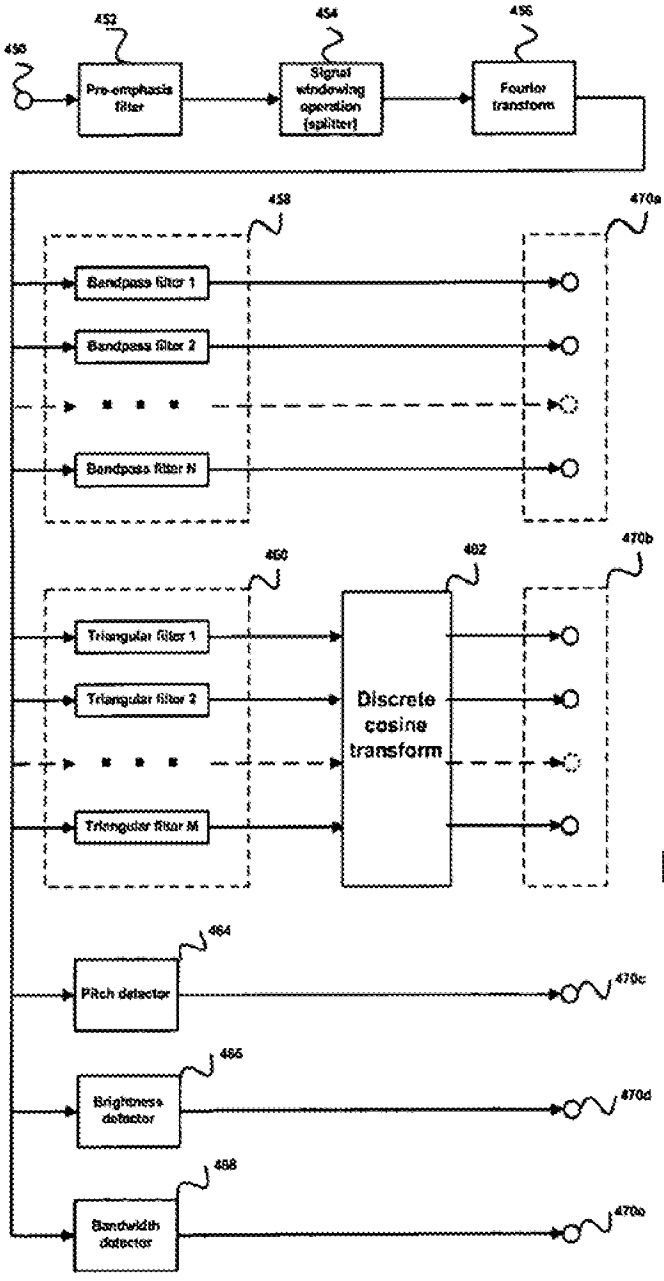
FIG. 7



166

FIG. 8

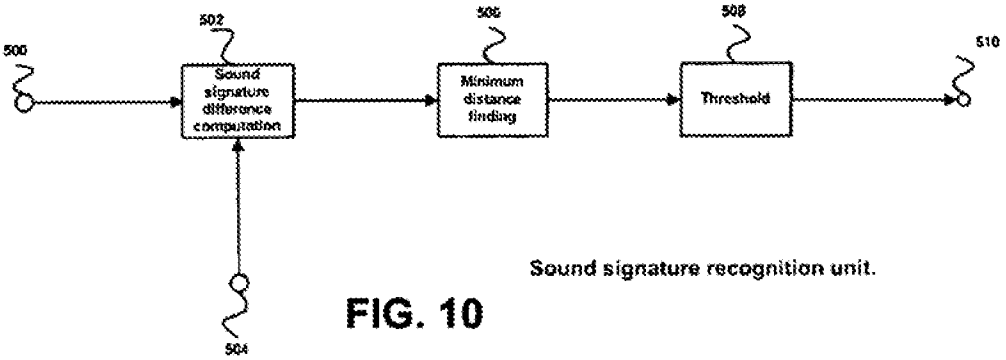
Relevance Detecting Unit



168

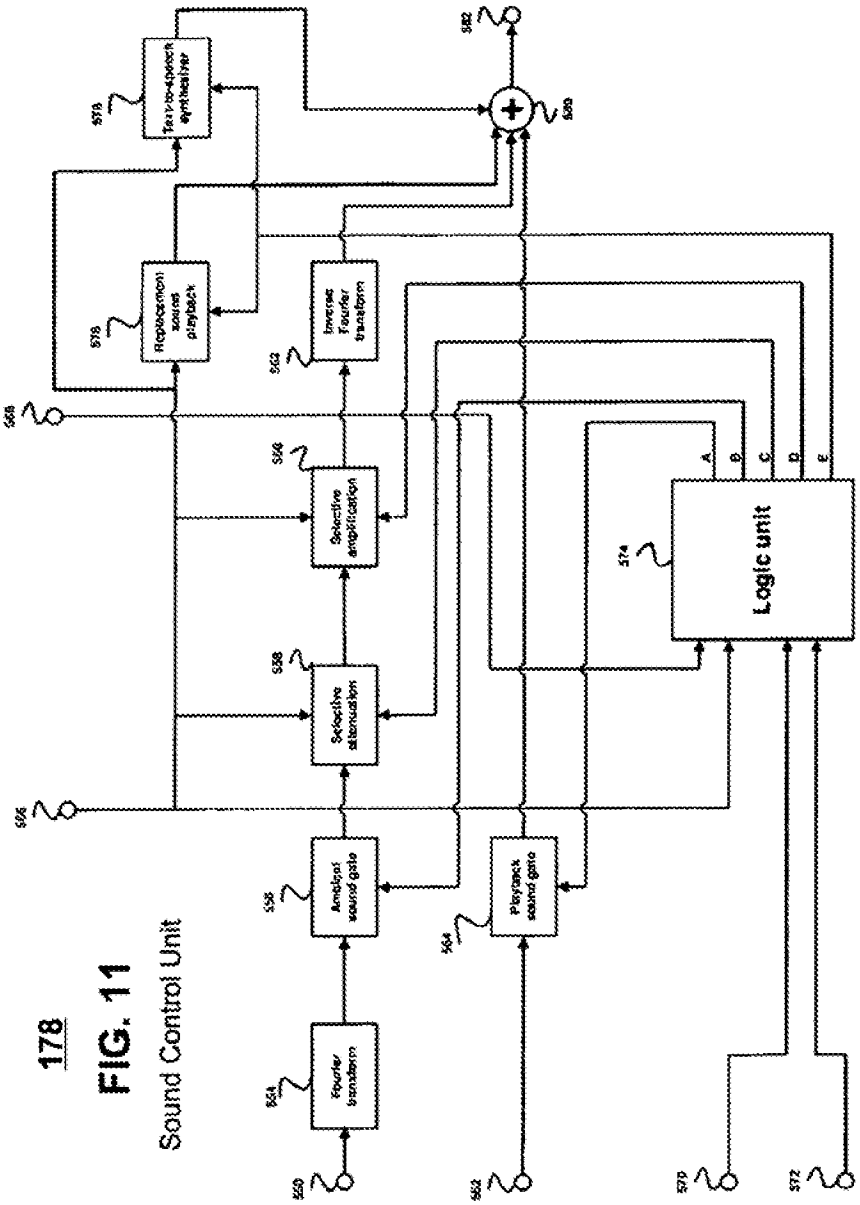
FIG. 9

SSEU



Sound signature recognition unit.

FIG. 10



178

FIG. 11

Sound Control Unit

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/054756

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H04R 29/00 (2008.04)
USPC - 381/56
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - H04R 29/00 (2008.04)
USPC - 381/56

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
USPTO EAST System (US, USPG-PUB, EPO, DERWENT), PatBase

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/0165770 A1 (NELSON et al) 12 August 2004 (12.08.2004) entire document	1, 8-12, 16, 19-24
Y		2-7, 13-15, 17, 18, 25
Y	US 5,710,555 A (MCCONNELL et al) 20 January 1998 (20.01.1998) entire document	3-7, 13-15, 18, 25
Y	US 2004/0179694 A (ALLEY) 16 September 2004 (16.09.2004) entire document	2, 15, 17

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

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 July 2008	15 JUL 2008
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

[Continued on next page]

(54) Title: HEADSET HAVING WIRELESSLY LINKED EARPIECES

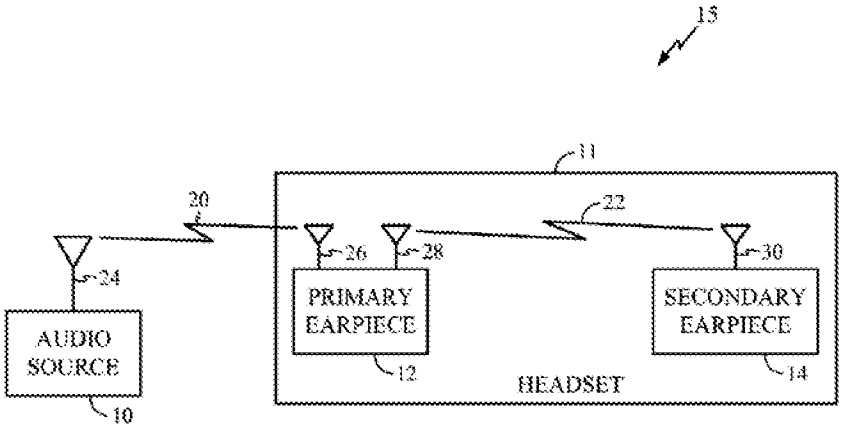


FIG. 2

(57) Abstract: A wireless headset includes a first earpiece and a second earpiece, where the first and second earpieces communicate with each other over a wireless link. In some configurations, the first earpiece includes both a primary wireless interface for receiving audio from an audio source and a secondary wireless interface transmitting a portion of the audio to the second earpiece. The earpieces can incorporate Near Field Communication (NFC) technology to provide the wireless link between each other. The wireless headset can be configured to synchronize audio output at the earpieces, and can also include a second-earpiece detection mechanism that permits the first earpiece to be used in either a stand-alone mode, with audio output at only the first earpiece, or full-headset mode, with audio output at both earpieces when the second earpiece is detected within wireless range of the first earpiece.

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HEADSET HAVING WIRELESSLY LINKED EARPIECES

Claim of Priority under 35 U.S.C. §119

[0001] The present Application for Patent claims priority to Provisional Application No. 60/918,252, entitled "Near-Field Communications Headset" filed March 14, 2007, and assigned to the assignee hereof.

BACKGROUND

Field

[0002] This disclosure generally relates to audio communications, and more particularly, to audio headsets.

Background

[0003] Wired and wireless headsets are known. Conventional wired headsets include a wire running between an audio source and either one or two earpieces that are intended to fit on or within a user's ears. In many cases, a wireless headset is simply a replacement for a wired headset. Generally, wireless headsets substitute a wireless link for the wire running between the headset and audio source. Wireless headsets are used to provide a greater degree of user freedom, as the user is no longer tethered to the audio source by a wire. It is known for both wired and wireless headsets to be used with audio sources such as communication devices, e.g., cordless telephones, mobile radios, personal digital assistants (PDAs), cellular subscriber units and the like, as well as other devices, such as MP3 players, stereo systems, radios, video games, personal computers, laptop computers and the like.

[0004] Known wireless headsets communicate with audio sources using radio frequency (RF) or infrared wireless technology. Such wireless headset communications have been extended to personal wireless networks, such as the one defined by the Bluetooth Specification available at www.bluetooth.com. The Bluetooth Specification provides specific guidelines for providing wireless headset functionality. In particular, the Bluetooth Specification provides a Headset Profile that defines protocols and procedures for connecting a wireless headset to a device private network. Once configured, the headset can function as a device's audio input and/or output. Thus, a particularly popular use of Bluetooth networks is to provide wireless headset

connectivity for cellular telephones, MP3 players and PDAs. In addition, the Bluetooth Specification also provides the Advanced Audio Distribution Profile (A2DP) that defines protocols and procedures for wirelessly distributing high-quality stereo or mono audio over a Bluetooth network.

[0005] Wireless and wired headsets are available in both single earpiece and dual earpiece configurations. In dual-earpieces headsets, the earpieces are wired together and are often integrated into a headband that secures an earpiece over or in each ear.

[0006] Dual-earpiece headsets are advantageous because they allow playback of stereo audio and also because in some circumstances they allow users to fully immerse themselves in the audio output, while masking out noise from the immediate environment. However, known dual-earpiece headsets require additional wiring between earpieces and often include headbands, frequently making the headsets larger than some of contemporary audio source devices that they are intended to support, e.g., MP3 players, PDAs, and cellular phones. In addition, although dual-earpiece headsets are highly desirable in some situations, they are not desirable in others. For example, in some jurisdictions, it is not permissible to operate motor vehicles on public roadways while wearing dual-earpiece headsets.

[0007] Thus, there is a need for an improved headset that allows a user to conveniently select either a single earpiece or dual earpiece configuration. There is also a need for an improved headset that provides a dual-earpiece configuration that eliminates the need for headbands and wiring between earpieces, and is therefore better scaled to the relatively small size of many contemporary audio devices.

SUMMARY

[0008] Disclosed herein is a new and improved wireless headset that introduces significantly greater user freedom. The headset described herein can be entirely wireless, with no wires running between the earpieces or the audio source. A dual-earpiece configuration of the headset does not require a headband or wiring between the earpieces.

[0009] According to one aspect of the wireless headset, the wireless headset includes a first earpiece and a second earpiece, where the first and second earpieces communicate with each other over a wireless link.

[0010] According to another aspect of the wireless headset, the first earpiece may include both a primary wireless interface for receiving audio from an audio source and a secondary wireless interface for transmitting at least a portion of the audio to the second earpiece.

[0011] According to a further aspect of the wireless headset, a method of outputting audio at a headset includes receiving audio at a first earpiece, transmitting the audio from the first earpiece to a second earpiece over a wireless link, and outputting the audio at the first and second earpieces.

[0012] According to an additional aspect of the wireless headset, a system for outputting audio at a headset includes means for receiving audio at a first earpiece, means for transmitting the audio from the first earpiece to a second earpiece over a wireless link, and means for outputting the audio at the first and second earpieces.

[0013] According to an another aspect of the wireless headset, a computer-readable medium embodying a set of instructions, wherein the set of instructions when executed by one or more processors includes a code segment for receiving audio at a first earpiece, a code segment for transmitting the audio from the first earpiece to a second earpiece over a wireless link, and a code segment for outputting the audio at the first earpiece.

[0014] Other aspects, features, and advantages of the wireless headset will be or will become apparent to one with skill in the art upon examination of the following figures and detailed description. It is intended that all such additional features, aspects, processes and advantages be included within this description and be protected by the accompanying claims.

[0015]

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] It is to be understood that the drawings are solely for purpose of illustration. Furthermore, the components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the wireless headset and its various aspects. In the figures, like reference numerals designate corresponding parts throughout the different views.

[0017] FIG. 1 is a diagram illustrating a user wearing an exemplary wireless headset with wirelessly linked earpieces.

[0018] FIG. 2 is a conceptual block diagram illustrating components of the wireless headset system of FIG. 1.

[0019] FIG. 3 is a detailed block diagram illustrating specific components of the wireless headset system of FIG. 1.

[0020] FIG. 4 is a conceptual block diagram illustrating certain functional aspects of a primary earpiece included in the wireless headset.

[0021] FIG. 5 is a flowchart illustrating a method of audio processing performed by the primary earpiece of the wireless headset.

[0022] FIG. 6 is a flowchart illustrating a method of operating the secondary earpiece included in the wireless headset.

[0023] FIG. 7 is a flowchart illustrating a method of audio output clock synchronization between the primary and secondary earpieces.

[0024] FIG. 8 conceptually illustrates a process of adjusting the local audio output clock within the secondary earpiece.

[0025] FIG. 9 illustrates exemplary formats for audio and time sync packets transmitted between the primary and secondary earpieces.

DETAILED DESCRIPTION

[0026] The following detailed description, which references to and incorporates the drawings, describes and illustrates one or more specific embodiments. These embodiments, offered not to limit but only to exemplify and teach, are shown and described in sufficient detail to enable those skilled in the art to practice what is claimed. Thus, for the sake of brevity, the description may omit certain information known to those of skill in the art.

[0027] The word "exemplary" is used throughout this disclosure to mean "serving as an example, instance, or illustration." Any embodiment or feature described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments or features.

[0028] Turning now to the drawings, and in particular to FIG. 1, there is illustrated a user 16 wearing an exemplary wireless headset 11 with wirelessly linked earpieces 12, 14. The wireless headset 11 communicates with an audio source 10 by way of a primary wireless link 20. The wireless headset 11 and audio source 10 form a wireless headset system 15.

[0029] The wireless headset 11 is worn as two separate pieces: a primary earpiece 12 and a secondary earpiece 14. The primary earpiece 12 communicates with the audio source 10 via an RF or infrared primary wireless link 20, and may be worn either alone or separately from the secondary earpiece 14. The secondary earpiece 14 receives audio and other information via a secondary wireless link with the primary earpiece 12. An optional microphone on the first earpiece 12 allows voice communication back to the audio source 10.

[0030] The audio source 10 may be any device capable of transmitting audio signals to the headset 11 such that the audio represented by the audio signals can be output to a user from the headset 11. The audio source may be a communication device, e.g., cordless telephone, mobile radio, personal digital assistant (PDA), cellular subscriber unit or the like, as well as another type of device, such as an MP3 player, stereo system, radio, video game, personal computer, laptop computer or the like.

[0031] The audio signals transmitted between the audio source 10 and the headset 11 over the primary wireless link 20 can represent digitized audio sampled at the industry standard rate of 44.1 KHz.

[0032] The headset 11 and earpieces 12, 14 can having any suitable physical shape and size adapted to securely fit the earpieces 12, 14 over or into a user's ears. For example, the earpieces 12, 14 can be conventional hook-shaped earpieces for attaching behind a user's earlobe and over or into the user's ear canal. The headset 11 can also include a headband (not shown) connecting the earpieces 12, 14.

[0033] FIG. 2 is a conceptual block diagram illustrating components of the wireless headset system 15 of FIG. 1. The primary earpiece 12 communicates with the audio source 10 via the primary wireless link 20 and with the secondary earpiece 14 by way of a secondary wireless link 22. The primary earpiece 12 may include a first antenna 26 for the primary wireless link 20 and a second antenna 28 for the secondary wireless link. The secondary earpiece 14 includes an antenna 30 for communicating over the secondary wireless link 22.

[0034] Although the primary earpiece 12 is shown as having separate antennas 26, 28 for the primary and secondary links 20,22, respectively, one of ordinary skill in the art will understand that in some circumstances the primary earpiece 12 could use a single antenna for both the primary and secondary wireless links 20, 22.

[0035] The primary wireless link 20 may be implemented using any suitable wireless communications technology, including short-range wireless networks such as Bluetooth, Wi-Fi, Ultra Wide Band (UWB), or Wireless USB links. Preferably, the primary wireless link 20 is a Bluetooth wireless link for transporting audio, implemented in accordance with the Bluetooth Specification.

[0036] The secondary wireless link 22 may use any suitable wireless communications technology, and is preferably implemented using Near Field Communication (NFC) wireless devices operating in accordance with the NFC standard specifications, including ECMA-340, ISO/IEC 18092.

[0037] In operation, the primary earpiece 12 may receive a stereo or monaural audio signal via the primary wireless link 20. The primary earpiece 12 decodes the audio signal and renders the audio signal to its own audio transducer for output to the user. A copy of the audio signal or a portion thereof, possibly transcoded to reduce the bitrate, is also sent to the secondary earpiece 14 via the secondary wireless link 22. If the audio signal received by the primary earpiece 12 is in stereo, the primary earpiece 12 may render one stereo channel via its audio transducer, and send the other stereo channel as encoded audio via the secondary wireless link 22. If the secondary earpiece 14 is not present, the primary earpiece 14 may instead downmix incoming stereo to monaural audio prior to rendering the audio to its own audio transducer.

[0038] FIG. 3 is a detailed conceptual block diagram illustrating specific components of the wireless headset system 15. The primary earpiece 12 includes the antennas 26, 28, a primary wireless interface 50, a secondary wireless interface 52, a processor 54, a memory 56, an audio output buffer 58, an audio transmit (Tx) buffer 60, audio output circuitry 62, microphone input circuitry 64, a speaker 68, and a microphone 66. The primary earpiece 12 also includes a battery 70 and a battery charger circuit 72.

[0039] The primary wireless interface 50 provides two-way wireless communications with the audio source 10. Preferably, the primary wireless interface 50 includes a commercially-available Bluetooth module that provides at least a Bluetooth core system consisting of a Bluetooth RF transceiver, baseband processor, protocol stack, as well as hardware and software interfaces for connecting the module to the processor 54.

[0040] The processor 54 controls the overall operation of the primary earpiece 12 and certain components contained therein. The processor 54 can be any suitable processing device for executing programming instructions stored in the memory 56 to cause the

primary earpiece 12 to perform its functions and processes as described herein. For example, the processor 54 can be a microprocessor, such as an ARM7, digital signal processor (DSP), one or more application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), complex programmable logic devices (CPLDs), discrete logic, software, hardware, firmware or any suitable combination thereof.

[0041] The memory 56 is any suitable memory device for storing programming instructions and data executed and used by the processor 54.

[0042] The audio output buffer 58 is any suitable memory device for temporarily storing digitized audio before it is transferred to the audio output circuitry 62 for rendering at the primary earpiece 12. The audio output buffer 58 is controlled by the processor 54 and buffers time-stamped audio packets awaiting output at the primary earpiece 12. Although shown as a separate component of the primary earpiece 12, the audio output buffer 58 may be included in the memory 56.

[0043] The audio output circuitry 62 includes a digital-to-analog converter (DAC) 70 and an audio amplifier 72. The DAC 70 converts digitized audio into an analog audio signal. The analog audio signal is then amplified by the audio amplifier 72 to drive the speaker 68. The audio output circuitry 62 is preferably implemented using commercially-available, off-the-shelf components.

[0044] The speaker 68 is any suitable audio transducer for converting the electronic signals output from the amplifier 72 into sound.

[0045] The microphone (MIC) 66 is any suitable microphone device for converting sound into electronic signals. The microphone 66 and speaker 68 may be combined into a single device in some configurations of the primary earpiece 12.

[0046] The microphone input circuitry 64 processing electronic signals received from the microphone 66. The microphone input circuitry 64 includes an analog-to-digital converter (ADC) 74 and a noise reduction and echo cancellation circuit (NREC) 76. The ADC 74 converts analog signals from the microphone into digital signal that are then processed by the NREC 76. The NREC 76 is employed to reduce undesirable audio artifacts for communications and voice control applications. The microphone input circuitry 64, the ADC 74 and NREC 76 may be implemented using commercially-available hardware, software, firmware, or any suitable combination thereof.

[0047] The microphone 66 may send audio data over the primary wireless link 20 to the audio source 10. The device receiving the microphone signal need not in general be the same audio source device as is sending the audio to the primary earpiece 12.

[0048] The audio Tx buffer 60 is any suitable memory device for temporarily storing digitized audio before it is transmitted over the secondary wireless interface 52 for rendering at the secondary earpiece 14. The audio Tx buffer 60 is controlled by the processor 54 and buffers time-stamped audio packets awaiting transmission to the secondary earpiece 14. Although shown as a separate component of the primary earpiece 12, the audio Tx buffer 60 may be included in the memory 56.

[0049] The secondary wireless interface 52 provides two-way wireless communications with the secondary earpiece 14. Preferably, the secondary wireless interface 52 includes a commercially-available NFC module that provides at least an NFC RF transceiver, baseband processor, protocol stack, as well as hardware and software interfaces for connecting the NFC module to the processor 54.

[0050] The battery 70 can be a replaceable, rechargeable battery for powering the primary earpiece 12. The battery charger circuit 72 may be a commercially-available battery charger circuit having an external jack that permits the battery 70 to be recharged using an AC wall adapter. The battery charger circuit 72 may be controlled by the processor 54.

[0051] The secondary earpiece 14 includes the antenna 30, a secondary wireless interface 100, a processor 102, a memory 104, an audio buffer 106, audio output circuitry 108, and a speaker 110. The secondary earpiece 14 also includes a battery 116 and a battery charger circuit 118.

[0052] The processor 102 controls the overall operation of the secondary earpiece 14 and certain components contained therein. The processor 102 can be any suitable processing device for executing programming instructions stored in the memory 104 to cause the secondary earpiece 14 to perform its functions and processes as described herein. For example, the processor 102 can be a microprocessor, such as an ARM7, digital signal processor (DSP), one or more application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), complex programmable logic devices (CPLDs), discrete logic, software, hardware, firmware or any suitable combination thereof.

[0053] The memory 104 is any suitable memory device for storing programming instructions and data executed and used by the processor 102.

[0054] The secondary wireless interface 100 provides two-way wireless communications with the primary earpiece 12. Preferably, the secondary wireless interface 100 includes a commercially-available NFC module that provides at least an NFC RF transceiver, baseband processor, protocol stack, as well as hardware and software interfaces for connecting the NFC module to the processor 102.

[0055] The audio buffer 106 is any suitable memory device for temporarily storing digitized audio before it is transferred to the audio output circuitry 108 for rendering at the secondary earpiece 14. The audio buffer 106 is controlled by the processor 102 and buffers time-stamped audio packets received at the secondary wireless interface 100 and awaiting output at the secondary earpiece 14. Although shown as a separate component of the secondary earpiece 14, the audio buffer 106 may be included in the memory 104.

[0056] The audio output circuitry 108 includes a digital-to-analog converter (DAC) 112 and an audio amplifier 114. The DAC 112 converts digitized audio into an analog audio signal. The analog audio signal is then amplified by the audio amplifier 114 to drive the speaker 110. The audio output circuitry 108 is preferably implemented using commercially-available, off-the-shelf components.

[0057] The speaker 110 is any suitable audio transducer for converting the electronic signals output from the amplifier 114 into sound.

[0058] The battery 116 can be a replaceable, rechargeable battery for powering the secondary earpiece 14. The battery charger circuit 118 may be a commercially-available battery charger circuit having an external jack that permits the battery 116 to be recharged using an AC wall adapter. The battery charger circuit 118 may be controlled by the processor 102.

[0059] FIG. 4 is a conceptual block diagram illustrating certain functional aspects of a primary earpiece 12. The primary earpiece functions 400 generally include, but are not limited to, a secondary earpiece discovery function 402, an earpiece synchronization function 404, and an audio processing function 406.

[0060] The secondary earpiece discovery function 402 involves detecting the presence of the secondary wireless earpiece 14 when it is within range of the first earpiece 12 through the secondary wireless link 22. Upon detecting the second earpiece 14, the first earpiece proceeds to initiate and establish the secondary wireless link 22 with the

secondary earpiece 14 so that audio can be output at the secondary earpiece 14. The detection and link initiation protocols and procedures are described by the NFC standard specification.

[0061] Each earpiece 12, 14 can store a unique identification number in its respective memory 56, 104 so that headset earpieces can be paired together to only recognize and communicate with each other.

[0062] The primary earpiece 12 can be adaptively configured to operate in a single-earpiece mode (stand-alone mode) when the secondary earpiece 14 is not within range of the secondary wireless link 22 and in a dual-earpiece mode (full-headset mode) when the secondary earpiece 14 is within range. In single-earpiece mode, the primary earpiece 12 does not process audio for transmission to the secondary earpiece 14 and down-mixes any stereo input for output only at the primary earpiece 12. This reduces that power consumption of the primary earpiece 12.

[0063] In dual-earpiece mode, the primary earpiece processes and transmits audio and time synchronization data to the secondary earpiece 14. The primary earpiece 12 can switch from the single-earpiece mode to the dual-earpiece mode upon detecting the presence of the secondary earpiece 14 with wireless range, and can also switch from the dual-earpiece mode to the single-earpiece mode upon determining that the secondary earpiece 14 has moved out of wireless range.

[0064] Software or firmware stored in the memory 56 and executed by the processor 54 can implement the earpiece mode functionality of the primary earpiece 12. The software/firmware can configure the processor 54 to actively monitor the secondary wireless interface 52 to detect the presence or absence of the secondary earpiece 14 on the secondary link 22, and to switch between the single-earpiece and dual-earpiece modes are described immediately above.

[0065] The earpiece synchronization function 402 involves synchronizing local clocks in the primary and secondary earpieces 12, 14 so as to synchronize the audio output at both earpieces 12, 14. This ensures that the separate rendering of the audio at the different earpieces 12, 14 retains inter-channel synchronization. Both earpieces 12, 14 maintain separate audio output clocks. These clocks are used to determine when to output chucks of audio from the earpieces 12, 14 at the speakers 68, 110. The audio output clocks have approximately the same frequency and each has an absolute current time value. The earpiece synchronization function 402 periodically adjusts the current

time value of the secondary earpiece audio output clock so that it is at least approximately equal to the current time value of the primary earpiece audio output clock. The earpiece synchronization function 402 can also control the frequency of the local audio output clocks. FIGS. 7 and 8 describe methods for synchronizing the earpiece audio output clocks.

[0066] The audio processing function 406 involves the reception, transcoding (if necessary), re-transmission, and playback of audio received from the audio source 10. FIG. 5 describes a method of performing the audio processing function 406 of the primary earpiece 12. FIG. 6 describes audio processing carried out by the secondary earpiece 14.

[0067] FIG. 5 is a flowchart 500 illustrating a method of audio process performed by the primary earpiece 12 of the wireless headset 11. Generally, the method is performed under the control of the processor 54, coordinating operations of the various components of the primary earpiece 12.

[0068] In step 502, a Bluetooth streaming audio connection is established between the audio source 10 and the primary earpiece 12, as described in the A2DP specification. During this step, the audio codec type for incoming audio from the audio source 10 is determined. Using Bluetooth as the primary wireless link 20, the audio source 10 and the primary earpiece 12 can negotiate and determine the codec type using standard A2DP protocols and procedures.

[0069] In step 504, after the Bluetooth streaming audio connection is established, audio packets are transmitted from the audio source 10 over the primary wireless link 20 and received by the primary wireless interface 50 of the primary earpiece 12. Generally, the audio packets include digitized audio that is encoded using the negotiated codec. Each audio packet represents a predetermined duration of sound, e.g., 20 milliseconds, that is to be output at the headset 11. The audio packets can be formatted according to the A2DP profile, including one or more frames of encoded audio. The audio can be encoded using any suitable audio codec, including but not limited to SBC, MPEG-1 audio, MPEG-2 audio.

[0070] In decision step 506, the processor 54 determines whether the incoming audio should be transcoded prior to re-transmission on the secondary wireless link 22. Generally, if the codec type used on the primary wireless link 20 is relatively complex, e.g., MPEG-1, the incoming audio is transcoded from the relatively complex code to a

simpler code using a reduced-complexity codec, such as a Bluetooth sub-band codec (SBC).

[0071] If the audio packets are to be transcoded, the incoming packets are first fully decoded into first and second audio channels (step 508). The second audio channel, which is destined for the secondary earpiece 14, is re-encoded using a reduced-complexity codec (step 510). The reduced-complexity codec can be implemented by software running on the processor 54.

[0072] If the audio packets are not transcoded, the audio packets are only partially decoded. Specifically, only the first audio channel is decoded for playback at the primary earpiece 12 (step 512). The second channel audio is not decoded and is simply re-packetized for transmission to the secondary earpiece 14 over the secondary wireless link 22.

[0073] In step 514, the decoded first audio channel is buffered in the audio output buffer 58 for subsequent output at the speaker 68 of the primary earpiece 12. Each packet of decoded first channel audio is time-stamped so that it can be output in synchronization with audio output at the secondary earpiece 14.

[0074] In step 516, the processor 54 packetizes the second audio channel into one or more audio packets for transmission to the secondary earpiece 14 by way of the secondary wireless link 22. FIG. 9 depicts an example format for the audio packets 800 transmitted on the secondary wireless link 22. The audio packets are preferably formatted for transmission over an NFC link, according to the NFC Interface and Protocol (NFCIP-1) specification, ISO/IEC 18092.

[0075] In step 518, a time stamp is included in each of the audio packets. The time stamps indicate the times at which the secondary earpiece 14 will output the audio contained in the packets. The time stamps are useful for synchronizing the audio output of the primary and secondary earpieces 12, 14.

[0076] In step 520, the primary earpiece 12 transmits the time-stamped audio packets over the secondary wireless link 22 to the secondary earpiece 14. The audio packets are preferably transmitted over an NFC link, according to the NFC Interface and Protocol (NFCIP-1) specification, ISO/IEC 18092.

[0077] In step 522, the decoded first channel audio stored in the audio output buffer 58 is output by the primary earpiece 12. Each packet of buffered first channel audio is output when the local clock in the primary earpiece 12 is equal to the audio packet's

time stamp. This is achieved by the processor 54 comparing the packet time stamps to the local audio output clock. When a packet time stamp is equal to the local audio output clock, the processor 54 begins to transfer the digitized audio contained in the packet out of the audio output buffer 58 to the audio output circuitry 62, where it is rendered for output at the speaker 68.

[0078] FIG. 6 is a flowchart 600 illustrating a method of operating the secondary earpiece 14 of the wireless headset 11. . Generally, the method is performed under the control of the processor 102, coordinating operations of the various components of the secondary earpiece 14.

[0079] In step 602, the secondary wireless link 22 is established with the primary earpiece 12. This step can be accomplished by the device discovery and link initiation protocols included in the NFC standard interfaces, which may be included in the secondary wireless interfaces 52, 100.

[0080] In step 604, the local audio output clock of the secondary earpiece 14 is synchronized with the primary earpiece 12 audio output clock. Details of this step are described herein below in connection with FIGS. 7 – 8.

[0081] In step 606, audio packets from the primary earpiece 12 are received at the secondary wireless interface 100. The audio packets are preferably transmitted over an NFC link and formatted according to the NFC Interface and Protocol (NFCIP-1) specification, ISO/IEC 18092. The audio packets are processed by the processor 102 to de-encapsulate and assemble their audio content for output at the speaker 110.

[0082] In step 608, the audio packets are decoded by the processor 102. The audio codec used by the primary and secondary earpieces 12, 14 for audio transmissions over the secondary wireless link 22 is preferably predetermined. The audio codec can be the SBC codec described in the A2DP standard.

[0083] In step 610, the decoded contents of the audio packets are buffered in the audio buffer 106.

[0084] In step 612, each buffered audio packet is output by the secondary earpiece 14 through its speaker 110 when the local audio output clock is equal to the audio packet time stamp. This is achieved by the processor 102 comparing the packet time stamps to the local audio output clock. When a packet time stamp is equal to the local audio output clock, the processor 102 begins to transfer the digitized audio contained in the

packet out of the audio buffer 106 to the audio output circuitry 108, where it is rendered for output at the speaker 110.

[0085] FIG. 7 is a flowchart 700 illustrating a method of clock synchronization between the primary and secondary earpieces 12, 14. The method steps 702 – 706 are periodically repeated at predefined intervals to maintain the synchronicity of the audio output clocks in the primary and secondary earpieces 12, 14. In step 702, a time stamp is generated by the primary earpiece 14. The time stamp can represent the current time kept by the primary earpiece 14, plus any anticipated transmission processing delay caused by the primary earpiece processing and any anticipated transmission delay caused by the secondary wireless link 22.

[0086] In step 704, the time stamp in transmitted to the secondary earpiece 14 over the secondary wireless link 22 in a time sync packet 850. An exemplary format of the time sync packet 850 in shown in FIG. 9. Upon successfully receiving a time sync packet, the secondary earpiece 14 transmits a time sync handshake back to the primary earpiece over the secondary wireless link 22. The primary earpiece 12 may include an error correction routine that re-sends a new time sync packet prior to the next clock synchronization cycle if the handshake is not successfully received at the primary earpiece 12.

[0087] In step 706, the local audio output clock of the secondary earphone 14 is set according to the time stamp contained in the time sync packet 850. FIG. 8 conceptually illustrates a process of adjusting the local audio output clock within the secondary earpiece 14. The process can be implemented in software/firmware executed by the processor 102 of the secondary earpiece 14. A subtractor 754 determines the difference between the current time value 752 of the local audio output clock and the received time stamp 750. The output of the subtractor 754 represents an estimated error between the time stamp and the local audio output clock. A filter 758 is applied to the estimated error to compare the estimated error with a receiver processing delay 756. The receiver processing delay 756 generally represents the amount of time it takes the secondary earpiece 12 to process a time sync packet. The receiver processing delay 756 can be a predefined, constant value stored within the secondary earpiece memory 104, or it can be dynamically determined, for example, based on statistics of processing delays typically experienced by the secondary earpiece processor 102. If the estimated error and the receiver processing delay 756 are not equal, the filter 758 generates an

adjustment factor to adjust the local audio output clock. The adjustment factor is typically the difference between the estimated error and the receiver processing delay 756.

[0088] FIG. 9 illustrates exemplary formats for audio and time synchronization (sync) packets transmitted between the primary and secondary earpieces 12, 14 over the secondary wireless link 22.

[0089] The audio packet 800 includes a packet type identifier 802, a payload length 804, a cyclic redundancy check (CRC) field 806, a packet time stamp 808, and one or more audio frames, e.g., audio frame 1 810 through audio frame N 812, where N is an integer greater than one. The payload of the audio packet includes the packet time stamp 808 and the audio frame 810, 812.

[0090] The packet type identifier 802 can be a single bit value that indicates whether the packet is an audio packet or a time sync packet. For example, if the packet type identifier 802 is set to '0', the packet is a time sync packet; and if the packet type identifier 802 is set to '1', the packet is an audio packet.

[0091] The payload length 804 can be a fifteen-bit value that indicates that byte count of the packet payload.

[0092] The CRC field 806 can contain a sixteen-bit CRC value computed over the other fields of the packet. Techniques of CRC error detection are well known, and the CRC value can be computed using any suitable CRC algorithm. Other types of error detection and/or correction may be employed instead of CRC, including checksums or the like.

[0093] The packet time stamp 808 contains the time stamp generated by the primary earpiece 12. The packet time stamp 808 indicates the time at which the audio contained in the audio packet 800 will begin output at the secondary earpiece 14. The packet time stamp may be a 32-bit value.

[0094] The audio frames 810, 812 can be Bluetooth SBC audio frames.

[0095] The time sync packet 850 includes the packet type identifier 802, the payload length 804, the CRC field 806 and a time stamp 814. The payload of the time sync packet in the time stamp. The time stamp can be a 32-bit value indicating the current time at the primary earpiece 14. The time stamp is used to adjust the local audio output clock of the secondary earpiece, as described above in connection with FIGS. 7 and 8.

[0096] In one or more exemplary embodiments, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A storage media may be any available media that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to carry or store desired program code in the form of instructions or data structures and that can be accessed by a computer. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a website, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

[0097] Certain embodiments have been described. However, various modifications to these embodiments are possible, and the principles presented herein may be applied to other embodiments as well. Methods and/or components as described herein may be implemented in hardware, software, firmware or any suitable combination of the foregoing. The various components and/or method steps may be implemented in a software program having sets of instructions (e.g., code segments) executable by one or more digital circuits, such as microprocessors, DSPs, embedded controllers, or intellectual property (IP) cores included in the headset 11 or audio source 10.

[0098] Other embodiments and modifications will occur readily to those of ordinary skill in the art in view of these teachings. Therefore, the following claims are intended to cover all such embodiments and modifications when viewed in conjunction with the above specification and accompanying drawings.

CLAIMS

1. A headset, comprising:

a first earpiece; and

a second earpiece;

wherein the first and second earpieces are configured to communicate with each other over a wireless link.

2. The headset of claim 1, wherein the first earpiece comprises a first wireless interface configured to communicate with an audio source over a first wireless link.

3. The headset of claim 2, wherein the first earpiece comprises a second wireless interface configured to communicate with the second earpiece over the wireless link; and wherein the second earpiece comprises a wireless interface configured to communicate with the first earpiece over the wireless link.

4. The headset of claim 1, wherein the first earpiece is configured to transmit one or more audio packets to the second earpiece over the wireless link.

5. The headset of claim 4, wherein the first earpiece comprises a processor configured to transcode digitized audio prior the digitized audio being transmitted to the second earpiece.

6. The headset of claim 5, wherein the processor is configured to decode audio received by the first earpiece and encode at least a portion of the decoded audio using a reduced-complexity codec.

7. The headset of claim 4, wherein each of the audio packets comprises a time stamp for synchronizing audio output of the first and second earpieces.

8. The headset of claim 1, further comprising:

means for synchronizing audio output of the first and second earpieces.

9. The headset of claim 1, wherein the first earpiece transmits one or more time synchronization packets to the second earpiece over the wireless link.

10. The headset of claim 1, wherein the wireless link is a near field communication (NFC) wireless link.

11. The headset of claim 1, wherein the first earpiece includes an audio buffer configured to buffer audio for output at the first earpiece.

12. The headset of claim 1, wherein the second earpiece includes an audio buffer configured to buffer audio for output at the second earpiece.

13. The headset of claim 1, wherein the first earpiece comprises a microphone.

14. The headset of claim 1, wherein the first earpiece comprises an echo canceller.

15. A headset, comprising:

a first earpiece having a first wireless interface configured to communicate with an audio source over a first wireless link, and a second wireless interface configured to communicate with a second earpiece over a second wireless link.

16. The headset of claim 15, further comprising:

a processor configured to transcode first encoded audio received from the audio source into second encoded audio; and

means for transmitting the second encoded audio through the second wireless interface.

17. The headset of claim 15, wherein the first wireless interface is selected from the group consisting of a Bluetooth interface and a Wi-Fi interface.

18. The headset of claim 15, wherein the second wireless interface is a near field communication (NFC) interface.

19. The headset of claim 15, further comprising:

a processor configured to receive audio from the first wireless interface, process the audio, and transfer at least a portion of the processed audio to the second wireless interface for transmission to the second earpiece over the second wireless link.

20. A method of outputting audio at a headset, comprising:

receiving audio at a first earpiece;

transmitting the audio from the first earpiece to a second earpiece over a wireless link; and

outputting the audio at the first and second earpieces.

21. The method of claim 22, further comprising:

determining a codec type corresponding to the received audio;

determining, based on the codec type, whether to transcode the received audio; and

transcoding the received audio if the codec type is in a predetermined class of codecs.

22. The method of claim 22, further comprising:

if the codec type is not in the predetermined class of codecs, decoding the received audio for only a first channel;

buffering the first channel audio for output at the first earpiece; and

packetizing a second channel of received, undecoded audio for transmission to the second earpiece over the wireless link.

23. The method of claim 22, wherein transcoding includes:

decoding the received audio into first and second channels; and

encoding the second channel audio using a reduced-complexity codec.

24. The method of claim 24, further comprising:

time stamping the first channel audio and second channel audio;

buffering the first channel audio for output at the first earpiece; and

packetizing the second channel audio for transmission to the second earpiece over the wireless link.

25. The method of claim 21, further comprising:

the first earpiece detecting the second earpiece; and

upon detection of the second earpiece, establishing the wireless link between the first and second earpieces.

26. The method of claim 21, further comprising:

synchronizing local clocks within the first and second earpieces.

27. The method of claim 21, further comprising:

generating a time stamp at the first earpiece;

transmitting the time stamp to the second earpiece over the wireless link;

setting a local clock in the second earpiece based on the time stamp; and

outputting the audio at the second earpiece based on the local clock.

28. The method of claim 21, further comprising:

the second earpiece decoding audio received over the wireless link.

29. A system for outputting audio at a headset, comprising:

means for receiving audio at a first earpiece;

means for transmitting the audio from the first earpiece to a second earpiece over a wireless link; and

means for outputting the audio at the first and second earpieces.

30. The system of claim 29, further comprising:

means for determining a codec type corresponding to the received audio;

means for determining, based on the codec type, whether to transcode the received audio; and

means for transcoding the received audio if the codec type is in a predetermined class of codecs.

31. The system of claim 30, further comprising:

means for decoding the received audio for only a first channel, if the codec type is not in the predetermined class of codecs;

means for buffering the first channel audio for output at the first earpiece; and

means for packetizing a second channel of received, undecoded audio for transmission to the second earpiece over the wireless link.

32. The system of claim 30, wherein the transcoding means includes:

means for decoding the received audio into first and second channels; and

means for encoding the second channel audio using a reduced-complexity codec.

33. The system of claim 32, further comprising:

means for time stamping the first channel audio and second channel audio;

means for buffering the first channel audio for output at the first earpiece; and

means for packetizing the second channel audio for transmission to the second earpiece over the wireless link.

34. The system of claim 31, further comprising:

means, included in the first earpiece, for detecting the second earpiece; and

means for establishing the wireless link between the first and second earpieces, upon detection of the second earpiece.

35. The system of claim 30, further comprising:

means for synchronizing local clocks within the first and second earpieces.

36. The system of claim 31, further comprising:

means for generating a time stamp at the first earpiece;

means for transmitting the time stamp to the second earpiece over the wireless link;

means for setting a local clock in the second earpiece based on the time stamp; and

means for outputting the audio at the second earpiece based on the local clock.

37. The system of claim 31, further comprising:

means, included in the second earpiece, for decoding audio received over the wireless link.

38. A computer-readable medium embodying a set of instructions, wherein the set of instructions when executed by one or more processors comprises:

a code segment for receiving audio at a first earpiece;

a code segment for transmitting the audio from the first earpiece to a second earpiece over a wireless link; and

a code segment for outputting the audio at the first earpiece.

39. The computer-readable medium of claim 38, further comprising:

a code segment for determining a codec type corresponding to the received audio;

a code segment for determining, based on the codec type, whether to transcode the received audio; and

a code segment for transcoding the received audio if the codec type is in a predetermined class of codecs.

40. The computer-readable medium of claim 39, further comprising:

a code segment for decoding the received audio for only a first channel, if the codec type is not in the predetermined class of codecs;

a code segment for buffering the first channel audio for output at the first earpiece; and

a code segment for packetizing a second channel of received, undecoded audio for transmission to the second earpiece over the wireless link.

41. The computer-readable medium of claim 39, wherein the transcoding code segment includes:

a code segment for decoding the received audio into first and second channels; and

a code segment for encoding the second channel audio using a reduced-complexity codec.

42. The computer-readable medium of claim 41, further comprising:

a code segment for time stamping the first channel audio and second channel audio;

a code segment for buffering the first channel audio for output at the first earpiece; and

a code segment for packetizing the second channel audio for transmission to the second earpiece over the wireless link.

43. The computer-readable medium of claim 38, further comprising:

a code segment, executable by the first earpiece, for detecting the second earpiece; and

a code segment for establishing the wireless link between the first and second earpieces, upon detection of the second earpiece.

44. The computer-readable medium of claim 38, further comprising:

a code segment for synchronizing local clocks within the first and second earpieces.

45. The computer-readable medium of claim 38, further comprising:

a code segment for generating a time stamp at the first earpiece;

a code segment for transmitting the time stamp to the second earpiece over the wireless link;

a code segment for setting a local clock in the second earpiece based on the time stamp; and

a code segment for outputting the audio at the second earpiece based on the local clock.

46. The computer-readable medium of claim 38, further comprising:

a code segment, executable by the second earpiece, for decoding audio received over the wireless link.

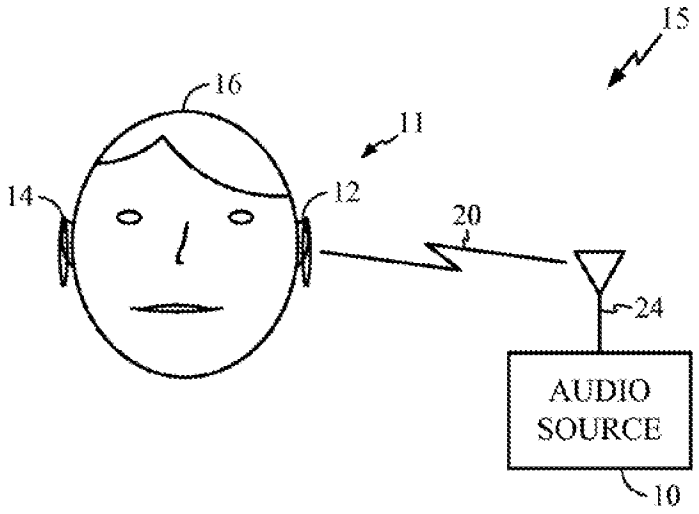

15
16
11
14
12
20
24
AUDIO SOURCE
10

FIG. 1

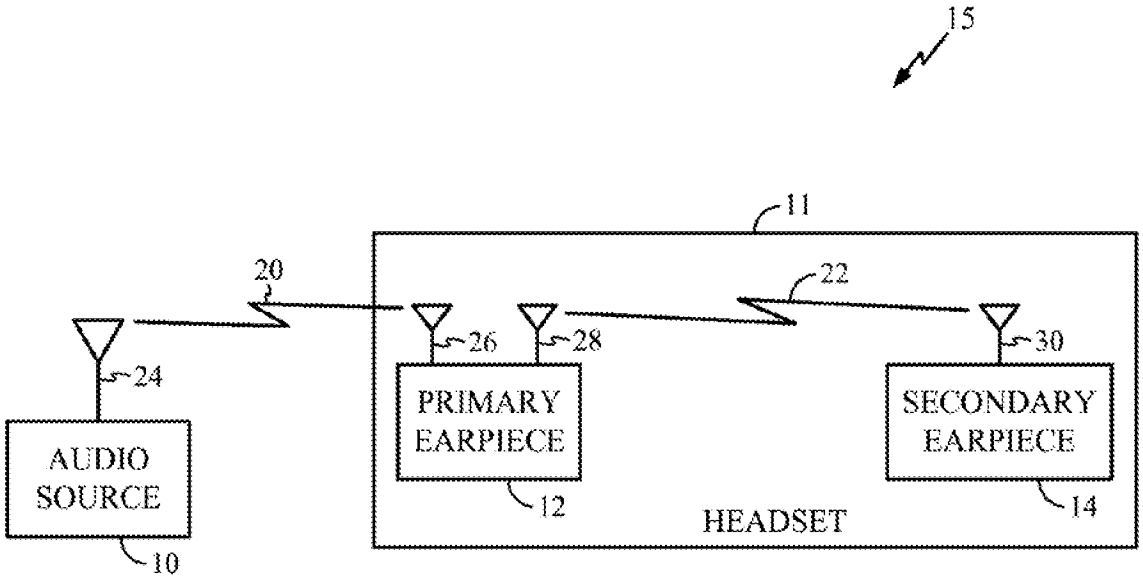

15
11
20
22
26
28
30
24
PRIMARY EARPIECE
SECONDARY EARPIECE
AUDIO SOURCE
12
14
HEADSET
10

FIG. 2

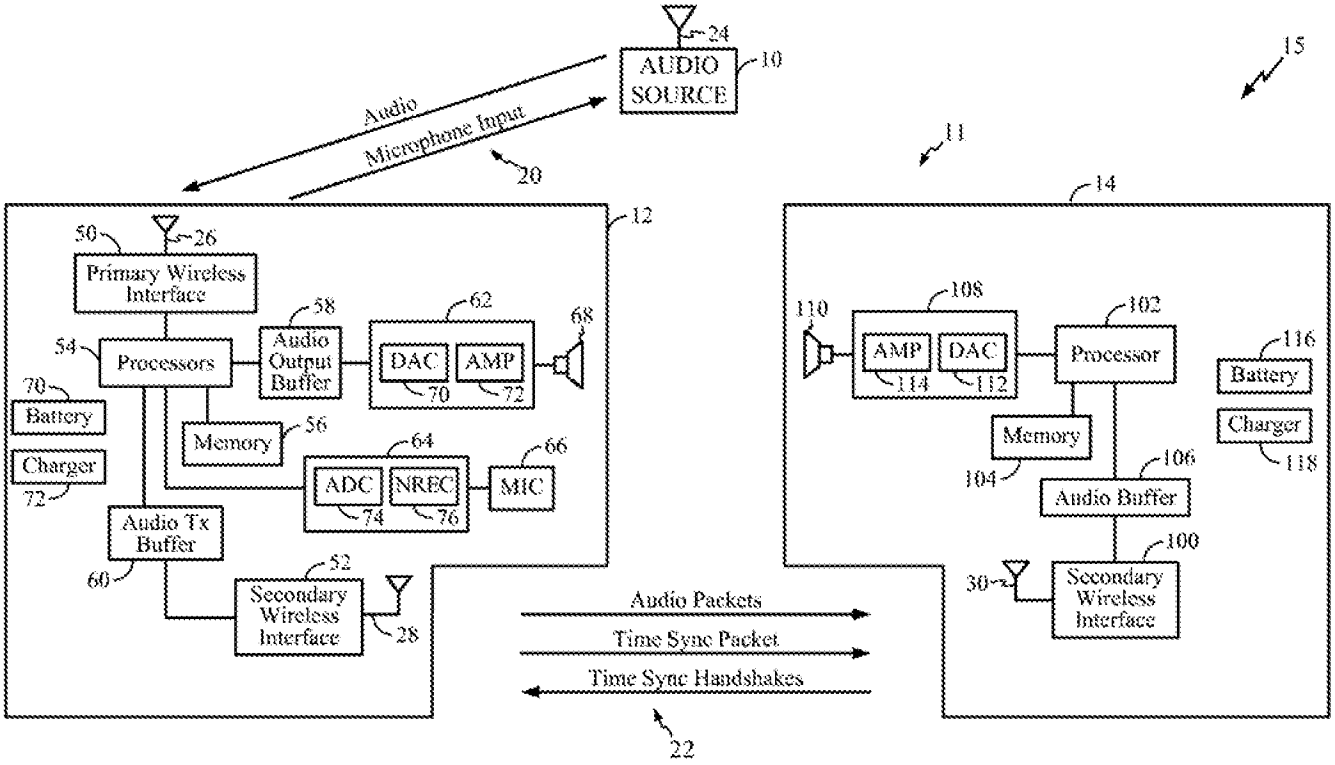

AUDIO SOURCE
10
24
Audio
Microphone Input
20
15
11
12
14
50
26
Primary Wireless Interface
54
Processors
58
Audio Output Buffer
62
DAC
AMP
70
72
68
70
Battery
Charger
72
Memory
56
64
ADC
NREC
74
76
MIC
66
Audio Tx Buffer
60
52
Secondary Wireless Interface
28
Audio Packets
Time Sync Packet
Time Sync Handshakes
22
110
108
AMP
DAC
114
112
102
Processor
116
Battery
Charger
118
Memory
104
106
Audio Buffer
100
30
Secondary Wireless Interface

FIG. 3

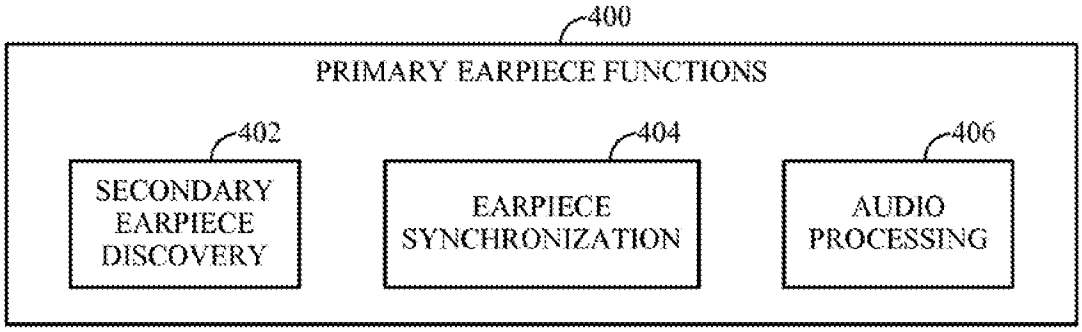

400
PRIMARY EARPIECE FUNCTIONS
402
SECONDARY EARPIECE DISCOVERY
404
EARPIECE SYNCHRONIZATION
406
AUDIO PROCESSING

FIG. 4

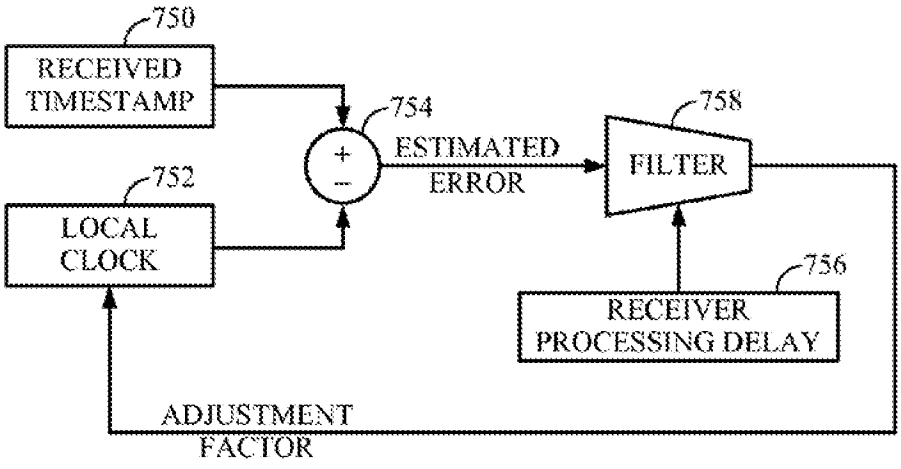

750
RECEIVED TIMESTAMP
752
LOCAL CLOCK
754
+
−
ESTIMATED ERROR
758
FILTER
756
RECEIVER PROCESSING DELAY
ADJUSTMENT FACTOR

FIG. 8

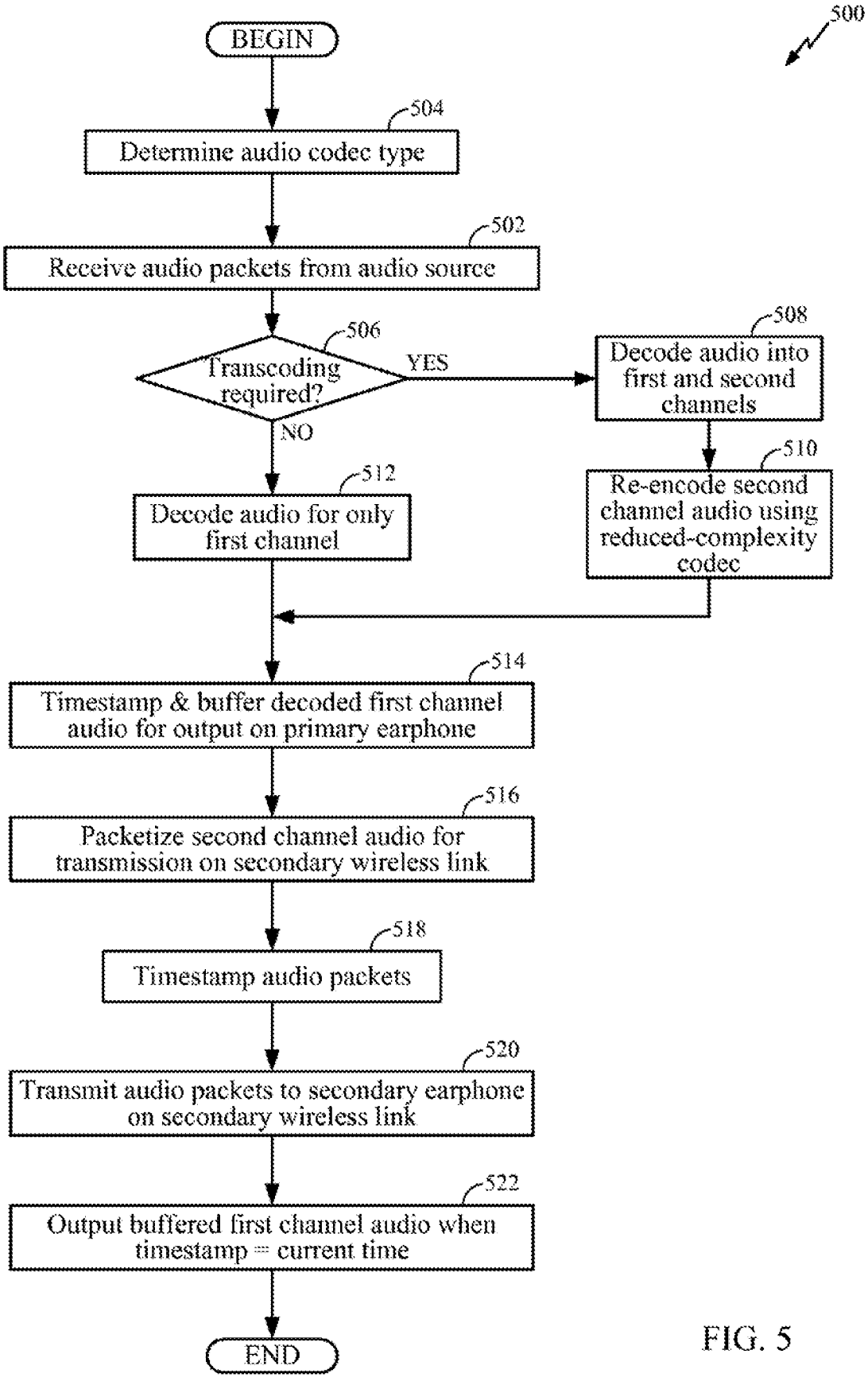

500
BEGIN
504
Determine audio codec type
502
Receive audio packets from audio source
506
Transcoding required?
YES
NO
508
Decode audio into first and second channels
510
Re-encode second channel audio using reduced-complexity codec
512
Decode audio for only first channel
514
Timestamp & buffer decoded first channel audio for output on primary earphone
516
Packetize second channel audio for transmission on secondary wireless link
518
Timestamp audio packets
520
Transmit audio packets to secondary earphone on secondary wireless link
522
Output buffered first channel audio when timestamp = current time
END

FIG. 5

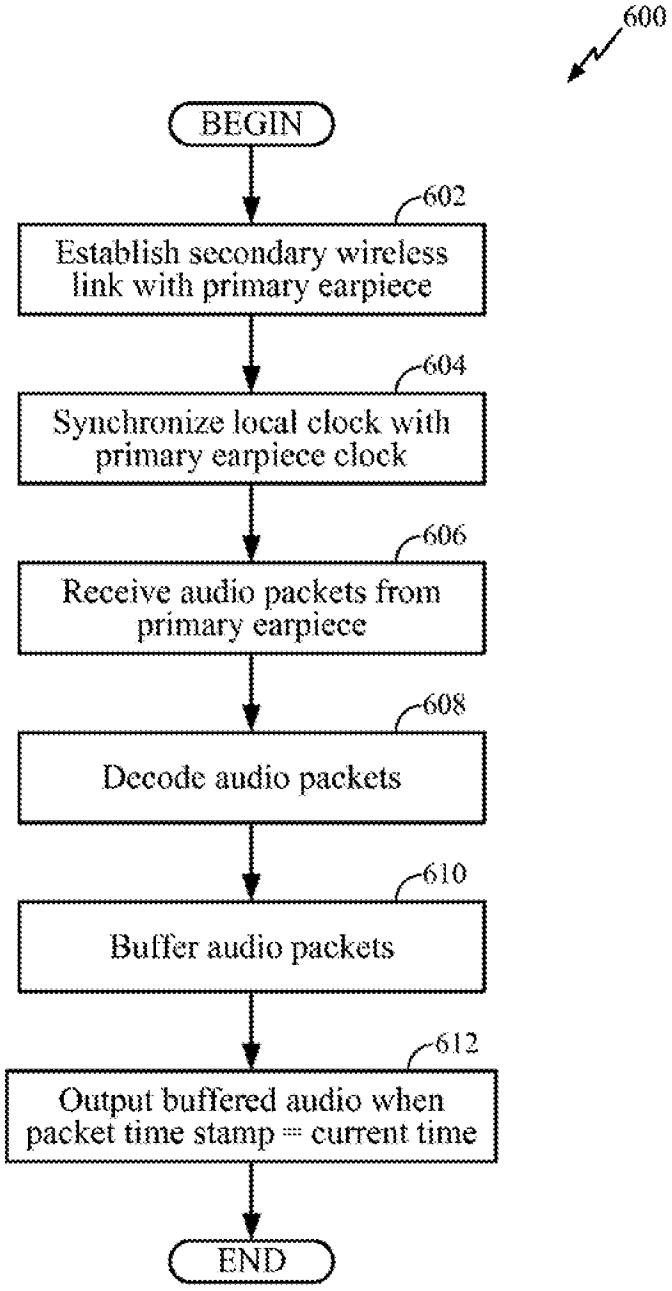

600
BEGIN
602
Establish secondary wireless link with primary earpiece
604
Synchronize local clock with primary earpiece clock
606
Receive audio packets from primary earpiece
608
Decode audio packets
610
Buffer audio packets
612
Output buffered audio when packet time stamp = current time
END

FIG. 6

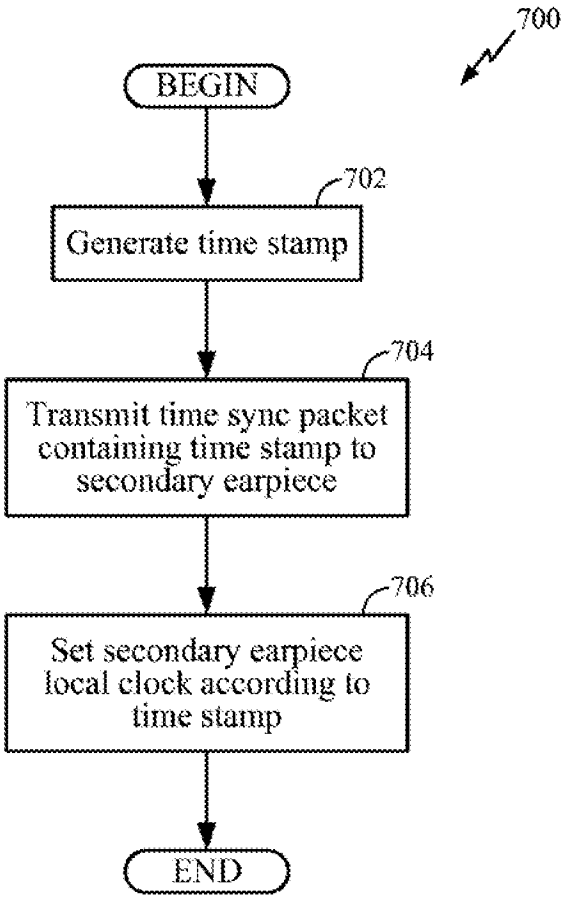
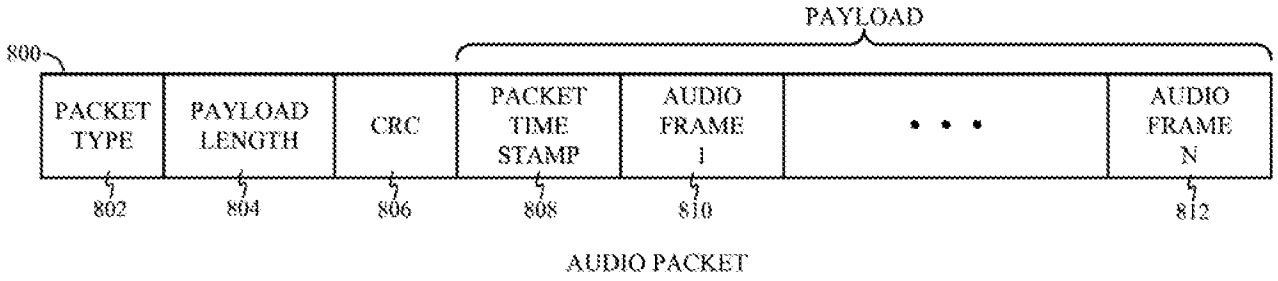

700
BEGIN
702
Generate time stamp
704
Transmit time sync packet containing time stamp to secondary earpiece
706
Set secondary earpiece local clock according to time stamp
END

FIG. 7


PAYLOAD
800
PACKET TYPE
PAYLOAD LENGTH
CRC
PACKET TIME STAMP
AUDIO FRAME 1
• • •
AUDIO FRAME N
802
804
806
808
810
812
AUDIO PACKET

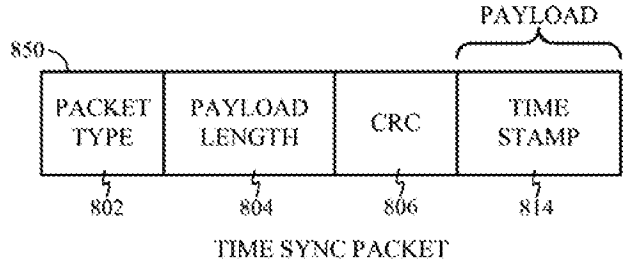

PAYLOAD
850
PACKET TYPE
PAYLOAD LENGTH
CRC
TIME STAMP
802
804
806
814
TIME SYNC PACKET

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2008/057153

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04M1/60 H04R5/033 H04R1/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04M H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/037615 A1 (GLEZERMAN ABRAHAM [IL]) 15 February 2007 (2007-02-15)	1-5,8,9, 13, 15-17, 19-22, 25-31, 34-40, 43-46
Y	paragraph [0001] paragraph [0005] paragraph [0010] paragraph [0013] paragraph [0015] paragraph [0018] - paragraph [0021] -/--	6,7, 10-12, 14,18, 23,24, 32,33, 41,42

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search	Date of mailing of the international search report
19 June 2008	27/06/2008

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Banerjea, Robin

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	paragraph [0024] figures 1,2	
Y	WO 2006/053704 A (NAT UNIVERSITY OF IRELAND GALW [IE]; CUCOS ALEX [IE]; CORCORAN PETER [ ) 26 May 2006 (2006-05-26) page 1, line 4 - line 6 page 1, line 16 - line 20 page 3, line 25 - page 4, line 1 page 5, line 26 - page 7, line 12 figures 2(b),3	7,11,12, 14,24, 33,42
Y	WO 2005/013639 A (KONINKL PHILIPS ELECTRONICS NV [NL]; PHILIPS NORBERT J L [BE]; DEROM K) 10 February 2005 (2005-02-10) page 8, line 4 - line 7 page 16, line 11 - line 14 figure 9	6,23,32, 41
Y	WO 2006/051505 A (KONINKL PHILIPS ELECTRONICS NV [NL]; PHILIPS CORP [US]; BUIL VINCENT [ ) 18 May 2006 (2006-05-18) page 2, line 1 - line 3	10,18
X	EP 1 715 718 A (SAMSUNG ELECTRONICS CO LTD [KR]) 25 October 2006 (2006-10-25)	1-5,13, 15-17, 19,20, 28,29, 37,38,46
A	paragraph [0001] paragraph [0011] paragraph [0014] - paragraph [0016] paragraph [0022] paragraph [0025] paragraph [0028] - paragraph [0032] paragraph [0037] figures 1,3A,4	24,25, 33,34, 42,43
X	EP 1 670 283 A (SONY ERICSSON MOBILE COMM AB [SE]) 14 June 2006 (2006-06-14)	1-5, 15-17, 19,20, 29,38
	paragraph [0001] paragraph [0003] - paragraph [0004] paragraph [0013] paragraph [0015] - paragraph [0017] paragraph [0021] figures 1,2	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2008/057153

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EP 1670283 A	14-06-2006	NONE	

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(22) International Filing Date:
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61/222,526 2 July 2009 (02.07.2009) US

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(72) Inventors; and

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(74) Agent: **RECHES, Oren**; 11 Hamenofim St., Pob 2148, 46120 Herzelia (IL).

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(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: A SYSTEM AND A METHOD FOR PROVIDING SOUND SIGNALS

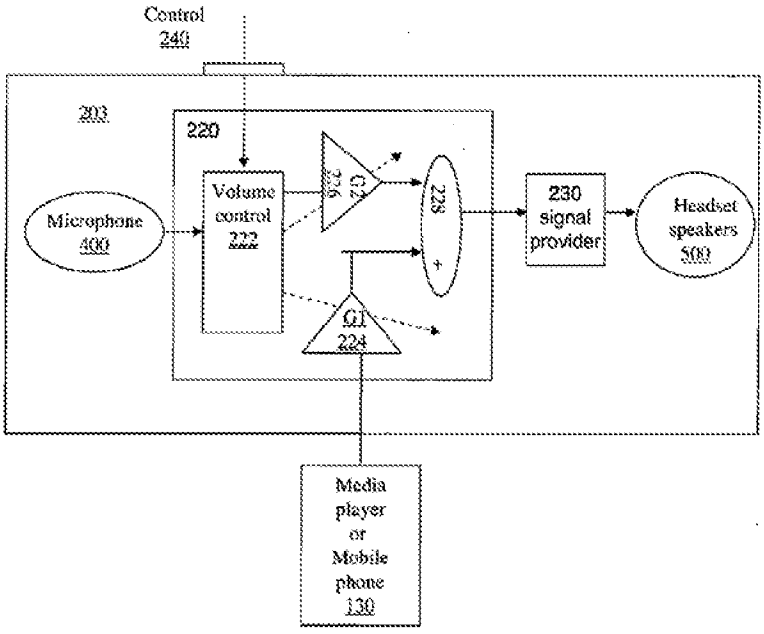


FIG. 4

(57) Abstract: A sound system, the sound system including: (i) a processor, configured to: (a) receive a requested sound signal and an ambient sound input signal; and (b) generate a modified requested signal by processing, in response to a desired level of ambient sound that is defined by a user, the requested sound signal and the ambient sound input signal, wherein an inclusion level of the ambient sound input signal in the modified requested signal is responsive to the desired level of ambient sound; and (ii) a signal provider configured to provide the modified requested signal to multiple speakers of a headset.

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A SYSTEM AND A METHOD FOR PROVIDING SOUND SIGNALS

RELATED APPLICATIONS

[001] This application claims priority from U.S. provisional patent application serial number 61/222,526 filing date July 2, 2009 which is incorporated herein by its entirety.

BACKGROUND OF THE INVENTION

[002] Today mobile music devices such as media player or mobile phones provides high quality music, users use it "on the go" and in any other places. In more advanced mobile devices the user can also watch high quality movies or TV programs. Such devices are provided by many vendors such as Apple, Microsoft, and SanDisk.

[003] In order to enhance the listening experience many vendors provide headsets that decrease the ambient sound. Some use "in ear" headset while other vendors use headset that close the pinna in order to block the ambient sound, some headset add some techniques of noise cancellation to further reduce the ambient noise for the listener. In some other cases users hear the music in very high volume.

[004] In all those above disclosed prior art solution, the user are partially "disconnected" from the external world and almost does not hear the external world sounds. In some cases this can be very dangerous as the user may not aware what is happening in his surround.

[005] There is therefore a need to provide a sound system that enables control over the level of ambient sound.

BRIEF DESCRIPTION OF THE DRAWINGS

[006] The subject matter regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, together with objects, features, and advantages thereof, may best be understood by reference to the following detailed description when read with the accompanying drawings in which:

[007] Figure 1A illustrates a sound system, according to an embodiment of the invention;

[008] Figure 1B illustrates a sound system incorporated into a headset, according to an embodiment of the invention;

[009] figure 1C illustrates a sound system incorporated into a cellular phone, according to an embodiment of the invention;

[0010] Figure 2 illustrates a method for providing a sound signal, according to an embodiment of the invention;

[0011] Figures 3, 4, and 5 illustrate various sound systems, according to various embodiments of the invention; and

[0012] Figure 6 illustrates a flowchart of a method for modifying an inclusion level of the ambient sound input signal in response to a detected state of at least one of the ambient sound input signal and the requested sound signal, according to an embodiment of the invention.

[0013] It will be appreciated that for simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity. Further, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

SUMMARY OF THE INVENTION

[0014] A sound system, the sound system including: (i) a processor, configured to: (a) receive a requested sound signal and an ambient sound input signal; and (b) generate a modified requested signal by processing, in response to a desired level of ambient sound that is defined by a user, the requested sound signal and the ambient sound input signal, wherein an inclusion level of the ambient sound input signal in the modified requested signal is responsive to the desired level of ambient sound; and (ii) a signal provider configured to provide the modified requested signal to multiple speakers of a headset.

[0015] A method for providing a sound signal, the method including: (i) receiving a requested sound signal and an ambient sound input signal; (ii) generating a modified requested signal by processing, in response to a desired level of ambient sound that is defined by a user, the requested sound signal and the ambient sound input signal,

wherein an inclusion level of the ambient sound input signal in the modified requested signal is responsive to the desired level of ambient sound; and (iii) providing the modified requested signal to at least one speaker of a headset.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0016] In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be understood by those skilled in the art that the present invention may be practiced without these specific details. In other instances, well-known methods, procedures, and components have not been described in detail so as not to obscure the present invention.

[0017] Figure 1A illustrates sound system 200, according to an embodiment of the invention. Sound system 200 includes processor 220 is configured to receive one or more requested sound signal 110 (e.g. from at least one sound signal providing system 300) and at least one ambient sound input signal 120 (e.g. from one or more microphones 400).

[0018] Processor 220 is further configured to generate modified requested signal 130 by processing, in response to a desired level of ambient sound that is defined by a user, requested sound signal 110 and ambient sound input signal 120, wherein an inclusion level of the ambient sound input signal in the modified requested signal is responsive to the desired level of ambient sound.

[0019] It is noted that the user may define the desired level of ambient sound in various manners, according to different embodiments of the invention. For example, the user may use dedicated interface of sound system 200 and/or of sound signal providing system 300 (e.g. up/down buttons, sliders, etc), may use a selection menu of interface of sound system 200 and/or of sound signal providing system 300, may provide voice commands (e.g. using microphone 400), and so forth.

[0020] It is noted that processor 220 may implement digital signal processing schemes, analogue signal processing schemes, or any combination thereof, for the implementation of its different functionalities, some of which are discussed herein.

[0021] According to an embodiment of the invention, sound providing system 300 may be a part of system 200, but this is not necessarily so. Requested sound signal 110 is requested in that it is intended to be heard by a recipient of modified sound signal 130.

Requested sound signal 110 may and may not be specifically requested for (e.g. selection of a song to be played, selecting to receive a telephone conversation, etc.). It is noted that, according to an embodiment of the invention, the intention to receive requested sound signal 110 may be expressed by connecting to sound providing system 300, by choosing to receive a type of sound signals or a group of sound signals (e.g. audio alarms), etc.

[0022] Likewise, according to an embodiment of the invention, microphone 400 may be a part of system 200, but this is not necessarily so. Microphone 400 may be, according to an embodiment of the invention, a dedicated microphone – dedicated to detect ambient sound signals to be at least partly included in modified sound signal 130 (and or at least partly canceled), but it is not necessarily so. Microphone 400 may also have other functionalities (e.g. a microphone of a smart phone) and may detect ambient sound input signal 120 as a secondary function, or as an additional function.

[0023] It is noted that according to an embodiment of the invention, multiple requested input signals 110 may be received and processed by processor 220 – possibly also concurrently. For example, one or more sound signal providing systems 300 may provide a music stream from a music player, a telephone conversation sound from a telephony unit, and an alarm indicative of some emergency state (e.g. battery is low, another vehicle is in close proximity, etc.).

[0024] It is noted that in some situations the user may wish not to be exposed to ambient sound (or to be exposed in a minimal level), e.g. when the user is listening to music in home. In such situations the user may benefit from null inclusion level of ambient sound in modified sound signal 130. it is noted that in such situations and according to some embodiments of the invention, the user may further benefit form various sound cancellation techniques (either active or passive) that may be implemented in sound system 200, e.g. as disclosed below.

[0025] In other situations, such cut off from the external world may be undesired. In many situations a user listening to modified sound signal 130 does not wish to be totally unaware of ambient sound input signal 120. For example, a bicycle rider listening to music as requested signal requested input signal 110 may not want external traffic sound

to be reduced too much, for security reasons. A technician repairing a system in an engines cabin may not want external machinery sounds reduced to maximum.

[0026] Therefore, processor 220 is configured to process requested input signal 110 and ambient sound input signal 120 to provide modified sound signal 130 in response to the desired level of ambient sound which is defined by a user. It is noted that, according to an embodiment of the invention, the processing may be further responsive to a user defined cancellation-parameter, that affects the level of active cancellation that may be applied to ambient sound input signal 120, in some embodiments of the invention.

[0027] The desired level of ambient sound defined by the user may take different forms in different embodiments of the invention. For example, a user defined parameter may define a minimum allowed volume of ambient noise provided, a maximum allowed volume of ambient noise provided, a reduction rate (e.g. in percents), a reduction level selected out of few provided options, a predetermined recipe (e.g. inclusion of only limited frequencies range), a recipe defined by the user, a ratio between the requested input signal 110 and ambient sound input signal 120, and so forth.

[0028] According to an embodiment of the invention, processor 220 may be configured to determine (or otherwise effect) the inclusion level of the ambient sound input signal 120 in the modified requested signal 130 based on: (1) the desired level selected by the user, and – according to some embodiments of the invention – also basing on (2) a state of ambient sound input signal 120 and/or a state of requested input signal 110.

[0029] It is noted that the inclusion level may be applied, according to different embodiments of the invention, to some or all of ambient sound input signal 120 – e.g. it may include a percentage of inclusion attempt (e.g. 8% of original ambient sound input signal 120), include a maximal or minimal level of allowed ambient sound input signal 120, an inclusion of only a limited range of frequencies (and to what extents), and so forth. It is noted that processor 220 may take into account when determining the inclusion level other parameters as well (e.g. detection of noise in ambient sound input signal 120, a low battery level of system 200, etc.).

[0030] It is noted that conveniently processor 220 may be configured to modify the inclusion level from time to time. This may happen in response to a modification in the user defined desired level, in response to a modification in the state of one of requested

input signal 110 and ambient sound input signal 120, or to other parameters (e.g. modification in processing requirements of other processes managed by processor 220).

[0031] After determining the inclusion level (or parameters affecting it), processor 220 is further configured to generate modified sound signal 130 by processing, in response to the desired level, requested input signal 110 and ambient sound input signal 120.

[0032] It is noted that in some embodiments of the invention, the user may modify the user defined desired level in different times. According to an embodiment of the invention, the user defined desired level of ambient sound is defined by a user or entity other then the one that listens to modified sound signal 130. By way of example, it may be defined by a supervisor or a parent of the listener, may be a standard determination in a factory or an airline, and so forth. According to an embodiment of the invention, the user defined desired level is set only by the listener.

[0033] According to an embodiment of the invention, the desired level defined by the user may be defined by a user of system 200 (e.g. using a user interface of system 200). According to an embodiment of the invention, desired level may be defined using a user interface of a system that is connected to system 200 (e.g. of sound signal providing system 300, or of a headset that transduces modified sound signal 130). According to an embodiment of the invention, the desired level may be defined remotely, e.g. by a wireless connection or by an internet connection.

[0034] According to an embodiment of the invention, processor 220 is further configured to modify the inclusion level of ambient sound input signal 120 in response to a detected state of ambient sound input signal 120 and/or of requested input signal 110.

[0035] According to an embodiment of the invention, processor 220 is further configured to modify the inclusion level of ambient sound input signal 120 in response to modification in the detected state of ambient sound input signal 120 and/or of requested input signal 110.

[0036] As will be demonstrated below, the inclusion level of ambient sound input signal 120 may be modified in various types of detected states (and/or modification of detected states) – according to various embodiments of the invention.

[0037] For example, the detected state may be detected by analysis of ambient sound input signal 120 (e.g. if ambient sound input signal 120 passes a predetermined threshold, if a predefined sound pattern is detected in ambient sound input signal 120, a conversation is detected, etc.). The detected may also be detected by detecting a modification in ambient sound input signal 120 – e.g. a reception state (e.g. on/off) of a microphone 400 out of one or more microphones 400 is changed.

[0038] For example, the detected state may be detected by analysis of requested input signal 110 (e.g. if requested input signal 110 passes a predetermined threshold, if a predefined sound pattern is detected in requested input signal 110, etc.). The detected may also be detected by detecting a modification in requested input signal 110 – e.g. a transmission state (e.g. on/off) of a sound signal providing system 300 out of one or more sound signal providing systems 300 is changed, if a conversation state is initiated in a cellular phone, etc.

[0039] According to an embodiment of the invention, the inclusion level of ambient sound input signal 120 in modified sound signal 130 may also be modified in response to a signal received from an external system. For example, if one or more systems 200 are used by employee in a factory or an organization, a remote system (e.g. in a control room) may choose to send a signal requesting change of the inclusion level (or of the desired level) of ambient sound input signals 120 of the one or more users, e.g. to increase the allowed level of some or all of requested input signal 110, and/or to decrease the allowed level of some or all of requested input signal 110 (e.g. of a limited range of frequencies of which).

[0040] It is noted that, according to an embodiment of the invention, the processor may also be adapted to change an inclusion level of ambient sound input signal 120 in modified sound signal 130 in response to a detected state of ambient sound input signal 120 and/or of requested input signal 110, in response to a signal from an external system, etc.

[0041] Sound system 200 further includes signal provider 230 that is configured to provide modified requested signal 130 (which is provided to it by processor 220) to at least one speaker 500. It is noted that in many embodiments of the invention, the modified requested signal 130 is provided to both speakers 500 of a headset that

includes two speakers. It is noted that wherein "at least one speaker" is used, in some embodiments multiple speakers may be implemented (e.g. two speakers of a two-speakers headset, or two or more speakers – and possibly all speakers – of a headset that includes more than two speakers)

[0042] However, other embodiments may be implemented as well and may be useful in some situations. For example, in a firing range one ear of the user may be blocked, and only one ear may be used for receiving a modified sound signal 130 that includes requested input signal 110 of a communication network, and a low level of ambient sound input signal 120 inserted.

[0043] In another embodiment, the user may wish to receive some level of ambient sound input signal 120 only in one ear, wherein the other speaker provides regular requested input signal 110 sound.

[0044] According to an embodiment of the invention, the at least one speaker 500 is included in sound system 200. According to an embodiment of the invention, the at least one speaker 500 is included in one or more external system, that may receive information from sound system 200 over a wired or wireless connection, and/or a combination thereof.

[0045] It is noted that in some situations, one processor 220 identifies that the detected state of ambient sound input signal 120 and/or of requested input signal 110 ceased (e.g. no siren is identified any longer), the inclusion level of requested input signal 110 may be restored to its previous level. According to an embodiment of the invention, the inclusion level is restored only in response to user input.

[0046] According to an embodiment of the invention, speaker 500 is a speaker of a headset. A headset include one or more speakers (e.g. one or two, and possibly more), wherein at least some of those speakers are intended to be placed in close proximity to a aural sensory organ such as the ear (it is noted that other types of speakers such as bone conduction speakers may also be implemented). Such a headset may include mechanical means for securing such speakers in the proximity of the ear (or other organ), but this is not necessarily so. For example, according to an embodiment of the invention, a cellular phone which is placed in the vicinity of the ear may also serve as a headset.

[0047] Figure 1B illustrates sound system 200 incorporated into a headset, according to an embodiment of the invention. It is noted that processor 220 and/or signal provider 230 may be incorporated into various components of the headset, in different embodiments of the invention.

[0048] It should be noted that sound system 200 may also be implemented in systems in which some or all of the speakers are not located in the vicinity of the ear. For example, sound system 200 may be incorporated in a car sound system, airplane sound system, factory sound system, etc. According to an embodiment of the invention, the microphone in such an embodiment may be located outside the car, airplane, etc., or the respective confined space (e.g. room, building).

[0049] It is noted that, according to an embodiment of the invention, ambient sound input signal 120 is picked up by a microphone that is located outside the ear, in vicinity to it (e.g. within a distance of under 7 centimeters from the our). However, this is not necessarily so. For example, a parent may want to include in modified sound signal 130 a signal detected by a microphone of a child sensor located in a cradle of his child.

[0050] According to an embodiment of the invention, processor 220 is further configured to analyze the ambient sound input signal 120 and to identify a predefined sound pattern in ambient sound input signal 120, wherein the processor is further configured to process the requested input signal 110 and ambient sound input signal 120 in response to the identified predefined sound pattern.

[0051] According to an embodiment of the invention, processor 220 is configured to determine the inclusion level of ambient sound input signal 120 in modified sound signal 130 in response to a detection of a predefined sound pattern in the ambient sound input signal, wherein the detection may and may not be carried out by processor 220.

[0052] In different embodiments, different predefined sound patterns may be implemented. For example, the predefined sound pattern may be related to emergency cases (siren of an ambulance, explosion, alarm), may be related to identification of human conversation, to mechanical malfunction (e.g. in a car), etc.

[0053] It is noted that the analysis of ambient sound input signal 120 may include digital and/or analog processing. It is noted that processor 220 may carry out different actions in response to a detection of the predefined sound pattern, and to process

requested input signal 110 and ambient sound input signal 120 in different ways. For example, once the predefined sound pattern is detected, processor 200 may reduce a volume of the music (or other requested input signal requested input signal 110), thus enabling the listener to hear the external sound. According to an embodiment of the invention, processor 220 may indicate to the listener in such situation by a synthesized sound or in any other way that the predefined event associated with the predefined sound pattern occurs.

[0054] According to an embodiment of the invention, processor 220 is configured to reduce a volume of requested sound signal 110 (or a portion of it – e.g. a predetermined duration, or a limited range of frequencies) in modified requested signal 130 provided to the at least one speaker 500, in response to the identification of the predefined sound pattern. This may enable a clearer aural perception of ambient sound by the listener, e.g. in a case of emergency.

[0055] According to an embodiment of the invention, processor 220 is configured to increase/reduce the inclusion level of the ambient sound input signal in response to a detection of the predefined sound pattern.

[0056] According to an embodiment of the invention, processor 220 is configured to increase a volume of requested sound signal 110 (or a portion of it – e.g. a predetermined duration, or a limited range of frequencies) in modified requested signal 130 provided to the at least one speaker 500, in response to the identification of the predefined sound pattern. This may enable a clearer aural perception of desirable sound signals received from one or more out of the at least one sound signal providing system 300, e.g. if the requested input signal 110 includes instructions, or if a volume of requested input signal 110 raised above efficient processing level.

[0057] According to an embodiment of the invention, processor 220 is configured to otherwise process requested sound signal 110 (or a portion of it – e.g. a predetermined duration, or a limited range of frequencies) in modified requested signal 130 provided to the at least one speaker 500, in response to the identification of the predefined sound pattern.

[0058] According to an embodiment of the invention, processor 220 is further configured to increase an inclusion level of ambient sound input signal 120 (or a portion

of it – e.g. a predetermined duration, or a limited range of frequencies) in modified sound signal 130 provided to the at least one speaker 500, in response to the identification of the predefined sound pattern. This may enable a clearer aural perception of ambient sound by the listener, e.g. in a case of emergency.

[0059] According to an embodiment of the invention, processor 220 is further configured to reduce an inclusion level of ambient sound input signal 120 (or a portion of it – e.g. a predetermined duration, or a limited range of frequencies) in modified sound signal 130 provided to the at least one speaker 500, in response to the identification of the predefined sound pattern. This may enable a clearer aural perception of desirable sound signals received from one or more out of the at least one sound signal providing system 300, e.g. if the requested input signal 110 includes instructions, or if a volume of requested input signal 110 raised above a predetermined threshold.

[0060] According to an embodiment of the invention, processor 220 is further configured to otherwise process ambient sound input signal 120 (or a portion of it – e.g. a predetermined duration, or a limited range of frequencies) in modified sound signal 130 provided to the at least one speaker 500, in response to the identification of the predefined sound pattern.

[0061] According to an embodiment of the invention, processor 220 is further configured to insert into modified sound signal 130 an indication about the detection of the predefined sound pattern. It is noted that the indication may be indicative of detection of the predefined sound pattern and/or on the type of the predefined sound pattern. According to an embodiment of the invention, processor 220 is further configured to insert into the modified requested signal an indication about a type of the predefined sound pattern.

[0062] For example, processor 220 may retrieve from a memory of sound system information for generation of a sound indication (e.g. a prolonged beep sound) or vocal indication (e.g. a recorded message indicating that there is a mechanical malfunction), and insert that indication into modified sound signal 130.

[0063] According to an embodiment of the invention, processor 220 is further configured to generate a power spectrum of the ambient sound input signal for multiple

time frames (e.g. by analyzing by spectrum analysis multiple time frames of the ambient sound input signal to provide a power spectrum), and to process the power spectrums to detect peaks that exceeds a predetermined threshold for more than a predetermined period in at least one frequency associated with the predefined sound pattern. An example of such operation is exemplified in relation to figure 6.

[0064] According to an embodiment of the invention, processor 220 is further configured to detect the predefined sound pattern by generating a power spectrum of the ambient sound input signal for each time frame out of multiple time frames, and by processing the multiple power spectrums to detect peaks that exceeds a predetermined threshold for more than a predetermined period in at least one frequency associated with the predefined sound pattern.

[0065] According to an embodiment of the invention, processor 220 is further configured to determine parameters of the predefined sound pattern in response to user input received from the user. That is, the user (either the listener or another user, e.g. as exemplified above) may provide parameters, or indicate a recording and/or analysis of ambient sound input signal 120, from which a predefined sound pattern may be defined and later recognized. For example, a user may train processor 220 to identify when the RPM of the engine of a car exceeds 7000RPM, and to stop any music played and increase the inclusion level of the ambient sound in such an event.

[0066] According to an embodiment of the invention, sound system 200 is included in a mobile communication device (denoted 201), such as a cellular phone or a PDA. For example, figure 1C illustrates sound system 200 incorporated into a cellular phone, according to an embodiment of the invention. It is noted that the mobile communication device 201 in its entirety may be considered, according to an embodiment of the invention, as sound system 200.

[0067] According to an embodiment of the invention, requested input signal 110 may be provided by a communication component 301 of mobile communication device 201 (wherein component 301 may thus serve as sound signal providing system) in response to a signal received over a wireless communication connection. For example, requested input signal 110 may include information of a voice conversation. It is noted that requested input signal 110 may also be received over other types of wireless

communication – e.g. Bluetooth communication. It is noted that requested input signal 110 may be provided by other components of mobile communication device 201 – e.g. from a music database of which.

[0068] According to an embodiment of the invention, ambient sound input signal 120 is detected by a microphone 400 of mobile communication system 201. Microphone 400 of mobile communication system 201 may also serve for detection of user speech signal, e.g. during telephone conversations, or memo recordings. According to an embodiment of the invention, signal provider 230 is configured to provide the modified requested signal 130 to at least one speaker 500 of mobile communication device 201, and/or to the speakers 500 of a headset 291 that is connected to mobile communication system 201. The one or more speakers 500 of mobile communication device 201 (or of a connected headset 291) may also serve for the provision of other sounds to the user.

[0069] According to an embodiment of the invention, processor 220 is further configured to determine an inclusion level of ambient sound input signal 120 that allows an inclusion of a desired level of user speech from ambient sound input signal 120 in modified sound signal 130.

[0070] It is known that in some cases during telephone conversations (e.g. in cases when the user speaks and his ears are blocked by a headset) the user does not hear himself properly, and due to the incorrect feedback the user might increase the level of the speaking, and as a result he might speak very loudly. Therefore, in such situations an increased level of inclusion of the ambient sound signal– that may enable inclusion of his voice in modified sound signal 130 – may benefit the user.

[0071] According to an aspect of the invention, microphone 400 is used to pick the ambient noise as well as the user's speech, wherein processor 220 may then inject it, in a controllable manner, modified sound signal 130 and thus to speaker 500 (e.g. to the headset speakers). This may improve significantly the phone conversation experience when the two ears are blocked. It is noted that, according to an embodiment of the invention, techniques of separating between user speech and back ground noise may be implemented (e.g. using two or more microphones 400 in different distances from a mouth of the user).

[0072] According to an embodiment of the invention, processor 220 is further configured to reduce sound level of portions of the ambient sound input signal that do not comprise user speech. This may be carried out, by way of example, by filtering frequency ranges not used by human speech, or by other techniques of separating between user speech and back ground noise may be implemented (e.g. using two or more microphones 400 in different distances from a mouth of the user).

[0073] According to an embodiment of the invention, processor 220 is further configured to determine the inclusion level in response to a detected level of the user speech in the ambient sound input signal, wherein the detection of the level of the user speech may be implemented in different ways, e.g. using two or more microphones 400 in different distances from a mouth of the user

[0074] According to an embodiment of the invention, processor 220 is configured to determine the inclusion level of the user speech further in response to the desired level of ambient sound defined by the user.

[0075] As aforementioned, according to an embodiment of the invention, sound system 200 further includes microphone 400 and/or speaker 500.

[0076] Referring to the processing of requested input signal 110 and ambient sound input signal 120 by processor 220, it is noted that processor 220 may usually process at any given moment information of requested input signal 110 that refers to substantially the same time frame as the information acquired from ambient sound input signal 120. Sound information pertaining to the sound that should be provided in a given time from requested input signal 110 may be processed with information relating to substantially the same given time – and possibly a little bit before that. It is noted that, according to an embodiment of the invention, estimation techniques may be implemented by processor 220 for ambient sound input signal 120, in order to estimate its value in the given time.

[0077] As sound systems may generally be adapted to reduce ambient noise effect, and to provide clear sound of requested input signal 110, processor 220 may be further configured, according to an embodiment of the invention, to process sound signals 110 and 120 by superimposing a cancellation signal for reducing a level of ambient sound input signal 120 onto requested input signal 110. The cancellation signal for example

may be an anti-phase signal having an opposite phase to that of the ambient sound input signal. It is noted that processor 220 may implement other types of active noise cancellation. It is further noted that other types of noise control may be implemented – either by system 200, or by another system (e.g. a headset connected to system 200 which provides modified requested signal 130 to a user, an external isolation system, etc.).

[0078] Some of the additional techniques that may be implemented may be, by way of example, sound insulation techniques (that prevent the transmission of noise by the introduction of a mass barrier), sound absorption techniques (in which a porous material that acts as a 'noise sponge' converts the sound energy into heat within the material), vibration damping techniques (in which vibration energy is extracted as dissipated as heat), and vibration isolation techniques (in which transmission of vibration energy from a source to a receiver is prevented by introducing a flexible element or a physical break).

[0079] The user defined cancellation may take different forms in different embodiments of the invention. For example, user defined cancellation-parameter may define a minimum allowed volume of ambient noise provided, a maximum allowed volume of ambient noise provided, a reduction rate (e.g. in percents), a reduction level selected out of few provided options, selection of cancellation frequencies (and cancellation levels for which), a predetermined recipe (e.g. engine noise reduction), a recipe defined by the user, and so forth.

[0080] Figure 2 illustrates method 700 for providing a sound signal, according to an embodiment of the invention. Referring to the examples set forth in the previous drawings, method 700 may be carried out by a sound system such as sound system 200. It is noted that various embodiments of method 700 may implement the various functionalities disclosed with relation to sound system 200 and or the other sound systems disclosed, even if not explicitly elaborated so.

[0081] Method 700 may include stage 710 of determining an inclusion level of an ambient sound input signal in a modified sound signal, based on a desired level defined by a user. The determining may be further responsive, according to an embodiment of the invention, to a state of at least one of the ambient sound input signal and a requested sound signal.

[0082] Referring to the examples set forth in the previous drawings, stage 710 may be carried out by processor 220.

[0083] Method 700 includes stage 715 of generating a modified requested signal by processing, in response to a desired level of ambient sound that is defined by a user, the requested sound signal and the ambient sound input signal, wherein an inclusion level of the ambient sound input signal in the modified requested signal is responsive to the desired level of ambient sound;

[0084] Referring to the examples set forth in the previous drawings, stage 715 may be carried out by processor 220.

[0085] According to an embodiment of the invention, method 700 may further include stage 720 of modifying the inclusion level of the ambient sound input signal in response to a detected state of at least one of the ambient sound input signal and the requested sound signal. Referring to the examples set forth in the previous drawings, stage 720 may be carried out by processor 220.

[0086] According to an embodiment of the invention, method 700 may further include modifying a cancellation level of the ambient sound input signal in response to a detected state of at least one of the ambient sound input signal and the requested sound signal. Referring to the examples set forth in the previous drawings, stage 720 may be carried out by processor 220.

[0087] According to an embodiment of the invention, method 700 further includes stage 725 of modifying an inclusion level of the ambient sound input signal in response to a modification in a detected state of at least one of the ambient sound input signal and the requested sound signal. Referring to the examples set forth in the previous drawings, stage 725 may be carried out by processor 220.

[0088] It is noted that, according to an embodiment of the invention, method 700 may further include stage 730 of stopping the modification and restoring the inclusion level of the ambient sound input signal to a previous state, after the detected state is no longer detected, after a predetermined time period, and/or after receiving user instruction. Referring to the examples set forth in the previous drawings, stage 730 may be carried out by processor 220.

[0089] Method 700 further includes stage 740 of providing the modified requested signal to at least one speaker, wherein – according to an embodiment of the invention the speaker is a speaker of a headset. Referring to the examples set forth in the previous drawings, stage 740 may be carried out by signal provider 230.

[0090] According to an embodiment of the invention, the determining includes stage 760 of determining the inclusion level further in response to a detection of a predefined sound pattern in the ambient sound input signal. Stage 760 may be carried out following stage 750 (discussed below), but this is not necessarily so. Referring to the examples set forth in the previous drawings, stage 760 may be carried out by processor 220.

[0091] According to an embodiment of the invention, method 700 further includes stage 750 of analyzing the ambient sound input signal wherein the analyzing includes identifying a predefined sound pattern in the ambient sound input signal. According to an embodiment of the invention, the processing is responsive to the identified predefined sound pattern. Referring to the examples set forth in the previous drawings, stage 750 may be carried out by processor 220. According to various embodiment of the invention, various actions relating to the processing of the requested input signal and or the ambient sound input signal may be carried out (as well as potentially other actions).

[0092] According to an embodiment of the invention, the processing includes reducing a volume of at least a portion of the requested sound signal in the modified requested signal provided to the at least one speaker. According to an embodiment of the invention, the processing includes increasing the volume of at least a portion of the requested sound signal in the modified requested signal provided to the at least one speaker. According to an embodiment of the invention, the processing includes otherwise processing the requested sound signal in the modified requested signal provided to the at least one speaker.

[0093] According to an embodiment of the invention, the processing includes reducing, increasing, or otherwise processing or modifying an inclusion level of at least a portion of the ambient sound input signal in the modified requested signal provided to the at least one speaker.

[0094] According to various embodiments of the invention, method 700 may include reducing, increasing, or otherwise modifying the inclusion level of the ambient sound input signal in response to a detection of the predefined sound pattern.

[0095] According to an embodiment of the invention, the processing includes inserting into the modified requested signal an indication about the detection of the predefined sound pattern. It is noted that the indication may be indicative of detection of the predefined sound pattern and/or on the type of the predefined sound pattern. According to an embodiment of the invention, the processing includes inserting into the modified requested signal an indication about a type of the predefined sound pattern.

[0096] According to an embodiment of the invention, method 700 further includes determining, prior to the analyzing, parameters of the predefined sound pattern in response to user input received from the user.

[0097] According to an embodiment of the invention, the analyzing includes generating a power spectrum of the ambient sound input signal for multiple time frames (e.g. analyzing by spectrum analysis multiple time frames of the ambient sound input signal to provide a power spectrum), and processing the power spectrums to detect peaks that exceeds a predetermined threshold for more than a predetermined period in at least one frequency associated with the predefined sound pattern.

[0098] According to an embodiment of the invention, method 700 further includes detecting the predefined sound pattern by generating a power spectrum of the ambient sound input signal for each time frame out of multiple time frames, and by processing the multiple power spectrums to detect peaks that exceeds a predetermined threshold for more than a predetermined period in at least one frequency associated with the predefined sound pattern.

[0099] According to an embodiment of the invention, the processing is carried out by a processor of a mobile communication device and includes processing the requested input signal, that is provided by a communication component of the mobile communication device in response to a signal received over a wireless communication connection, and the ambient sound input signal that is detected by a microphone of the mobile communication system. According to an embodiment of the invention, the processing further includes determining an inclusion level of the ambient sound input

signal that allows an inclusion of a desired level of user speech from the ambient sound input signal in the modified requested signal. According to an embodiment of the invention, the providing includes providing the modified requested signal to at least one speaker of the mobile communication device.

[00100] According to an embodiment of the invention, the processing includes reducing sound level of portions of the ambient sound input signal that do not include user speech.

[00101] According to an embodiment of the invention, the determining of the inclusion level is responsive to a detected level of the user speech in the ambient sound input signal.

[00102] According to an embodiment of the invention, the determining of the inclusion level is responsive to the user defined desired level and/or to another user defined level indicating parameter.

[00103] Figure 3 illustrates sound system 202 (which is an embodiment of sound system 200), according to an embodiment of the invention. Sound system 202 is incorporated into a headset, e.g. as disclosed above. Sound system 202 includes a headset microphone 400 (not illustrated in figure 3) that picks up ambient sound. Processor 220 of sound system 202 (not illustrated in figure 3) injects ambient sound input signal 120 into the speakers of the headset in a controllable volume, where the user can control the amount of external sound he is willing to hear simultaneously with requested input signal 110 (e.g. simultaneously with music).

[00104] Figure 4 illustrates sound system 203 (that is an embodiment of sound system 200), according to an embodiment of the invention. It is noted that sound system 203 may be incorporated into a mobile device, such as a cellular phone, a music player, a PDA, etc.

[00105] Today many mobile phones provide headset that consist of two speakers and a microphone. The two speakers may be used for listening to stereo music as well as to listening to incoming speech during the phone call. The microphone may be used to send the user's speech to the far end user. In cases that the user speaks and his ears are blocked by the headset, he does not hear himself correctly, hence due to the incorrect

feedback he might increase the level of the sound that he speaks and as a result he might speak very loudly.

[00106] According to an aspect of the invention, a microphone 400 of sound system 203 – that may be a mobile communication device – is integrated in a mobile phone (or other mobile communication device e.g. PDA). Microphone 400 may be used to pick the ambient noise and the user's speech (both as one or more ambient sound input signals 120) and processor 220 may then inject it (possibly after some processing) in a controllable manner to the headset speakers 500 (via signal provider 230). Such an implementation may significantly improve the phone conversation experience, e.g. when the two ears are blocked.

[00107] Sound system 203 may include a control 240, where the user can control the amount of music and ambient sound he wants to hear simultaneously. The control may be carried out in various manners, in various embodiments of the invention.

[00108] For example, the user may use the control 240 to defined a minimum allowed volume of ambient noise provided, a maximum allowed volume of ambient noise provided, a reduction rate (e.g. in percents), a reduction level selected out of few provided options, selection of inclusion frequencies (and inclusion level for which), a predetermined recipe (e.g. engine noise reduction), a recipe defined by the user, and so forth.

[00109] Microphone 400 collects ambient sound input signal 120 that is fed to processor 220 (e.g. to volume control component 222). Based on the user defined desired level of ambient sound (that may be received via control 240), processor 220 modifies a gain of requested input signal 110 produced by media player 130 (acting as system 300) and modifies ambient sound input signal 120 produced by microphone 400 – e.g. by reversing a phase of ambient sound input signal 120 and by modifying a gain of ambient sound input signal 120. It is noted that those signals may be otherwise modified. According to an embodiment of the invention, the two modified signals are added by processor 220, and are fed by signal provider 230 to the headset speakers 500. The modification of the gain of requested input signal 110 may be carried out by amplifier/gain modifier/processor 224 (denoted G1). The modification of the gain of ambient sound input signal 120 may be carried out by amplifier/gain modifier/processor

226 (denoted G2). The adding/summing of the modified signal may be implemented, according to an embodiment of the invention, by adder 228.

[00110] For example, according to an embodiment of the invention, in a case that the user does not want to listen to the ambient sound, volume control unit 222 may choose G2=0 and G1=1 (in the notation used, G2=0 means null inclusion of ambient sound input signal 120, and possibly also maximal cancellation of it, if cancellation is implemented). In cases where the user wants to hear some ambient sound, G1 is changed to reduce the volume of the sound produced by system 300 (here denoted 130) and the sound received from microphone 400 is increased by G2.

[00111] Figure 5 illustrates sound system 204 (that is an embodiment of sound system 200), according to an embodiment of the invention. Sound system 204 may be incorporated into a headset, but this is not necessarily so. Microphone 400 of sound system 204 collects the ambient sound (as ambient sound input signal 120) and processor 220 analyzes it by a DSP. According to an embodiment of the invention, microphone 400 may be implemented as one or multi channel microphones, it can be of a common type of microphone (e.g. a condenser microphone), but this is not necessarily so.

[00112] Processor 220 may be configured to check whether a predefined event occurred during the time that the user is listening to the music.

[00113] Ambient sound input signal 120 collected by microphone 400 may be digitized by analog to digital 250 (that may be incorporated into processor 220, and may be incorporated into microphone 400). The digitized sound is fed to processor 220 (e.g. to a DSP or ARM component 209 of which). Based on the DSP results, processor 220 may modify requested input signal 110 produced by the sound signal providing system 300 (also denoted media player 230) and ambient sound input signal 120 (e.g. by modifying a gain of which). The two sound signals may than be added up and then provided by signal provider 230 to one or more speakers 500.

[00114] According to an embodiment of the invention, in a case that no event occurred, G2=0 and G1=1. In cases where a predefined event is detected, G1 may be changed to reduce the volume of requested input signal 110 and the ambient sound input signal 120 may be increased by G2.

[00115] According to an embodiment of the invention, a predefined message that is generated by DSP 209 may be injected to the speaker 500. According to an embodiment of the invention, once the predefined event is over the gains are set that the user will continue to listen to the music as usual. Some examples of the process are illustrated in figure 6.

[00116] Figure 6 illustrates a flowchart of method 800 for modifying an inclusion level of the ambient sound input signal in response to a detected state of at least one of the ambient sound input signal and the requested sound signal, according to an embodiment of the invention.

[00117] It is noted that the process illustrated in figure 6 is exemplified where the predefined event is an ambulance siren, and that other – more complex – embodiments may be implemented. This example is provided to demonstrate the flexibility of the apparatus however different events can be also detected with the same apparatus by changing the DSP process.

[00118] In stage 805 of method 800, the ambient sound input signal (either digitized or not) is divided into frames, where the size of the frame may be, by way of example, 20ms.

[00119] Stage 810 includes applying spectrum analysis to each of the frames (or to a subgroup of frames, e.g. every third frame), and calculating its power spectrum. According to an embodiment of the invention, the power spectrum can be calculated by the DSP using FFT.

[00120] Following stage 810 of calculation of the power spectrum, stage 820 includes searching for features of the sound signals such as peaks in the range of frequencies that we can expect to find Ambulance siren (or other predefined sound pattern).

[00121] Stag 825 includes determining if a peak (e.g. the highest peak in a region of peaks) exceeds a predetermined threshold.

[00122] If the peak is lower than the threshold, denoted 830, it may be assumed that there is no siren in this area and the processing may be carried out as determined using the user defined inclusion level (e.g. G1=1, G2=0, namely no change in gain of the music).

[00123] If the peak is above the threshold, stage 835 may be carried out, that includes continue to check for consistency in the exceeding of the threshold. It is noted that according to an embodiment of the invention stage 835 may be skipped, and instead stage 837 may be carried out directly. By way of example, a simple consistency check as implemented in stage 835 may include determining whether the period of the siren is long enough. If it fails we assume no siren in our neighborhood, and stage 830 may be carried out. Otherwise we assume that there is a siren and stage 837 may be carried out, that includes reducing (or otherwise modifying) a volume of the requested sound signal in the modified requested signal, and/or increasing (or otherwise modifying) an inclusion level of the ambient sound input signal in the modified requested signal. For example, G1 and G2 may be modified.

[00124] By returning to stages 810, 820 and 830 (e.g. on a frame by frame basis) during all the session that the user listens to the music, the user defined inclusion level may be resumed once the predefined sound pattern ceases. .

[00125] It is obviously clear to a person who is skilled in the art that methods which are suitable for the operation of the systems disclosed above which differ from the method illustrated in flow chart 800 are also included in the scope of the invention.

[00126] Additionally, all of those methods could be incorporated into computer readable codes which could be stored in computer readable mediums, which can upgrade specially designed mobile devices and headsets, or upgrade existing mobile devices and/or headsets to operate according to the different embodiments of the invention.

[00127] While certain features of the invention have been illustrated and described herein, many modifications, substitutions, changes, and equivalents will now occur to those of ordinary skill in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

CLAIMS

What is claimed is:

1. A sound system, the sound system comprising:

a processor, configured to: (a) receive a requested sound signal and an ambient sound input signal; and (b) generate a modified requested signal by processing, in response to a desired level of ambient sound that is defined by a user, the requested sound signal and the ambient sound input signal, wherein an inclusion level of the ambient sound input signal in the modified requested signal is responsive to the desired level of ambient sound; and

a signal provider configured to provide the modified requested signal to multiple speakers of a headset.

2. The sound system according to claim 1, wherein the processor is further configured to modify the inclusion level of the ambient sound input signal in the modified requested signal in response to a modification in the detected state of at least one of the ambient sound input signal and the requested sound signal.

3. The sound system according to any of the preceding claims, wherein the processor is configured to determine the inclusion level of the ambient sound input signal in the modified requested signal in response to a detection of a predefined sound pattern in the ambient sound input signal.

4. The sound system according to claim 3, wherein the processor is configured to increase the inclusion level of the ambient sound input signal in the modified requested signal in response to a detection of the predefined sound pattern.

5. The sound system according to claim 3 or 4, wherein the processor is further configured to insert into the modified requested signal an indication about the detection of the predefined sound pattern.

6. The sound system according to claim 3, 4, or 5 , wherein the processor is further configured to insert into the modified requested signal an indication about a type of the predefined sound pattern.

7. The sound system according to claim 3, 4, 5, or 6, wherein the processor is further configured to detect the predefined sound pattern by generating a power spectrum of the ambient sound input signal for each time frame out of multiple time frames, and by processing the multiple power spectrums to detect peaks that exceeds a predetermined threshold for more than a predetermined period in at least one frequency associated with the predefined sound pattern.

8. The sound system according to claim 3, 4, 5, 6, or 7, wherein the processor is further configured to determine parameters of the predefined sound pattern in response to user input received from the user.

9. The sound system according to any of the preceding claims, wherein the sound system is included in a mobile communication device, wherein the requested input signal is provided by a communication component of the mobile communication device in response to a signal received over a wireless communication connection; wherein the ambient sound input signal is detected by a microphone of the mobile communication system; wherein the processor is further configured to determine the inclusion level of the ambient sound input signal in the modified requested signal that allows an inclusion of a desired level of user speech from the ambient sound input signal in the modified requested signal.

10. The sound system according to claim 9, wherein the processor is further configured to determine the inclusion level of the ambient sound input signal in the modified requested signal in response to a detected level of the user speech in the ambient sound input signal.

11. The sound system according to any of the preceding claims, wherein the inclusion level of the ambient sound input signal in the modified requested signal is responsive to the desired level of ambient sound defined by a

supervisor user that defines at least one desired level of ambient sound for multiple listeners.

12. The sound system according to any of the preceding claims, further comprising the microphone and the speaker.

13. A method for providing a sound signal, the method comprising:

receiving a requested sound signal and an ambient sound input signal;

generating a modified requested signal by processing, in response to a desired level of ambient sound that is defined by a user, the requested sound signal and the ambient sound input signal, wherein an inclusion level of the ambient sound input signal in the modified requested signal is responsive to the desired level of ambient sound; and

providing the modified requested signal to at least one speaker of a headset.

14. The method according to claim 13, wherein the processing further comprises modifying the inclusion level of the ambient sound input signal in the modified requested signal in response to a modification in a detected state of at least one of the ambient sound input signal and the requested sound signal.

15. The method according to claim 13 or 14, wherein the determining comprises determining the inclusion level of the ambient sound input signal in the modified requested signal further in response to a detection of a predefined sound pattern in the ambient sound input signal.

16. The method according to claim 15, wherein the processing comprises increasing the inclusion level of the ambient sound input signal in the modified requested signal in response to a detection of the predefined sound pattern

17. The method according to claim 15 or 16, wherein the processing comprises inserting into the modified requested signal an indication about the detection of the predefined sound pattern.

18. The method according to claim 15, 16, or 17, wherein the processing comprises inserting into the modified requested signal an indication about a type of the predefined sound pattern.

19. The method according to claim 15, 16, 17, or 18 wherein further comprising determining, prior to the analyzing, parameters of the predefined sound pattern in response to user input received from the user.

20. The method according to claim 15, 16, 17, 18, or 19, further comprising detecting the predefined sound pattern by generating a power spectrum of the ambient sound input signal for each time frame out of multiple time frames, and by processing the multiple power spectrums to detect peaks that exceeds a predetermined threshold for more than a predetermined period in at least one frequency associated with the predefined sound pattern.

21. The method according to any of the preceding claims, wherein the processing is carried out by a processor of a mobile communication device and comprises processing the requested input signal, that is provided by a communication component of the mobile communication device in response to a signal received over a wireless communication connection, and the ambient sound input signal that is detected by a microphone of the mobile communication system; wherein the processing further comprises determining the inclusion level of the ambient sound input signal in the modified requested signal that allows an inclusion of a desired level of user speech from the ambient sound input signal in the modified requested signal; wherein the providing comprises providing the modified requested signal to at least one speaker of the mobile communication device.

22. The method according to claim 21, wherein the processing comprises reducing sound level of portions of the ambient sound input signal that do not comprise user speech.

23. The method according to claim 21 or 22, wherein the determining of the cancellation level is responsive to a detected level of the user speech in the ambient sound input signal.

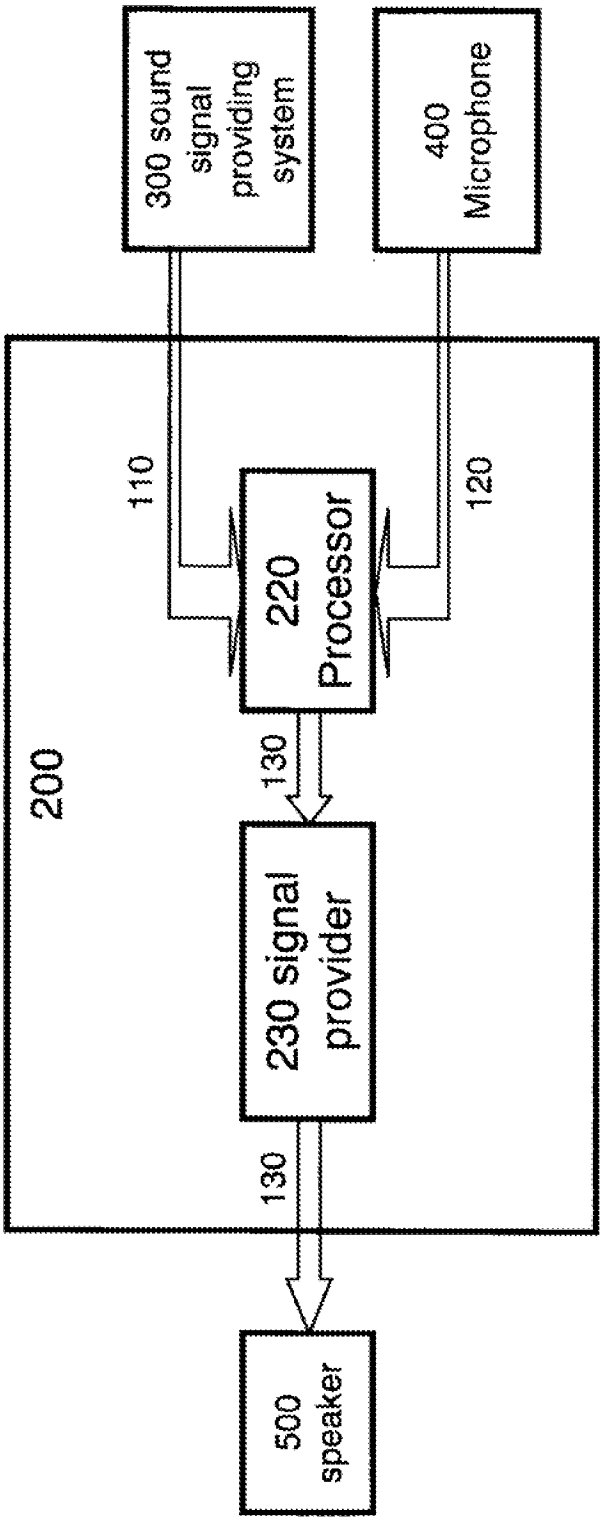

300 sound signal providing system
400 Microphone
200
110
120
220 Processor
130
230 signal provider
130
500 speaker

FIG. 1A

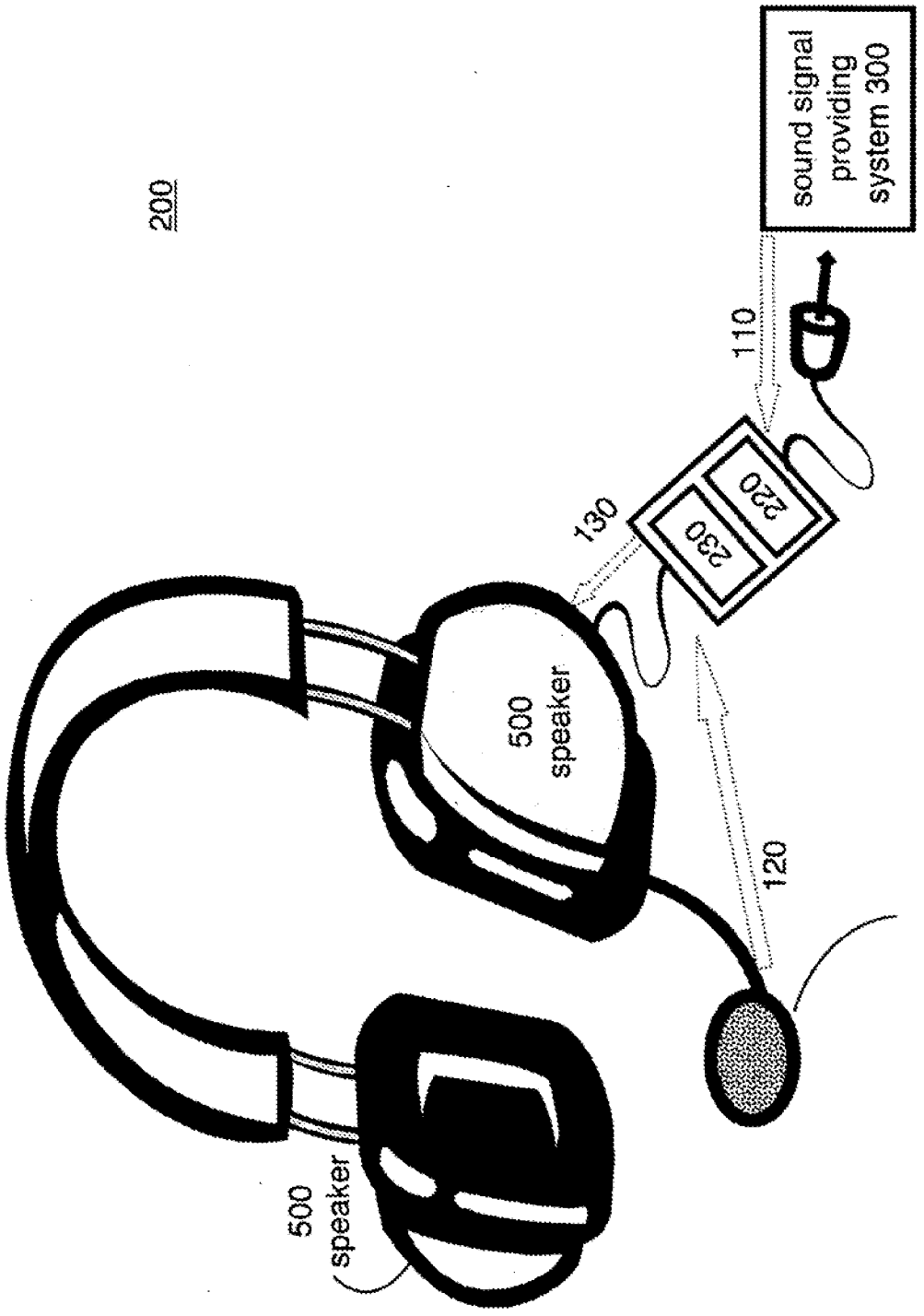

200
sound signal providing system 300
110
130
220
230
500 speaker
500 speaker
120
Microphone 400

FIG. 1B

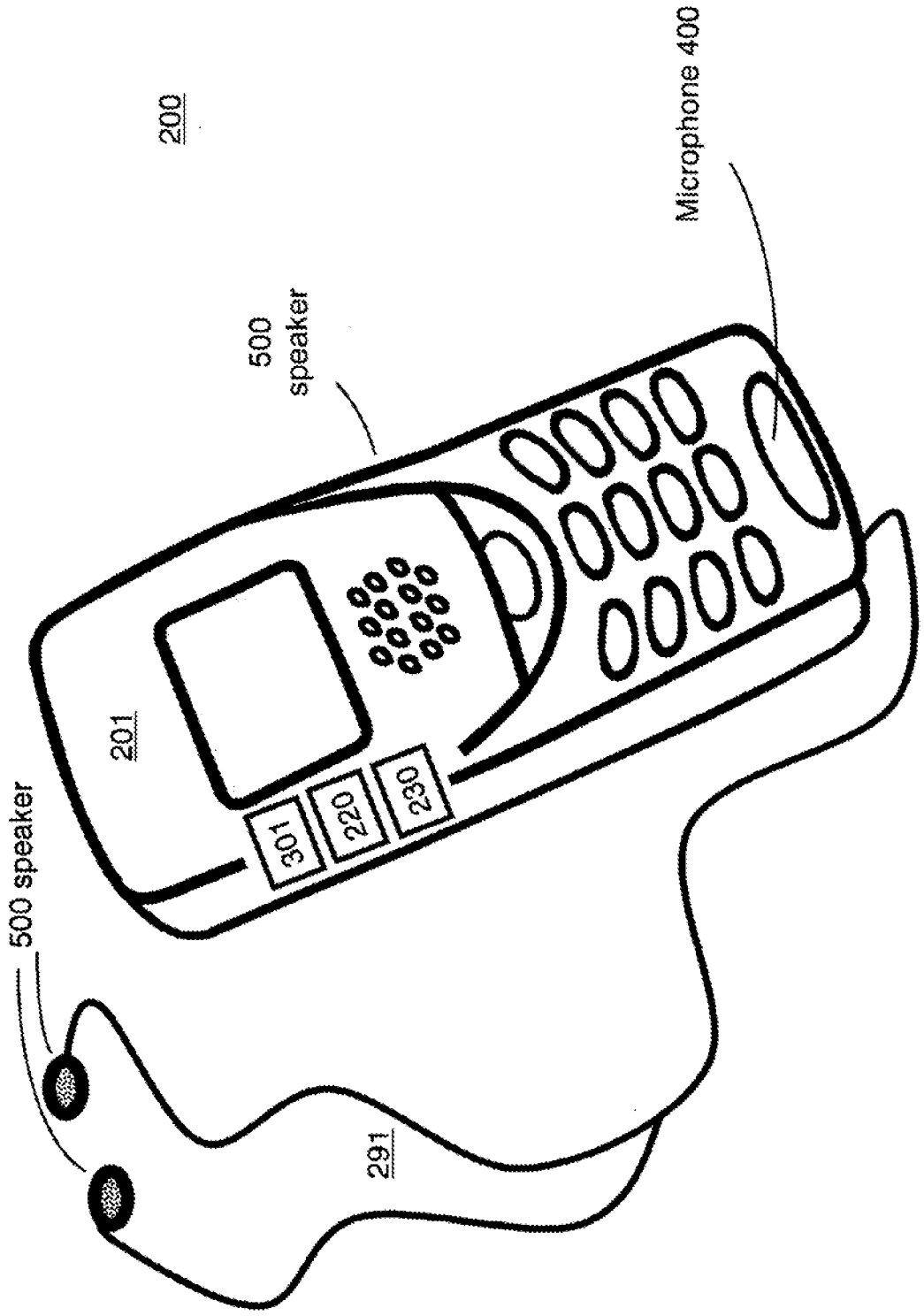

200
Microphone 400
500
speaker
201
301
220
230
500 speaker
291

FIG. 1C

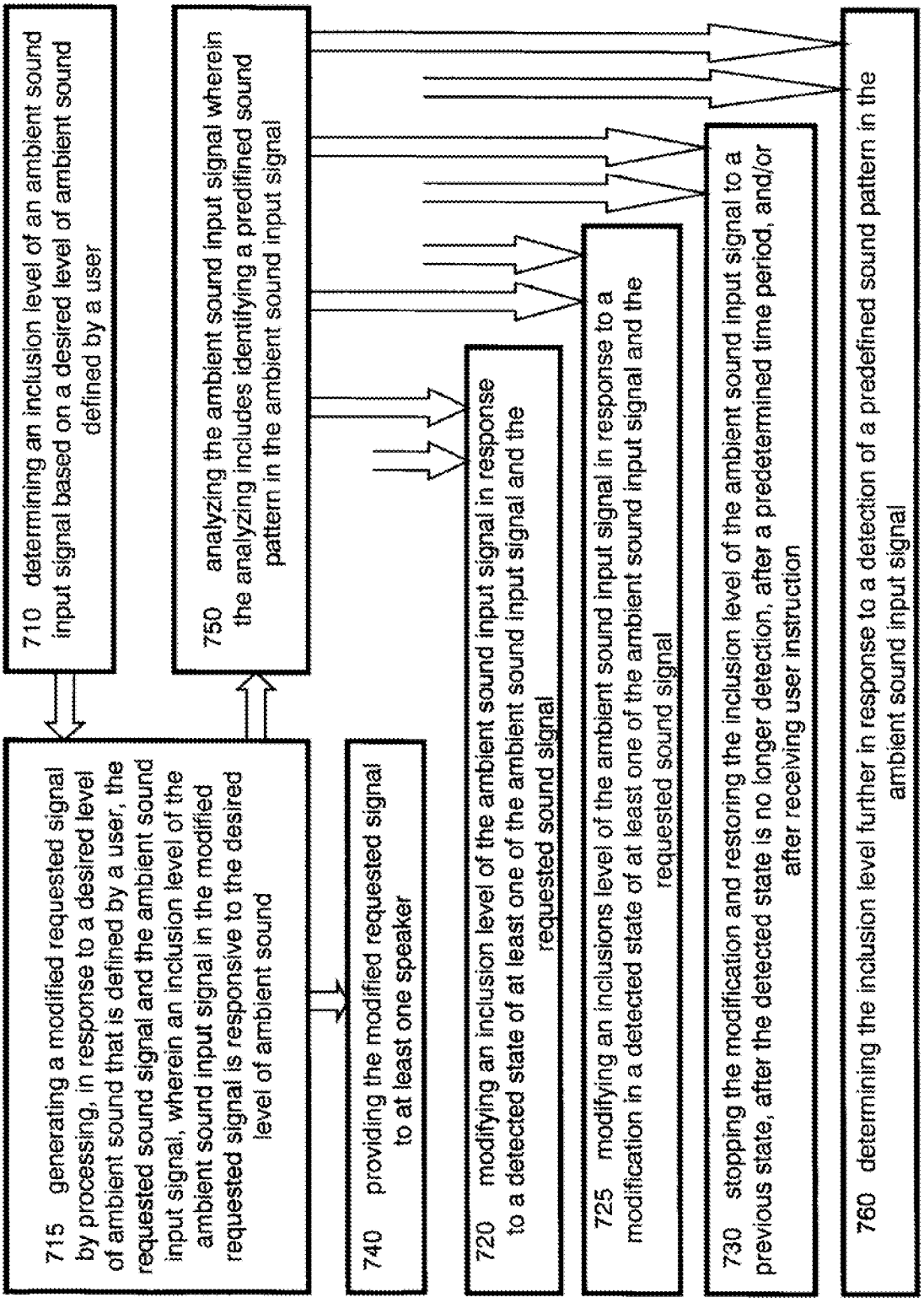

710 determining an inclusion level of an ambient sound input signal based on a desired level of ambient sound defined by a user
715 generating a modified requested signal by processing, in response to a desired level of ambient sound that is defined by a user, the requested sound signal and the ambient sound input signal, wherein an inclusion level of the ambient sound input signal in the modified requested signal is responsive to the desired level of ambient sound
740 providing the modified requested signal to at least one speaker
750 analyzing the ambient sound input signal wherein the analyzing includes identifying a predifined sound pattern in the ambient sound input signal
720 modifying an inclusion level of the ambient sound input signal in response to a detected state of at least one of the ambient sound input signal and the requested sound signal
725 modifying an inclusions level of the ambient sound input signal in response to a modification in a detected state of at least one of the ambient sound input signal and the requested sound signal
730 stopping the modification and restoring the inclusion level of the ambient sound input signal to a previous state, after the detected state is no longer detection, after a predetermined time period, and/or after receiving user instruction
760 determining the inclusion level further in response to a detection of a predefined sound pattern in the ambient sound input signal
700

FIG. 2

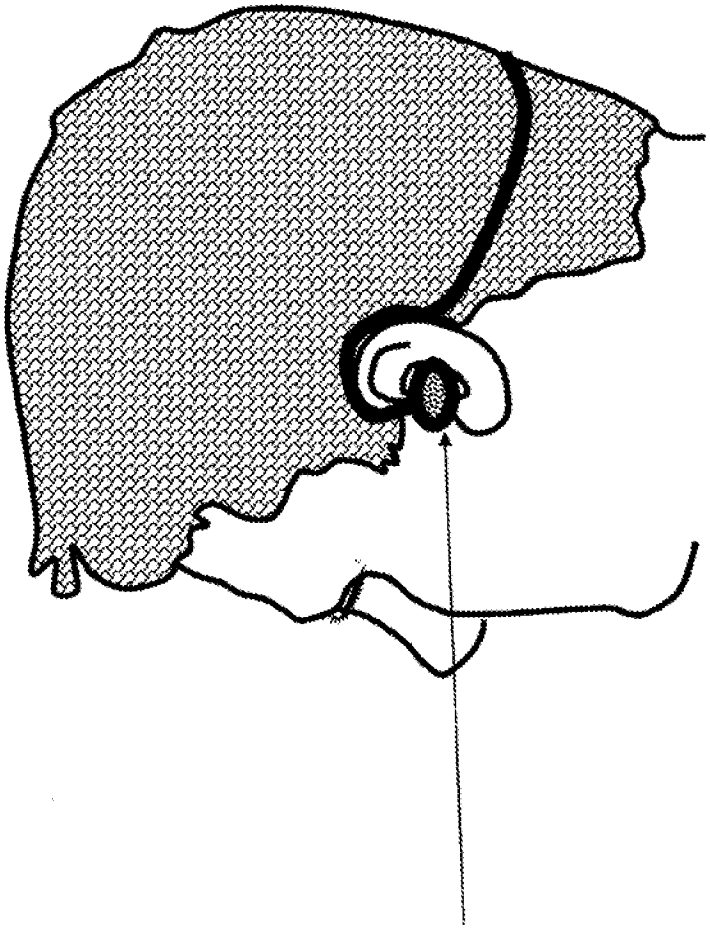

202
"In ear" headset
combined with
microphone that
picks the external
sounds

FIG. 3

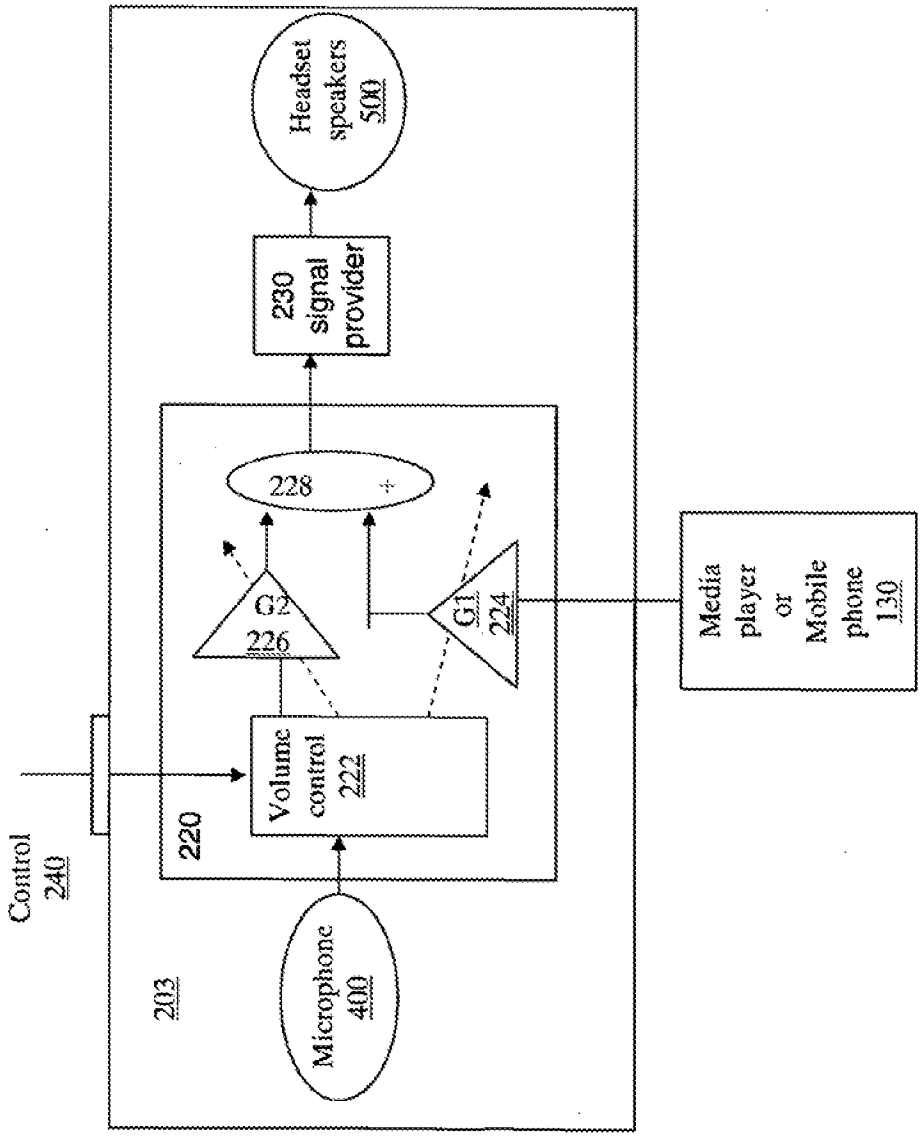

Headset speakers 500
230 signal provider
228
+
G2 226
G1 224
Media player or Mobile phone 130
Volume control 222
220
Control 240
203
Microphone 400

FIG. 4

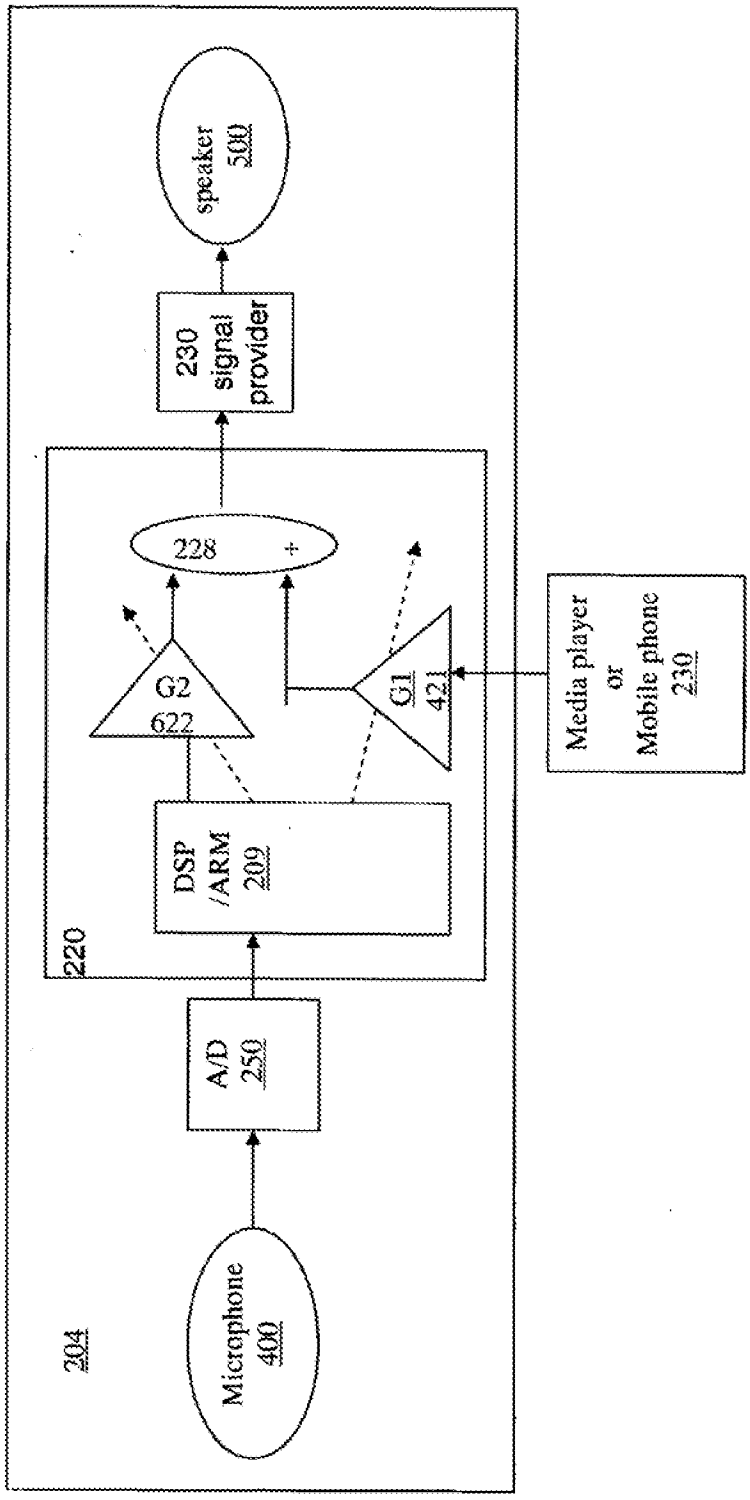

speaker
500
230
signal
provider
228
+
G2
622
G1
421
Media player
or
Mobile phone
230
DSP
/ARM
209
220
A/D
250
Microphone
400
204

FIG. 5

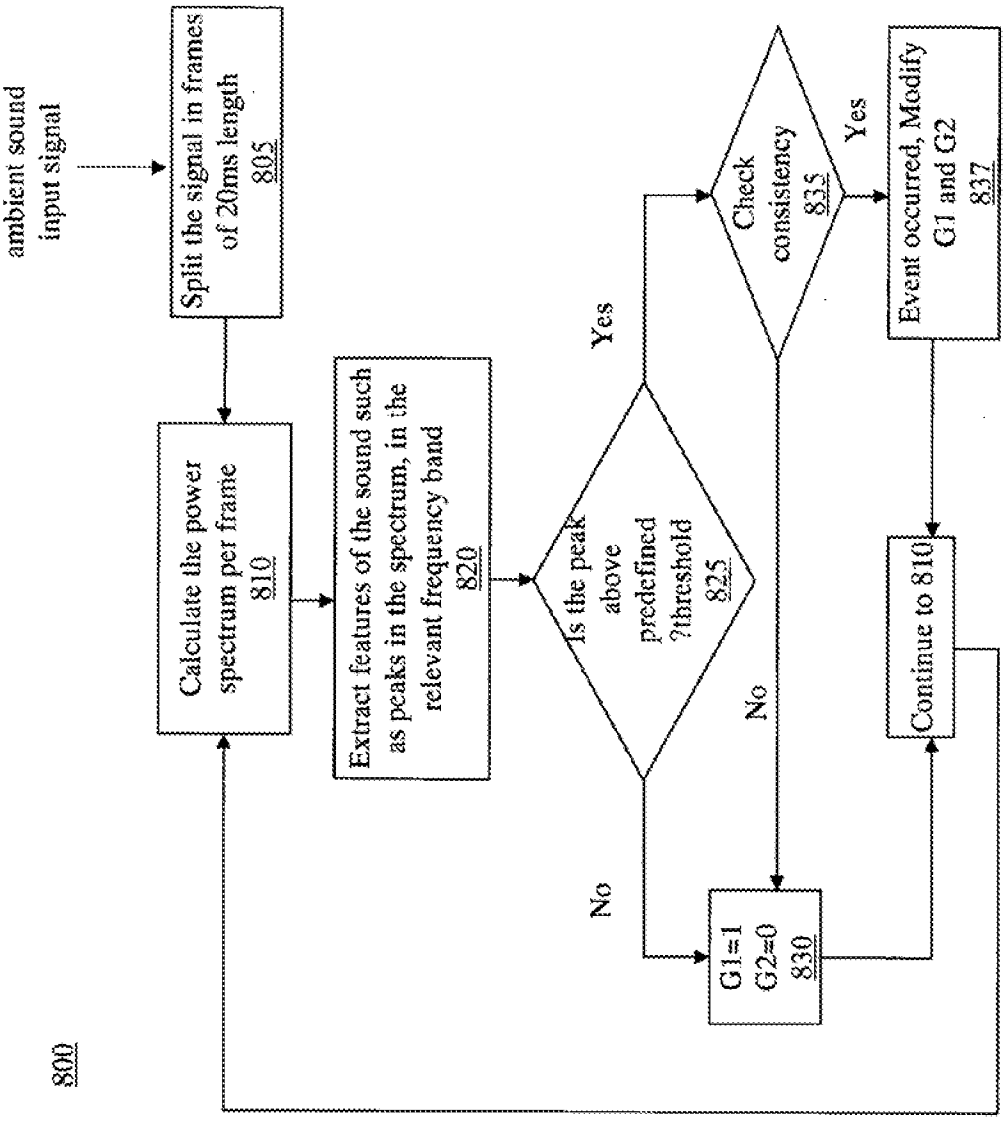

800
ambient sound input signal
Split the signal in frames of 20ms length 805
Calculate the power spectrum per frame 810
Extract features of the sound such as peaks in the spectrum, in the relevant frequency band 820
Is the peak above predefined ?threshold 825
Yes
No
Check consistency 835
Yes
No
Event occurred, Modify G1 and G2 837
G1=1 G2=0 830
Continue to 810

FIG. 6

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[Continued on next page]

(54) Title: A SYSTEM AND A METHOD FOR PROVIDING SOUND SIGNALS

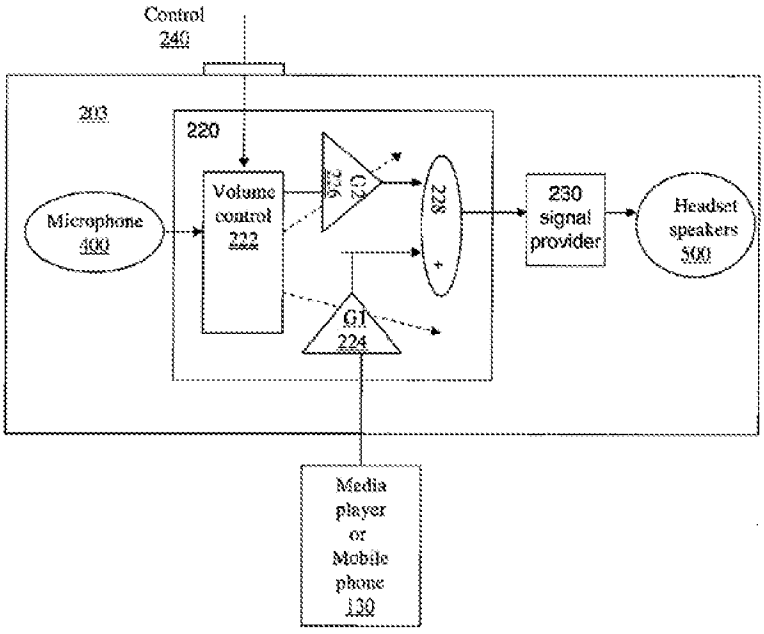


FIG. 4

(57) Abstract: A sound system, the sound system including: (i) a processor, configured to: (a) receive a requested sound signal and an ambient sound input signal; and (b) generate a modified requested signal by processing, in response to a desired level of ambient sound that is defined by a user, the requested sound signal and the ambient sound input signal, wherein an inclusion level of the ambient sound input signal in the modified requested signal is responsive to the desired level of ambient sound; and (ii) a signal provider configured to provide the modified requested signal to multiple speakers of a headset.

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USPC - 381/107
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B. FIELDS SEARCHED

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USPC: 381/107

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 381/72; 381/71.1 (see terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(PGPB,USPT,USOC,EPAB,JPAB), GOOGLE SCHOLAR
terms: headset, ambient, external, audio, audible, sound, headphone, siren, alarm, acoustic, pattern, processor, inclusion, level, warning, alert, occluded, microphone.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/0240458 A1 (Goldstein et al.) 02 October 2008 (02.10.2008), fig. 1-3, 8, para [0025]-[0036], [0072]-[0074].	1-4, 13-16
A	US 2008/0267416 A1 (Goldstein et al.) 30 October 2008 (30.10.2008), entire document.	1-4, 13-16
A	US 2008/0181419 A1 (Goldstein et al.) 31 July 2008 (31.07.2008), entire document.	1-4, 13-16
A	US 2001/0046304 A1 (Rast) 29 November 2001 (29.11.2001), entire document.	1-4, 13-16

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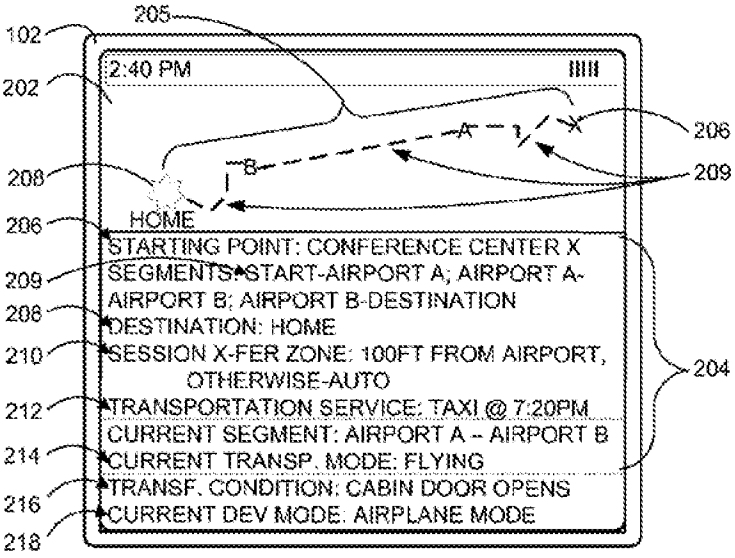


FIG. 2

(57) Abstract: A method of operation of a navigation system includes: establishing a navigation session for routing from a starting point to a destination on a device; setting a transfer condition for continuing the navigation session between the device and a further device; and transferring the navigation session when the transfer condition is satisfied for routing with the further device for displaying on the further device.

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NAVIGATION SYSTEM WITH SESSION TRANSFER MECHANISM AND METHOD OF OPERATION THEREOF

TECHNICAL FIELD

The present invention relates generally to a navigation system, and more particularly to a system for navigating and routing.

BACKGROUND ART

Modern portable consumer and industrial electronics, especially client devices such as navigation systems, smart phones, portable digital assistants, and combination devices are providing increasing levels of functionality to support modern life including location-based information services. Research and development in the existing technologies can take a myriad of different directions.

As users become more empowered with the growth of mobile navigation service devices, new and old paradigms begin to take advantage of this new device space. There are many technological solutions to take advantage of this new device-location opportunity. One existing approach is to use location information to locate the user and guide the user to a destination.

Often, multi-modal routes for guiding the user are not logically connected to accurately reflect the user's movements. Furthermore, the routes and methods for guiding the user do not reflect the travel status of the user.

The need to reduce costs, improve efficiencies and performance, and meet competitive pressures adds an even greater urgency to the critical necessity for finding answers to these problems. However, solutions to these problems have been long sought but prior developments have not taught or suggested any solutions and, thus, solutions to these problems have long eluded those skilled in the art. Thus, a need still remains for a navigation system with session transfer mechanism.

DISCLOSURE OF THE INVENTION

The present invention provides a method of operation of a navigation system including: establishing a navigation session for routing from a starting point to a destination on a device; setting a transfer condition for continuing the navigation session between the device and a further device; and transferring the navigation session when the transfer condition is satisfied for routing with the further device for displaying on the further device.

The present invention provides a navigation system, including: a session creator module for establishing a navigation session for routing from a starting point to a destination on a device; a condition module, coupled to the session creator module, for setting a transfer condition for continuing the navigation session between the device and a further device; and a session transfer module, coupled to the condition module, for transferring the navigation session when the transfer condition is satisfied for routing with the further device for displaying on the further device.

Certain embodiments of the invention have other steps or elements in addition to or in place of those mentioned above. The steps or elements will become apparent to those skilled in the art from a reading of the following detailed description when taken with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a navigation system with session transfer mechanism in an embodiment of the present invention.

FIG. 2 is a first example of a display interface of the first device.

FIG. 3 is a second example of the display interface of the first device.

FIG. 4 is an exemplary block diagram of the navigation system.

FIG. 5 is a control flow of the navigation system.

FIG. 6 is a flow chart of a method of operation of the navigation system in a further embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

The following embodiments are described in sufficient detail to enable those skilled in the art to make and use the invention. It is to be understood that other embodiments would be

evident based on the present disclosure, and that system, process, or mechanical changes may be made without departing from the scope of the present invention.

In the following description, numerous specific details are given to provide a thorough understanding of the invention. However, it will be apparent that the invention may be practiced without these specific details. In order to avoid obscuring the present invention, some well-known circuits, system configurations, and process steps are not disclosed in detail.

The drawings showing embodiments of the system are semi-diagrammatic and not to scale and, particularly, some of the dimensions are for the clarity of presentation and are shown exaggerated in the drawing FIGs. Similarly, although the views in the drawings for ease of description generally show similar orientations, this depiction in the FIGs. is arbitrary for the most part. Generally, the invention can be operated in any orientation. The embodiments have been numbered first embodiment, second embodiment, etc. as a matter of descriptive convenience and are not intended to have any other significance or provide limitations for the present invention.

One skilled in the art would appreciate that the format with which navigation information is expressed is not critical to some embodiments of the invention. For example, in some embodiments, navigation information is presented in the format of (X, Y), where X and Y are two ordinates that define the geographic location, i.e., a position of a user.

In an alternative embodiment, navigation information is presented by longitude and latitude related information. In a further embodiment of the present invention, the navigation information also includes a velocity element including a speed component and a heading component.

The term "relevant information" referred to herein includes the navigation information described as well as information relating to points of interest to the user, such as local business, hours of businesses, types of businesses, advertised specials, traffic information, maps, local events, and nearby community or personal information.

The term "module" referred to herein can include software, hardware, or a combination thereof. For example, the software can be machine code, firmware, embedded code, and application software. Also for example, the hardware can be circuitry, processor, computer, integrated circuit, integrated circuit cores, a pressure sensor, an inertial sensor, a microelectromechanical system (MEMS), passive devices, or a combination thereof.

Referring now to FIG. 1, therein is shown a navigation system 100 with session transfer mechanism in an embodiment of the present invention. The navigation system 100 includes a first device 102, such as a client or a server, connected to a second device 106, such as a client or server, with a communication path 104, such as a wireless or wired network. The navigation system 100 can include a further device 103, such as a client or a server, connected to the first device 102 or the second device 106, with the communication path104.

For example, the first device 102 can be of any of a variety of mobile devices, such as a cellular phone, personal digital assistant, a notebook computer, automotive telematic navigation system, or other multi-functional mobile communication or entertainment device. The first device 102 can be a standalone device, or can be incorporated with a vehicle, for example a car, truck, bus, or train. The first device 102 can couple to the communication path 104 to communicate with the second device 106.

The further device 103 can also be of any of a variety of mobile devices, such as a cellular phone, personal digital assistant, a notebook computer, automotive telematic navigation system, or other multi-functional mobile communication or entertainment device. The further device 103 can be a standalone device, or can be incorporated with a vehicle, for example a car, truck, bus, or train. The further device 103 can couple to the communication path 104 to communicate with the second device 106. The further device 103 can couple to the communication path 104 to communicate with the first device 102.

For illustrative purposes, the navigation system 100 is described with the first device 102 as a mobile computing device, although it is understood that the first device 102 can be different types of computing devices. For example, the first device 102 can also be a non-mobile computing device, such as a server, a server farm, or a desktop computer.

Also, for illustrative purposes, the navigation system 100 is described with the further device 103 as a mobile computing device in vehicles, although it is understood that the first device 102 can be different types of computing devices. For example, the first device 102 can also be a non-mobile computing device, such as a server, a server farm, or a desktop computer, or a mobile computing device not attached to vehicles, such as a cell phone or a notebook computer.

The second device 106 can be any of a variety of centralized or decentralized computing devices. For example, the second device 106 can be a computer, grid computing

resources, a virtualized computer resource, cloud computing resource, routers, switches, peer-to-peer distributed computing devices, or a combination thereof.

The second device 106 can be centralized in a single computer room, distributed across different rooms, distributed across different geographical locations, embedded within a telecommunications network. The second device 106 can have a means for coupling with the communication path 104 to communicate with the first device 102. The second device 106 can also be a client type device as described for the first device 102.

In another example, the first device 102 can be a particularized machine, such as a mainframe, a server, a cluster server, rack mounted server, or a blade server, or as more specific examples, an IBM System z10 Business Class mainframe or a HP ProLiant ML server. Yet another example, the second device 106 can be a particularized machine, such as a portable computing device, a thin client, a notebook, a netbook, a smartphone, personal digital assistant, or a cellular phone, and as specific examples, an Apple iPhone, Palm Centro, or Moto Q Global.

For illustrative purposes, the navigation system 100 is described with the second device 106 as a non-mobile computing device, although it is understood that the second device 106 can be different types of computing devices. For example, the second device 106 can also be a mobile computing device, such as notebook computer, another client device, or a different type of client device. The second device 106 can be a standalone device, or can be incorporated with a vehicle, for example a car, truck, bus, or train.

Also for illustrative purposes, the navigation system 100 is shown with the second device 106 and the first device 102 as end points of the communication path 104, although it is understood that the navigation system 100 can have a different partition between the first device 102, the second device 106, and the communication path 104. For example, the first device 102, the second device 106, or a combination thereof can also function as part of the communication path 104.

The communication path 104 can be a variety of networks. For example, the communication path 104 can include wireless communication, wired communication, optical, ultrasonic, or the combination thereof. Satellite communication, cellular communication, Bluetooth, Infrared Data Association standard (IrDA), wireless fidelity (WiFi), and worldwide interoperability for microwave access (WiMAX) are examples of wireless communication that can be included in the communication path 104. Ethernet, digital

subscriber line (DSL), fiber to the home (FTTH), and plain old telephone service (POTS) are examples of wired communication that can be included in the communication path 104.

Further, the communication path 104 can traverse a number of network topologies and distances. For example, the communication path 104 can include direct connection, personal area network (PAN), local area network (LAN), metropolitan area network (MAN), wide area network (WAN) or any combination thereof.

Referring now to FIG. 2, therein is shown a first example of a display interface 202 of the first device 102. The display interface 202 can show a navigation session 204.

The navigation session 204 is the set of details regarding the user's travel including route information as well as point of interest information, appointment information, travel segment for the route information, or a combination thereof. The navigation session 204 can detail the locations the user will be traversing, times associated with the travel, notable information, such as reminders and notes, associated with the travel, or a combination thereof.

For example, the navigation session 204 can be the car trip from the user's house to an amusement park or the user's flight itinerary with multiple layovers. Also, for example, the navigation session 204 can be the planned trip for returning home from a convention, using multiple modes of transportation.

The navigation session 204 can also include the notes and reminders associated with time or location within the user's travel. For example, the navigation session 204 can have a note detailing a conversation with a potential client the user met and spoke to along the way or a note on why the flight was delayed. Also, for example, the user could have received a reminder to pick up the milk on the way home or wrote a reminder to call the travel agent from the airport.

The navigation session 204 can have a travel-route 205, having a starting point 206 and a destination 208. The travel-route 205 is a route the user can traverse to get from the starting point 206 to the destination 208. The starting point 206 is a location where the user can start travelling for the navigation session 204. The destination 208 is a location where the user is designated to finish travelling for the navigation session 204.

The travel-route 205 can have a route segment 209. The route segment 209 is a portion of the travel-route 205 that is dividable. The route segment 209 can be divided by an intermediate stop or by the mode of transportation. For example, the route segment 209 can be the portion of the travel-route 205 from the starting point 206 to the stop at the nearest gas

station. Also, for example, the route segment 209 can be the portion where the user walks between airport terminals to transfer from one flight to another.

The navigation system 100 can use the navigation session 204 to guide the user along the travel. The navigation system 100 can guide the user from the starting point 206 to the destination 208 along the travel-route 205. The navigation system 100 can transfer the navigation session 204 between the first device 102, the further device 103, the second device 106, or a combination thereof for continuing the navigation session 204 between these devices while traversing the travel-route 205. The details of transferring the navigation session 204 will be discussed below.

The navigation session 204 can also include a session-transfer zone 210 and a transportation service 212. The session-transfer zone 210 is a geographic location designated for transferring the navigation session 204 between the first device 102, the further device 103, the second device 106, or a combination thereof. For example, the session-transfer zone 210 can be a parking lot where the user will go from using the first device 102 to the further device 103 embedded in the car, or an airport gate where the user will go from using the further device 103 embedded in the airplane to the first device 102.

The transportation service 212 is an arrangement for the user to be transported by a person or entity other than the user. For example, the transportation service 212 can be arranging for a friend to pick up the user from the airport or from the train station.

The display interface 202 can also show a current transportation mode 214, a transfer condition 216, and a device-mode 218. The current transportation mode 214 is a manner, way, or method of travel currently being used by the user. For example, the current transportation mode 214 can be pedestrian, personal vehicle, taxi service, boat, or airplane.

The navigation system 100 can determine the current transportation mode 214 based on the time of transferring the navigation session 204. The details of determining the current transportation mode 214 will be discussed below.

The transfer condition 216 is the requirement that must be met for the navigation system 100 to transfer the navigation session 204 between devices. The transfer condition 216 can be the user being in the session-transfer zone 210, the first device 102 being within a threshold distance from the further device 103, or a combination thereof.

The transfer condition 216 can also require certain operations on the devices, such as the further device 103 being on or navigation software running on the first device 102,

associated with locations on the travel-route 205. For example, the transfer condition 216 can include the airplane cabin door opening at the arriving airport gate.

Also, for example, the transfer condition 216 can be specific for the route segment 209 where the user has planned to pick up a rental car and start driving. For accommodating the start of travel by car, the transfer condition 216 can include the further device 103 to be powered on, and the vehicle ignition to be on. When the transfer condition 216 is met, the navigation system 100 can transfer the navigation session 204 from the first device 102 to the further device 103.

The details of setting the transfer condition 216 will be discussed below. The details of the use of the transfer condition 216 in transferring the navigation session 204 will also be discussed below.

The device-mode 218 is a given condition of function or a status for operating the first device 102. For example, the device-mode 218 can denote commanding the first device 102 on or off. Also, for example, the device-mode 218 can be the operational functions, such as initiating the navigation software or setting the cellular phone to airplane mode and restricting the communication of the first device 102.

The navigation system 100 can set the device-mode 218 when the navigation session 204 is transferred to control the operation of the first device 102. The detailed function of the device-mode 218 will be discussed below.

Referring now to FIG. 3, therein is shown a second example of the display interface 202 of the first device 102. The display interface 202 can show a device-location 302, a control zone 304, a further-device mode 306, and a session status 308.

The device-location 302 is the geographical location of the first device 102. The device-location 302 can be represented in multiple ways. For example, the device-location 302 can be a set of coordinates, such as GPS coordinates or longitude and latitude. Continuing with the example, the device-location 302 can be an address or a set of landmarks, such as the intersection of two roads or a highway exit.

The device-location 302 can also be represented relative to known landmarks. For example, the device-location 302 can be 5 miles north and 2 miles west of the user's home or 100 feet past the First Street exit on Highway 1, in the second lane from right.

The device-location 302 can further be expressed as relative location to the other devices. For example, the device-location 302 can express whether the first device 102 is inside or outside a vehicle as the further device 103.

The control zone 304 is a geographical area surrounding the further device 103 that is used to determine when transfer of the navigation session 204 of FIG. 2 is permissible. The control zone 304 can be included in the transfer condition 216. The control zone 304 can be a circular area set by a radial distance around the further device 103 at the center. For example, the control zone 304 can be the area within 10 feet of the further device 103.

The control zone 304 can also be set relative to the vehicle associated with the further device 103. For example, the control zone 304 can be the front row of the car or inside of the airplane cabin.

The navigation system 100 can transfer the navigation session 204 from the first device 102 to the further device 103 when the first device 102 is within the control zone 304. The navigation system 100 can transfer the navigation session 204 to the first device 102 when the first device 102 goes out of the control zone 304.

The details of setting the control zone 304 and the use of the control zone 304 will be discussed below. For illustrative purposes, the control zone 304 is described as being tied to the further device 103, although it is understood that the control zone 304 is not limited to the further device 103. For example, the first device 102 and the second device 106 of FIG. 1 can each have the control zone 304 associated with the device.

The further-device mode 306 is a condition of function or a status of the hardware or software on the further device 103. The further-device mode 306 can be the response of hardware or software running on the further device 103, responding to a query by the navigation system 100. For example, the further-device mode 306 can denote whether the further device 103 is on or off, or the operational status of the further device 103, such as navigation in progress or cabin doors closed.

The further-device mode 306 can identify the operations of the further device 103. The navigation system 100 can use the further-device mode 306 to determine when to transfer the navigation session 204. The detailed use of the further-device mode 306 will be discussed below.

The session status 308 is the part of the navigation session 204 that has been complete. The session status 308 can be the route segment 209 the user has traveled. The session status 308 can be the reminder or the note that is associated with the route segment 209 that has been travelled. For example, if the user has travelled the route segment 209 that includes the grocery store, the session status 308 can include the route segment 209 and the reminder to pick up milk on the way home.

Referring now to FIG. 4, therein is shown an exemplary block diagram of the navigation system 100. The navigation system 100 can include the first device 102, the communication path 104, and the second device 106.

The first device 102 can communicate with the second device 106 over the communication path 104. For example, the first device 102, the communication path 104, and the second device 106 can be the first device 102 of FIG. 1, the communication path 104 of FIG. 1, and the second device 106 of FIG. 1, respectively. The screen shot shown on the display interface 202 described in FIG. 2 can represent the screen shot for the navigation system 100.

The first device 102 can send information in a first device transmission 408 over the communication path 104 to the second device 106. The second device 106 can send information in a second device transmission 410 over the communication path 104 to the first device 102.

For illustrative purposes, the navigation system 100 is shown with the first device 102 as a client device, although it is understood that the navigation system 100 can have the first device 102 as a different type of device. For example, the first device 102 can be a server.

Also for illustrative purposes, the navigation system 100 is shown with the second device 106 as a server, although it is understood that the navigation system 100 can have the second device 106 as a different type of device. For example, the second device 106 can be a client device.

For brevity of description in this embodiment of the present invention, the first device 102 will be described as a client device and the second device 106 will be described as a server device. The present invention is not limited to this selection for the type of devices. The selection is an example of the present invention.

The first device 102 can include a first control unit 412, a first storage unit 414, a first communication unit 416, a first user interface 418, and a location unit 420. The first device 102 can be similarly described by the first device 102. The first control unit 412 can include a first control interface 422. The first storage unit 414 can include a first storage interface 424.

The first control unit 412 can execute a first software 426 to provide the intelligence of the navigation system 100. The first control unit 412 can operate the first user interface 418 to display information generated by the navigation system 100. The first control unit 412 can also execute the first software 426 for the other functions of the navigation system 100,

including receiving location information from the location unit 420. The first control unit 412 can further execute the first software 426 for interaction with the communication path 104 of FIG. 1 via the first communication unit 416.

The first control unit 412 can be implemented in a number of different manners. For example, the first control unit 412 can be a processor, an embedded processor, a microprocessor, a hardware control logic, a hardware finite state machine, a digital signal processor, or a combination thereof.

The first control unit 412 can include the first control interface 422. The first control interface 422 can be used for communication between the first control unit 412 and other functional units in the first device 102. The first control interface 422 can also be used for communication that is external to the first device 102.

The first control interface 422 can receive information from the other functional units or from external sources, or can transmit information to the other functional units or to external destinations. The external sources and the external destinations refer to sources and destinations external to the first device 102.

The first control interface 422 can be implemented in different ways and can include different implementations depending on which functional units or external units are being interfaced with the first control interface 422. For example, the first control interface 422 can be implemented with a pressure sensor, an inertial sensor, a microelectromechanical system (MEMS), optical circuitry, waveguides, wireless circuitry, wireline circuitry, or a combination thereof.

The first storage unit 414 can store the first software 426. The first storage unit 414 can also store the relevant information, such as advertisements, points of interest, navigation routing entries, or any combination thereof.

The first storage unit 414 can be a volatile memory, a nonvolatile memory, an internal memory, an external memory, or a combination thereof. For example, the first storage unit 414 can be a nonvolatile storage such as non-volatile random access memory, Flash memory, disk storage, or a volatile storage such as static random access memory.

The first storage unit 414 can include the first storage interface 424. The first storage interface 424 can be used for communication between the location unit 420 and other functional units in the first device 102. The first storage interface 424 can also be used for communication that is external to the first device 102.

The first storage interface 424 can receive information from the other functional units or from external sources, or can transmit information to the other functional units or to external destinations. The external sources and the external destinations refer to sources and destinations external to the first device 102.

The first storage interface 424 can include different implementations depending on which functional units or external units are being interfaced with the first storage unit 414. The first storage interface 424 can be implemented with technologies and techniques similar to the implementation of the first control interface 422.

The first communication unit 416 can enable external communication to and from the first device 102. For example, the first communication unit 416 can permit the first device 102 to communicate with the second device 106 of FIG. 1, an attachment, such as a peripheral device or a computer desktop, and the communication path 104.

The first communication unit 416 can also function as a communication hub allowing the first device 102 to function as part of the communication path 104 and not limited to be an end point or terminal unit to the communication path 104. The first communication unit 416 can include active and passive components, such as microelectronics or an antenna, for interaction with the communication path 104.

The first communication unit 416 can include a first communication interface 428. The first communication interface 428 can be used for communication between the first communication unit 416 and other functional units in the first device 102. The first communication interface 428 can receive information from the other functional units or can transmit information to the other functional units.

The first communication interface 428 can include different implementations depending on which functional units are being interfaced with the first communication unit 416. The first communication interface 428 can be implemented with technologies and techniques similar to the implementation of the first control interface 422.

The first user interface 418 allows a user to interface and interact with the first device 102. The first user interface 418 can include an input device and an output device. Examples of the input device of the first user interface 418 can include a keypad, a touchpad, soft-keys, a keyboard, a microphone, or any combination thereof to provide data and communication inputs.

The first user interface 418 can include a first display interface 430. Examples of the output device of the first user interface 418 can include the first display interface 430. The

first display interface 430 can include a display, a projector, a video screen, a speaker, or any combination thereof.

The location unit 420 can generate location information, current heading, current acceleration, and current speed of the first device 102, as examples. The location unit 420 can be implemented in many ways. For example, the location unit 420 can function as at least a part of a global positioning system (GPS), an inertial navigation system, a cellular-tower location system, a pressure location system, or any combination thereof. Also, for example, the location unit 420 can utilize components such as an accelerometer or GPS receiver.

The location unit 420 can identify the location of the device. On the first device 102 the location unit 420 identifies the device-location 302 for locating the first device 102. The location unit 420 on the further device 103 can also locate the further device 103.

The location unit 420 can include a location interface 432. The location interface 432 can be used for communication between the location unit 420 and other functional units in the first device 102. The location interface 432 can also be used for communication that is external to the first device 102.

The location interface 432 can receive information from the other functional units or from external sources, or can transmit information to the other functional units or to external destinations. The external sources and the external destinations refer to sources and destinations external to the first device 102.

The location interface 432 can include different implementations depending on which functional units or external units are being interfaced with the location unit 420. The location interface 432 can be implemented with technologies and techniques similar to the implementation of the first control unit 412.

For illustrative purposes, the first device 102 is shown with the partition having the first control unit 412, the first storage unit 414, the first user interface 418, the first communication unit 416, and the location unit 420 although it is understood that the navigation system 100 can have a different partition. For example, the first software 426 can be partitioned differently such that some or all of its function can be in the first control unit 412, the location unit 420, and the first communication unit 416. Also, the first device 102 can include other functional units not shown in FIG. 4 for clarity.

The functional units in the first device 102 can work individually and independently of the other functional units. The first device 102 can work individually and independently from the second device 106 and the communication path 104.

For brevity of description in this embodiment of the present invention, the further device 103 of FIG. 1 will be described as having the same functional units as the first device 102. The present invention is not limited to this selection of functional units or having the first device 102 and the further device 103 share the same functional units. The selection is an example of the present invention.

The second device 106 can be optimized for implementing the present invention in a multiple device embodiment with the first device 102. The second device 106 can provide the additional or higher performance processing power compared to the first device 102. The second device 106 can include a second control unit 434, a second communication unit 436, and a second user interface 438.

The second user interface 438 allows a user to interface and interact with the second device 106. The second user interface 438 can include an input device and an output device. Examples of the input device of the second user interface 438 can include a keypad, a touchpad, soft-keys, a keyboard, a microphone, or any combination thereof to provide data and communication inputs. Examples of the output device of the second user interface 438 can include a second display interface 440. The second display interface 440 can include a display, a projector, a video screen, a speaker, or any combination thereof.

The second control unit 434 can execute a second software 442 to provide the intelligence of the second device 106 of the navigation system 100. The second software 442 can operate in conjunction with the first software 426. The second control unit 434 can provide additional performance compared to the first control unit 412.

The second control unit 434 can operate the second user interface 438 to display information. The second control unit 434 can also execute the second software 442 for the other functions of the navigation system 100, including operating the second communication unit 436 to communicate with the first device 102 over the communication path 104.

The second control unit 434 can be implemented in a number of different manners. For example, the second control unit 434 can be a processor, an embedded processor, a microprocessor, a hardware control logic, a hardware finite state machine, a digital signal processor, or a combination thereof.

The second control unit 434 can include a second controller interface 444. The second controller interface 444 can be used for communication between the second control unit 434 and other functional units in the second device 106. The second controller interface 444 can also be used for communication that is external to the second device 106.

The second controller interface 444 can receive information from the other functional units or from external sources, or can transmit information to the other functional units or to external destinations. The external sources and the external destinations refer to sources and destinations external to the second device 106.

The second controller interface 444 can be implemented in different ways and can include different implementations depending on which functional units or external units are being interfaced with the second controller interface 444. For example, the second controller interface 444 can be implemented with a pressure sensor, an inertial sensor, a microelectromechanical system (MEMS), optical circuitry, waveguides, wireless circuitry, wireline circuitry, or a combination thereof.

A second storage unit 446 can store the second software 442. The second storage unit 446 can also store the relevant information, such as advertisements, points of interest, navigation routing entries, or any combination thereof. The second storage unit 446 can be sized to provide the additional storage capacity to supplement the first storage unit 414.

For illustrative purposes, the second storage unit 446 is shown as a single element, although it is understood that the second storage unit 446 can be a distribution of storage elements. Also for illustrative purposes, the navigation system 100 is shown with the second storage unit 446 as a single hierarchy storage system, although it is understood that the navigation system 100 can have the second storage unit 446 in a different configuration. For example, the second storage unit 446 can be formed with different storage technologies forming a memory hierarchal system including different levels of caching, main memory, rotating media, or off-line storage.

The second storage unit 446 can be a volatile memory, a nonvolatile memory, an internal memory, an external memory, or a combination thereof. For example, the second storage unit 446 can be a nonvolatile storage such as non-volatile random access memory, Flash memory, disk storage, or a volatile storage such as static random access memory.

The second storage unit 446 can include a second storage interface 448. The second storage interface 448 can be used for communication between the location unit 420 and other

functional units in the second device 106. The second storage interface 448 can also be used for communication that is external to the second device 106.

The second storage interface 448 can receive information from the other functional units or from external sources, or can transmit information to the other functional units or to external destinations. The external sources and the external destinations refer to sources and destinations external to the second device 106.

The second storage interface 448 can include different implementations depending on which functional units or external units are being interfaced with the second storage unit 446. The second storage interface 448 can be implemented with technologies and techniques similar to the implementation of the second controller interface 444.

The second communication unit 436 can enable external communication to and from the second device 106. For example, the second communication unit 436 can permit the second device 106 to communicate with the first device 102 over the communication path 104.

The second communication unit 436 can also function as a communication hub allowing the second device 106 to function as part of the communication path 104 and not limited to be an end point or terminal unit to the communication path 104. The second communication unit 436 can include active and passive components, such as microelectronics or an antenna, for interaction with the communication path 104.

The second communication unit 436 can include a second communication interface 450. The second communication interface 450 can be used for communication between the second communication unit 436 and other functional units in the second device 106. The second communication interface 450 can receive information from the other functional units or can transmit information to the other functional units.

The second communication interface 450 can include different implementations depending on which functional units are being interfaced with the second communication unit 436. The second communication interface 450 can be implemented with technologies and techniques similar to the implementation of the second controller interface 444.

The first communication unit 416 can couple with the communication path 104 to send information to the second device 106 in the first device transmission 408. The second device 106 can receive information in the second communication unit 436 from the first device transmission 408 of the communication path 104.

The second communication unit 436 can couple with the communication path 104 to send information to the first device 102 in the second device transmission 410. The first device 102 can receive information in the first communication unit 416 from the second device transmission 410 of the communication path 104. The navigation system 100 can be executed by the first control unit 412, the second control unit 434, or a combination thereof.

For illustrative purposes, the second device 106 is shown with the partition having the second user interface 438, the second storage unit 446, the second control unit 434, and the second communication unit 436, although it is understood that the second device 106 can have a different partition. For example, the second software 442 can be partitioned differently such that some or all of its function can be in the second control unit 434 and the second communication unit 436. Also, the second device 106 can include other functional units not shown in FIG. 4 for clarity.

The functional units in the second device 106 can work individually and independently of the other functional units. The second device 106 can work individually and independently from the first device 102 and the communication path 104.

For illustrative purposes, the navigation system 100 is described by operation of the first device 102 and the second device 106. It is understood that the first device 102 and the second device 106 can operate any of the modules and functions of the navigation system 100. For example, the first device 102 is described to operate the location unit 420, although it is understood that the second device 106 can also operate the location unit 420.

Referring now to FIG. 5, therein is shown a control flow of the navigation system 100. The navigation system 100 can include a session creator module 502, a condition module 504, a mode module 508, a navigation module 510, and an accommodation module 512.

The session creator module 502 can be coupled to the condition module 504, which can be coupled to the mode module 508. The mode module 508 can be coupled to the navigation module 510. The navigation module 510 can be coupled to the accommodation module 512.

The purpose of the session creator module 502 is to identify a method and associated information for the user to go from the starting point 206 of FIG. 2 to the destination 208 of FIG. 2. The session creator module 502 can establish the navigation session 204 of FIG. 2. The session creator module 502 can include a route module 514, a progress module 516, and an arrangement module 517.

The session creator module 502 can establish the navigation session 204 for routing from the starting point 206 to the destination 208 on the first device 102 of FIG. 4. The session creator module 502 can establish the navigation session 204 by associating the travel-route 205 of FIG. 2 with notes, reminders and other location-based items with the travel-route 205.

The route module 514 select the starting point 206 and the destination 208. The starting point 206 and the destination 208 can be identified by an address, a set of coordinates, a name, or combination thereof.

For example, the route module 514 can select the address of the user's employer as the starting point 206 if the user needs to go from work to a meeting at the vendor's office. Also, for example, the route module 514 can select the device-location 302 of FIG. 3 using the coordinates, such as GPS coordinates or longitude and latitude, identified by the location unit 420 of FIG. 4.

The route module 514 can also select the starting point 206 by searching the user's schedule calendar. The route module 514 can search the user's schedule calendar for the appointment or event occurring before the time of the proposed travel. The route module 514 can assign the location of the appointment or event occurring before the time of the proposed travel as the starting point 206.

The route module 514 can select the destination 208 in a manner similar to selecting the starting point 206. The route module 514 can select the destination 208 by identifying the physical location where the user will end the travel.

The route module 514 can select the destination 208 by searching the user's schedule calendar. The route module 514 can search the user's schedule calendar for the appointment or event occurring after the time of the proposed travel.

The route module 514 can select the destination 208 by setting the destination 208 as the coordinates of the location of the appointment or event, occurring after the time of the proposed travel. The route module 514 can also select the destination 208 by setting the coordinates of the location of the next appointment or event occurring after the current time.

The route module 514 can calculate the travel-route 205 from the starting point 206 to the destination 208. The route module 514 can calculate the travel-route 205 by identifying a collection of paths and nodes that are connected to form a continuous path that the user can traverse from the starting point 206 to the destination 208. The route module 514 can utilize

known routing algorithms such as Dijkstra's algorithm or Johnson's algorithm to calculate the travel-route 205.

In calculating the travel-route 205, the route module 514 can identify the route segment 209 of FIG. 2. The route module 514 can identify a directly connected path between predetermined locations as the route segment. For example, the route module 514 can identify a directly connected path between two airports as the route segment 209.

The route module 514 can also identify a location on the travel-route 205 where the mode of transportation, such as walking or driving, changes. The route module 514 can compare the mode of transportation before and after each node on the travel-route 205.

When the mode of transportation before the node and after the node are different, the route module 514 can identify the path before the node on the travel-route 205 as the route segment 209. The route module 514 can identify the path after the node on the travel-route 205 as the route segment 209 as well.

For illustrative purposes, the route module 514 is described as calculating the route segment 209 from the travel-route 205, although it is understood the session creator module 502 can also operate differently. The route module 514 can identify a set of the route segment 209 that can be connected to calculate the travel-route 205.

The route module 514 can identify a set of the route segment 209 by identifying the modes of transportation necessary to travel between the starting point 206 and the destination 208. The route module 514 can search the user's calendar for travel arrangements, such as air-travel reservation or rental car reservation closest in time to the time of departure specified in the navigation session 204.

The route module 514 can include the travel arrangements in the navigation session 204. The route module 514 can connect the location associated with the travel arrangement, such as an airport or a rental car pick-up lot, with the starting point 206 to identify the route segment 209.

The route module 514 can repeat the process for identifying the route segment 209 from the end of the route segment 209 to the location associated with the next occurring travel arrangement. The route module 514 can repeat the process for identifying the route segment 209 until all travel arrangements have been connected. The route module 514 can calculate the travel path from the end of the route segment 209 to the destination 208.

The route module 514 can use the first control unit 412 of FIG. 4, the second control unit 434 of FIG. 4, or a combination thereof to calculate the travel-route 205 and the route

segment 209. The route module 514 can use the first control unit 412, the second control unit 434, or a combination thereof to search the user's calendar stored on the first storage unit 414 of FIG. 4, the second storage unit 446 of FIG. 4, or a combination thereof. The route module 514 can also use the location unit 420 to locate the starting point 206.

The session creator module 502 can establish the navigation session 204 by associating the notes, reminders, and intermediate stops that are connected with the user's travel. For example, the session creator module 502 can associate the name of the client requesting the visit to the travel-route 205. Also, for example, the session creator module 502 can associate the reminder the buy milk to all of the grocery stores within 100 feet of the travel-route 205 for going home.

The session creator module 502 can identify the notes and reminders from the user's calendar. The session creator module 502 can identify the notes and reminders by searching the user's calendar during the time the user is scheduled to traverse the travel-route 205. The session creator module 502 can compare the location of the calendar event to the travel-route 205. The session creator module 502 can associate the notes or reminders if the location of the calendar event is on the travel-route 205.

The session creator module 502 can associate the notes or reminders of an appointment in the calendar to the travel-route 205 by flagging the reminder or the note to display based on location. The session creator module 502 can flag the reminder or the note when the user is within a threshold distance from the location of the calendar event, while traversing the travel-route 205. The threshold distance for displaying the reminder or the note can be predetermined by the user, the navigation system 100, software manufacturer, or a combination thereof.

The session creator module 502 can identify intermediate stops from the route segment 209. The session creator module 502 can identify the ends of the route segment 209 as the intermediate stops.

The session creator module 502 can plan for transferring the navigation session 204 at the intermediate stops. The session creator module 502 can set a flag that allows the navigation session 204 to transfer only at the intermediate stops.

The session creator module 502 can use the first control unit 412, the second control unit 434, or a combination thereof to establish the navigation session 204. The session creator module 502 can use the first control unit 412, the second control unit 434, or a

combination thereof to search the user's calendar and the route segment 209 stored on the first storage unit 414, the second storage unit 446, or a combination thereof.

The purpose of the progress module 516 is to keep track of the user's progress and activity while traversing the travel-route 205. The progress module can keep track of the user's progress by determining the session status 308 of FIG. 3 for monitoring the progress of the navigation session 204.

The progress module 516 can determine the session status 308 by locating the first device 102. The locator module can use the location unit 420 to identify the device-location 302 for locating the first device 102. The progress module 516 can compare the coordinates of the device-location 302 to the travel-route 205.

The progress module 516 can display the notes and reminders as flagged by the session creator module 502. The progress module 516 can display the notes or reminders when the device-location 302 is within the predetermined threshold distance from their identified locations.

The progress module 516 can determine the session status 308 by identifying the notes and reminders that have been displayed. The progress module 516 can identify the displayed items by setting a bit or a flag associated with the display item. The progress module 516 can set the bit or the flag when the item is displayed.

The progress module 516 can also determine the session status 308 by identifying the route segment 209 the user traversed. The progress module 516 can compare the device-location 302 to the travel-route 205. The progress module 516 can mark the portion of the travel-route 205 when the coordinates of the device-location 302 is the same as a coordinate within the travel-route 205.

The progress module 516 can mark the corresponding portions of the travel-route 205 to indicate where the user traversed. The progress module 516 can indicate where the user has been on the travel-route 205 in many ways. For example, the progress module 516 can set a bit or a flag of the coordinate in the travel-route 205, change the color on the travel-route 205 displayed on the screen, change the width of the travel-route 205 displayed on the screen, or a combination thereof.

The physical transformation of the session status 308 results in movement in the physical world, such as people using the reminder to complete tasks while traversing the travel-route 205 or notifying other people or entities of the user's travel, based on the operation of the navigation system 100. The movement of people and entities in the real

world can be fed back to the navigation system 100 to further operate the navigation system 100 to guide the user.

The progress module 516 can use the first display interface 430 of FIG. 4, the second display interface 440 of FIG. 4 to display the notes and reminders. The progress module 516 can use the location unit 420 to identify the device-location 302. The progress module 516 can use the first control unit 412, the second control unit 434, or a combination thereof to determine the session status 308.

The arrangement module 517 can arrange the transportation service 212 of FIG. 2. The arrangement module 517 can arrange the transportation service 212 by reserving with the service provider. For example, the arrangement module 517 can contact the provider of the transportation service 212, such as the airline company or the taxi company, and make a reservation for the transportation service 212.

The arrangement module 517 can determine the time for the transportation service 212. The arrangement module 517 can use the travel-route 205 to calculate where the user will be along the travel-route 205 at different times. The arrangement module 517 can identify the calculated time where the user will be at a transition point, such as the hotel lobby or the airport, as the time for the transportation service 212.

For illustrative purposes, the navigation system 100 is described as establishing the navigation session 204 through the first device 102 and transferring the navigation session 204 to the further device 103 of FIG. 4. However, it is understood that the navigation system 100 can operate differently and that each of the modules can operate individually and independently of the other modules.

For example, the navigation session 204 can be established on the further device 103, such as an in-dash navigation unit, and then transferred to the first device 102. Also, for example, the navigation session 204 can be established on the second device 106 and transferred to the first device 102, the further device 103, or a combination thereof.

The arrangement module 517 can use the first control unit 412, the second control unit 434, or a combination thereof to arrange the transportation service 212. The arrangement module 517 can use the first communication unit 416 of FIG. 4, the second communication unit 436 of FIG. 4, the communication path 104 of FIG. 4, or a combination thereof to contact the service provider of the transportation service 212. The arrangement module 517 can store the navigation session 204 in the first storage unit 414, the second storage unit 446, or a combination thereof.

The physical transformation of the navigation session 204 results in movement in the physical world, such as people using the travel-route 205 for navigating the vehicle associated with the route segment 209 within the travel-route 205, based on the operation of the navigation system 100. The movement of people and entities in the real world can be fed back to the navigation system 100 to further operate the navigation system 100 to guide the user.

It has been discovered that the present invention provided the navigation system 100 that provide improved accuracy for monitoring and cataloging the user's travel. The navigation session 204, having the travel-route 205 and therein the route segment 209, the session status 308, and the associated notes and reminders, gives rise to the benefit by allowing for more details to be associated with travelling from the starting point 206 to the destination 208.

For example, the navigation session 204 can include the stopping points, such as stopping to pick up the groceries or airports, as part of the travel from the starting point to the destination 208. The traditional use of points of interest and navigating between endpoints will treat each stop as separate destinations and disassociate them from the overall travel. The navigation session 204 can identify different stopping points using the route segment 209, while retaining the overall travel from the starting point 206 to the destination 208 through the travel-route 205.

The purpose of the condition module 504 is to define the situations where the navigation system 100 transfers the navigation session 204 between devices. The condition module 504 sets the transfer condition 216 of FIG. 2, sets the control zone 304 of FIG.3, and identifies the session-transfer zone 210 of FIG. 2.

The condition module 504 sets the transfer condition 216 for continuing the navigation session 204 between the first device 102 and the further device 103 or vice versa. The condition module 504 can determine when to transfer the navigation session 204 from one device to another.

For example, the condition module 504 can set the transfer condition 216 for transferring the navigation session 204 from the further device 103 on the airplane to the first device 102 as when the airplane cabin door opens. Also, for example, the transfer condition 216 can be when the airplane cabin door closes for transferring the navigation session 204 from the first device 102 to the further device 103 on the airplane.

The condition module 504 can set the transfer condition 216 by setting the requirements or conditions that can initiate the transfer of the navigation session 204. The conditions or requirements for transferring the navigation session 204 can be predetermined by the user, the navigation system 100, the software manufacturer, or a combination thereof.

The condition module 504 sets the control zone 304 for identifying a geographic area encompassing the further device 103. The condition module 504 can set the control zone 304 by identifying the area around the further device 103. The condition module 504 can set a radius to identify a circular area with the further device 103 at the center.

The condition module 504 can also set the control zone 304 by identifying the shape of the vehicle that has the further device 103 installed. The condition module 504 can set the control zone 304 as a set of locations or distances that identify the passenger area of the vehicle or an interior of the vehicle.

For example, the control zone 304 can be a set of points relative to the location of the further device 103 that describe the airplane passenger cabin. Also, for example, the control zone 304 can be a set of distances, such as 3 feet to the right and to the left and 6 feet away from the direction of travel, that describe the seating area of a car.

The condition module 504 identifies the session-transfer zone 210 as a stationary geographic area. The condition module 504 can identify the session-transfer zone 210 by identifying the locations where the navigation session 204 will transfer between devices. For example, the condition module 504 can identify the gates at airports and rental car pick-up lots and drop-off lots as the session-transfer zone 210.

The condition module 504 can match the types of locations and the associated direction of the transfer for the navigation session 204. For example, the list can match the airport gates as a type of location and define the direction of transfer based on the movement of the airplane.

Also, for example, the condition module 504 can identify rental car lots as a type of location and match the direction as from the first device 102 to the further device 103 at pick-up lots and from the further device 103 to the first device 102 at drop-off lots. The matching relationships between types and directions can be predetermined by the user, the navigation system 100, the software manufacturer, or a combination thereof.

The physical transformation of the transfer condition 216 results in movement in the physical world, such as people using the in-dash navigation unit in a vehicle or disabling functions on their cellular phone, based on the operation of the navigation system 100. The

movement of people and entities in the real world can be fed back to the navigation system 100 to further operate the navigation system 100 to guide the user.

For illustrative purposes, the navigation system 100 is described as setting the transfer condition 216 as a condition, status, or combination thereof and transferring the navigation session 204 when condition and status is met. However, it is understood that the navigation system 100 can operate differently and that each of the modules can operate individually and independently of the other modules.

For example, the transfer condition 216 can be a function of ranking system. The condition module 504 can assign each of the devices therein a score. The devices in vehicles that transport passengers, such as in-dash navigation unit or the auto-pilot system on an airplane, can have higher score than the portable devices, such as cellular phones or PDA.

The scores can be predetermined by the navigation system 100, the user, the software manufacturer or a combination thereof. The transfer condition 216 can be to transfer the navigation session 204 to device with the highest score within a predetermined distance.

The condition module 504 can use the first control unit 412, the second control unit 434, or a combination thereof to set the transfer condition 216 and the control zone 304. The condition module 504 can use the first storage unit 414, the second storage unit 446, or a combination thereof to store the transfer condition 216 and the control zone 304.

The condition module can use the first control unit 412, the second control unit 434, or a combination thereof to identify the session-transfer zone 210. The condition module 504 can use the first storage unit 414, the second storage unit 446, or a combination thereof to store the session-transfer zone 210.

The purpose of the mode module 508 is to determine the status of the hardware and software running on the first device 102 and the further device 103. The mode module 508 can include a current-mode module 518, a first-mode module 520, and a further-mode module 522.

The current-mode module 518 determines the current transportation mode 214 of FIG. 2 based on the transfer condition 216 satisfied for transferring the navigation session 204. The current-mode module 518 can determine the current transportation mode 214 by matching the identity of the device receiving the navigation session 204 to categories.

The current-mode module 518 can determine the identity of the device receiving the navigation session 204 by querying the device that received the navigation session 204. The

current-mode module 518 can match the query response to a category to determine the current transportation mode 214.

The current-mode module 518 can match the reply to a category of devices. For example, the current-mode module 518 can match the device names to categories, such as on-foot or flying. The current-mode module 518 can determine the category name as the current transportation mode 214. The device names can be categorized by the user, the navigation system 100, the software manufacturer, or a combination thereof.

The current-mode module 518 can also determine the current transportation mode 214 by matching the transfer condition 216 to a category. For example, the transfer condition 216 of airplane cabin door being closed can be categorized as flying. Also, for example, the transfer condition 216 requiring the ignition to turn off while the first device 102 is in the control zone 304 can be categorized as walking. The current-mode module 518 can determine the category name as the current transportation mode 214. The transfer condition 216 can be categorized by the user, the navigation system 100, the software manufacturer, or a combination thereof.

The current-mode module 518 can use the first communication unit 416 on the first device 102, the first communication unit 416 on the further device 103, the second communication unit 436, or a combination thereof to query the devices. The current-mode module 518 can use the first control unit 412 on the first device 102, the first control unit on the further device 103, the second control unit 434, or a combination thereof to determine the current transportation mode 214.

The first-mode module 520 identifies the device-mode 218 of FIG. 2 for operating the first device 102 according to the settings associated with the device-mode 218. The first-mode module 520 can identify the device-mode 218 by grouping the operating functions on the first device 102 for different situations.

The first-mode module 520 can group the operating functions by identifying a sequence of commands. For example, the first-mode module 520 can identify a command for saving the configuration of the first device 102 and then a command for turning the power supply off on the first device 102 as a shut down sequence. Also for example, the first-mode module 520 can identify the commands for disabling the location unit 420 and the first communication unit 416 as an airplane mode.

The first-mode module 520 can identify the sequence of commands based on matching the device-location 302 to category locations. For example, the first-mode module

520 can match the location of LAX airport to airports and identify the sequence of commands associated with airports as the device-mode 218. Also, for example, the first-mode module 520 can match the location of a testing room at the Driver Licensing agency with no communication category and identify the sequence of commands associated with no communication areas.

The user, the navigation system 100, the software manufacturer, or a combination thereof can associate necessary and unnecessary functions to category of locations. For example, the user can associate enabling the Bluetooth (TM) headset to car driver seat. Also, for example, the navigation system 100 can associate turning off the user communication functions, such as calling or texting, on cellular phones that are inside the airplane cabin.

The first-mode module 520 can also identify the appropriate commands by storing the user's previous actions. For example, the first-mode module 520 can retain the commands the user entered before flying. The first-mode module 520 can identify the stored sequence of commands as the device-mode 218.

The physical transformation of the device-mode 218 results in movement in the physical world, such turning off the first device 102 or setting the cellular phone to airplane mode, based on the operation of the navigation system 100. The movement of people and entities in the real world can be fed back to the navigation system 100 to further operate the navigation system 100 to guide the user.

The first-mode module 520 can use the first control unit 412 on the first device 102, the second control unit 434, or a combination thereof to determine sequence of commands that make up the device-mode 218. The first-mode module 520 can store the device-mode 218 on the first storage unit 414 on the first device 102, the second storage unit 446, or a combination thereof to store the device-mode 218.

The further-mode module 522 determines the further-device mode 306 of FIG. 3 for identifying the operations of the further device 103. The further-mode module 522 can determine the further-device mode 306 by querying the hardware components or the software on the further device 103.

For example, the further-mode module 522 can query the power supply of the further device 103 for status. The further-mode module 522 can determine the reply of the power supply as the further-device mode 306 to report whether the further device 103 is on or off. Also, for example, the further-mode module 522 can query the operating system or the currently running software execution or application for the status and identity. The further-

mode module 522 can determine the reply of the software as the further-device mode 306 to report the current activity of the further device 103.

The further-mode module 522 can use the first communication unit 416 on the further device 103, the second communication unit 436, or a combination thereof to query the further device 103. The further-mode module 522 can use the first control unit on the further device 103, the second control unit 434, or a combination thereof to determine the further-device mode 306.

The navigation module 510 routes and guides the user through multiple devices seamlessly to provide a continuous and uninterrupted operation of the navigation session 204. The session transfer module 526 can provide continuity in the navigation session 204 across multiple devices by transferring the navigation session 204 when the transfer condition 216 is satisfied. The navigation module 510 can include a condition verification module 524, a session transfer module 526, and a mode control module 528.

The purpose of the condition verification module 524 is to determine when the transfer condition 216 is satisfied. The condition verification module 524 can determine when the transfer condition 216 is satisfied by comparing the device-location 302 to the control zone 304, matching the further-device mode 306 of FIG. 3 to the transfer condition 216, comparing the device-location 302 to the session-transfer zone 210, or a combination thereof.

The condition verification module 524 compares the device-location 302 to the control zone 304 to determine when the transfer condition 216 is satisfied. The condition verification module 524 can compare the device-location 302 to the control zone 304 when the transfer condition 216 requires the first device 102 to be within the control zone 304 of the further device 103.

The condition verification module 524 can compare the device-location 302 to the boundary coordinates or the distance limits that identify the control zone 304. The condition verification module 524 can determine that the transfer condition 216 is satisfied when the device-location 302 is between the boundary coordinates of the control zone 304 or within the distance limits of the control zone 304.

For example, if the control zone 304 is defined by longitude and latitude boundary coordinates of latitude 37 degrees to 39 degrees and longitude 76 degrees to 78 degrees, the device-location 302 of latitude 38 degrees and longitude 77 degrees would satisfy the transfer condition 216. Also, for example, if the control zone 304 is defined as a 10 foot radius

around a vehicle, the device-location 302 that is 20 feet to the north of the vehicle would not satisfy the transfer condition 216.

The condition verification module 524 can determine the distance between the first device 102 and the further device 103 by calculating the distance between the coordinates. The condition verification module 524 can take the difference between the coordinates and use predetermined methods to translate the difference in coordinates to a distance value.

The condition verification module 524 can also determine the distance between the first device 102 and the further device 103 by sending a signal to the devices and measuring the reply time. The condition verification module 524 can send a signal from the further device 103 to the first device 102. The first device 102, when it receives the signal, can send a reply signal. The further device 103, can calculate the distance between the two devices based on the time between sending the signal and receiving the reply signal.

The condition verification module 524 can compare the distance between the two devices to the control zone 304. When the distance between the two devices is less than the distance identifying the control zone 304, the condition verification module 524 can determine the transfer condition 216 is satisfied.

The condition verification module 524 can also determine when the transfer condition 216 is no longer satisfied. The condition verification module 524 can monitor the relative locations that initially satisfied the transfer condition 216.

When first device 102 moves out of the control zone 304, the further-device mode 306 can determine the transfer condition 216 is no longer satisfied. The condition verification module 524 can identify the change in the device-location 302 relative to the control zone 304 as condition for transferring the navigation session 204 to the first device 102.

The condition verification module 524 matches the further-device mode 306 to the transfer condition 216 to determine when the transfer condition 216 is satisfied. The condition verification module 524 can compare the further-device mode 306 to the transfer condition 216 when the transfer condition 216 requires the further device 103 to be in a certain state or mode.

The condition verification module 524 can compare the further-device mode 306 to the transfer condition 216 by comparing the values. The condition verification module 524 can match the Boolean value, text, number, symbols, or a combination thereof in the further-device mode 306 to the transfer condition 216. When the transfer condition 216 includes the

value of the further-device mode 306, the condition verification module 524 can determine the transfer condition 216 as being satisfied.

For example, if the transfer condition 216 requires the further device 103 to be ON and in ACTIVE mode, the condition verification module 524 can determine that the transfer condition 216 is satisfied when the further-device mode 306 contains ON and ACTIVE mode. Also, for example, if the transfer condition 216 requires the plane cabin door to be closed, the condition verification module 524 can determine that the transfer condition 216 is satisfied when the further-device mode 306 indicates that the cabin door is closed.

The condition verification module 524 can also determine when the transfer condition 216 is no longer satisfied. The condition verification module 524 can monitor the further-device mode 306 that initially satisfied the transfer condition 216.

When the further-device mode 306 changes and no longer satisfies the transfer condition 216, the further-device mode 306 can determine the transfer condition 216 is no longer satisfied. The condition verification module 524 can identify the change in the further-device mode 306 as condition for transferring the navigation session 204 to the first device 102.

Continuing with the above examples, when the further device 103 turns OFF or goes into STAND-BY mode, the condition verification module 524 can identify the transfer condition 216 is no longer satisfied. Also, continuing with the above examples, when the plane cabin door opens, the condition verification module 524 can determine that the transfer condition 216 is no longer satisfied. The condition verification module 524 can notify the session transfer module 526 to transfer the navigation session 204 from the further device 103 to the first device 102.

The condition verification module 524 compares the device-location 302 to the session-transfer zone 210 to determine when the transfer condition 216 is satisfied. The condition verification module 524 can compare the device-location 302 to the session-transfer zone 210 when the transfer condition 216 requires the first device 102 to be within the session-transfer zone 210.

The condition verification module 524 can compare the coordinates identifying the device-location 302 to the boundary coordinates that identify the session-transfer zone 210. The condition verification module 524 can determine that the transfer condition 216 is satisfied when the device-location 302 is between the boundary coordinates of the session-transfer zone 210 or within the distance limits of the session-transfer zone 210.

The condition verification module 524 can use the first control unit 412 on the first device 102, the second control unit 434, the first communication unit 416 on the first device 102, the second communication unit 436, or a combination thereof to query the first device 102 and receive the response. The condition verification module 524 can use the first control unit 412 on the further device 103, the second control unit 434, the first communication unit 416 on the further device 103, the second communication unit 436, or a combination thereof to query the further device 103 and receive the response.

The condition verification module 524 can use the first control unit 412 on the first device 102, the first control unit 412 on the further device 103, the first communication unit 416 on the first device 102, the first communication unit 416 on the further device 103, or a combination thereof to query and respond directly between the first device 102 and the further device 103. The condition verification module 524 can use the first control unit 412 on the first device 102, the first control unit 412 on the further device 103, the second control unit 434, or a combination thereof to determine when the transfer condition 216 is satisfied.

The purpose of the session transfer module 526 is to transfer the navigation session 204 between devices when the transfer condition 216 is satisfied. The session transfer module 526 can transfer the navigation session 204 from the first device 102 to the further device 103 or from the further device 103 to the first device 102.

The session transfer module 526 transfers the navigation session 204 when the transfer condition 216 is satisfied for routing with the further device 103 for displaying on the further device 103. The session transfer module 526 can transfer the navigation session 204 from the first device 102 to the further device 103 when the transfer condition 216 is satisfied.

For illustrative purposes, the details of the transfer will be described as transferring the navigation session 204 from the first device 102 to the further device 103, although it is understood that the session transfer module 526 can operate differently. For example, the session transfer module 526 can similar details to transfer the navigation session 204 from the further device 103 to the first device 102 or to and from the second device 106.

The session transfer module 526 can transfer the navigation session 204 by identifying the destination 208, the travel-route 205, the session status 308, the transportation service 212, or a combination thereof on the further device 103. The session transfer module 526 can identify the destination 208 on the further device 103 by selecting the same coordinates or address as the destination 208 on the further device 103 to end the travel.

The session transfer module 526 can identify the travel-route 205 on the further device 103 by setting the starting and ending locations of the travel on the further device 103 same as the starting point 206 and the destination 208. The session transfer module 526 can use the identical nodes, paths, and the route segment 209 used for the travel-route 205 on the further device 103 to identify the travel-route 205 on the further device 103.

The session transfer module 526 can also transfer the device-location 302 and the session status 308. The session transfer module 526 can transfer the coordinates of the device-location 302 in the same way as the destination 208.

The session transfer module 526 can transfer the session status 308 by transferring the notes and reminders along with the markers indication whether the items have been displayed. The session transfer module 526 can also transfer the session status 308 by marking the locations on the travel-route 205 where the user has been on the further device 103.

The session transfer module 526 can also transfer the navigation session 204 to the further device 103 by establishing the navigation session 204 in the same way as the session creator module 502. The session transfer module 526 can then transfer the indications and markings to determine the session status 308 on the further device 103.

By transferring the navigation session 204, including the route segment 209, the notes, and the session status 308, to the further device, the user can continue the navigation session 204 on the further device 103. Also, by transferring the navigation session 204, the navigation system 100 can retain the continuity of the overall trip between different segments and transportation modes.

The session transfer module 526 can use the first control unit 412 on the first device 102, the first control unit 412 on the further device 103, the second control unit 434, or a combination thereof to transfer the navigation session 204. The session transfer module 526 can transfer the navigation session 204 that is stored in the first storage unit 414 on the first device 102. The session transfer module 526 can store the navigation session 204 that has been transferred in the first storage unit 414 on the further device 103.

The session transfer module 526 transfers the navigation session 204 when the transfer condition 216 is satisfied for routing with the first device 102 for displaying on the first device 102. The session transfer module 526 can transfer the navigation session 204 from the further device 103 to the first device 102.

For example, if the transfer condition 216 is the airplane cabin door opening, the session transfer module 526 can transfer the navigation session 204 from the airplane navigation tool to the first device 102. Also, for example, if the transfer condition 216 for transferring from the in-dash navigation device to a cellular phone is the car ignition being off, the session transfer module 526 can transfer the navigation session 204 when the in-dash navigation devices detects the car ignition is off.

The session transfer module 526 can also transfer the navigation session 204 to the first device 102 when the transfer condition 216 for transferring to the further device 103 is no longer satisfied. Continuing with the above examples, the transfer condition 216 for transferring from the first device 102 to the further device 103 was the cabin door being closed. The session transfer module 526 can transfer the navigation session 204 from the airplane navigation system to the first device 102 when the cabin door opens. The transfer condition 216 for the original transfer is no longer satisfied when the cabin door opens.

Also, continuing with the above examples, the transfer condition 216 for transferring from the cellular phone to the in-dash navigation device was the first device 102 being in the control zone 304 and the vehicle ignition being on. If the user walks away with the cellular phone, outside of the control zone 304, the session transfer module 526 can transfer the navigation session 204 back to the cellular phone. Also, the session transfer module 526 can transfer the navigation session 204 back to the cellular phone when the driver turns off the ignition.

The session transfer module 526 can transfer the navigation session 204 that is stored in the first storage unit 414 on the further device 103. The session transfer module 526 can store the navigation session 204 that has been transferred in the first storage unit 414 on the first device 102.

The session transfer module 526 can use the first control unit 412 on the first device 102, the first control unit 412 on the further device 103, the first communication unit 416 on the first device 102 and the first communication unit 416 on the further device 103 to communicate directly. The session transfer module 526 can use peer-to-peer communication methods such as Bluetooth (TM) or Infrared Data Association standard.

The session transfer module 526 can also use the second device 106 to transfer the navigation session 204 between devices. The session transfer module 526 can transfer the navigation session 204 from the first device 102 to the second device 106 when the navigation session 204 is established. The second device 106 can calculate the travel-route

205 and guide the user through the first device 102. The second device 106 can transfer the navigation session 204 to the further device 103 when the transfer condition 216 is met.

For example, the cellular phone can be used to establish the navigation session 204. The session transfer module 526 can transfer the navigation session 204 from the cell phone to the navigation server. The second device 106 can calculate the travel-route 205 and send the guiding instructions to the cell phone. The session transfer module 526 can transfer the navigation session 204 to the in-dash navigation device in the further device 103 when the transfer condition 216 is met.

The session transfer module 526 can also utilize the second device 106 differently. The first device 102 can calculate the travel-route 205 and guide the user. The session transfer module 526 can transfer the navigation session 204 to the second device 106 when the transfer condition is met. The second device 106 can send the navigation session 204 to the further device 103.

Continuing with the above example, the cellular phone can establish the navigation session 204 and guide the user. The cellular phone can send the navigation session 204 to the server when the transfer condition 216 is met. The server can relay the navigation session 204 to the in-dash navigation device.

For illustrative purposes, the navigation system 100 is described as transferring the navigation session 204 when condition and status is met. However, it is understood that the navigation system 100 can operate differently and that each of the modules can operate individually and independently of the other modules.

The session transfer module 526 can share the navigation session 204 established on the first device 102 with the further device 103. For example, the session transfer module 526 can share the navigation session 204 by transferring only the route segment 209 or the destination 208 while not transferring the notes or the starting point 206.

The session transfer module 526 can use the first communication unit 416 on the first device 102, the second communication unit 436, and the first communication unit 416 on the further device 103 to transfer the navigation session 204. The session transfer module 526 can transfer the navigation session 204 that is stored in the first storage unit 414 on the first device 102 or the second storage unit 446. The session transfer module 526 can store the navigation session 204 that has been transferred in the first storage unit 414 on the further device 103 or the second storage unit 446.

It has been discovered that the present invention provided the navigation system 100 that provide improved accuracy for monitoring the user's travel. The navigation session 204 gives rise to the benefits by including the travel-route 205, the session-transfer zone 210, the device-mode 218, the notes, reminders, the route segment 209, and the session status 308, all detailing the user travel from the starting point 206 to the destination 208.

The transfer of the navigation session 204 can allow the user to accurately log the user's mode of transportation as well as the time and duration of each use. The transfer of the navigation session 204 can allow the user to track the travel from the beginning to the end, instead of accessing separate sets of destinations and the associated travel information to piece together the entire travel.

The transfer of the navigation session 204 can increase the accuracy by eliminating the possibility of the user erroneously piecing the entire travel together. The improved accuracy can be applied to real world examples, such as in attorneys billing the client for the time and distance of the travel.

It has also been discovered that the present invention provided the navigation system 100 that provide improved usability for the user. The navigation session 204 gives rise to the benefits by including the travel-route 205 and the destination 208 therein, the notes, reminders, the route segment 209, and the session status 308. The transfer of the navigation session 204 eliminates the user from having to enter the relevant components of the navigation session 204 repeatedly.

For example, the user walking from the airport terminal to their car does not need to re-enter the destination 208 to travel the route segment 209 on the navigation session 204 using the car. The navigation system 100 can transfer the navigation session 204 and eliminate the hassle of entering the destination 208 and other important information for the user.

It has further been discovered that the present invention provided the navigation system 100 that provide improved accuracy in guiding the user and improved safety for the user.

The navigation session 204 gives rise to the benefits by including the travel-route 205, the notes, reminders, the route segment 209, and the session status 308, all necessary for guiding the user from the starting point 206 to the destination 208. The transfer of the navigation session 204 allows the navigation system 100 to guide the user through the appropriate device.

For example, rather than using a cellular phone to guide the driver, the navigation system 100 can transfer the navigation session 204 and take advantage of the audio-visual system to guide the user. The speaker system in the car can provide clearer and more distinguishable audible instructions to the user than the cellular phone. The navigation system 100 can also use the display screens on the in-dash navigation unit, which is often bigger and better situated than cellular phones.

Using the appropriate device to route the user can improve the safety of the user since the user can take advantage of the appropriate device. Continuing with the example, the user's safety is improved since the user can hear the directions better and can see the screen easier on the in-dash navigation too. The user does not have to struggle to hear the driving directions on the cellular phone or turn their head to view the travel-route 205 on a smaller screen on the cellular phone.

It has yet further been discovered that the present invention provided the navigation system 100 that provide less power consumption of the first device 102. The transfer condition 216, the session-transfer zone 210, and the control zone 304 each give rise to the benefits by utilizing devices other than the first device 102 to locate and guide the user. Transferring the navigation session 204 based on the transfer condition 216, the session-transfer zone 210, and the control zone 304 can decrease the route calculation and guiding operations on the first device 102.

Furthermore, the transferring of the navigation session 204 can allow the navigation system 100 to utilize antennas and other hardware components that are on the further device 103 instead of the first device 102. The decrease in use of the first device 102 can lessen the power consumption of the first device 102, which increases the time the first device 102 can operate before requiring a battery charge.

The purpose of the mode control module 528 is to set the device-mode 218 when the transfer condition 216 is satisfied. The mode control module 528 can set the device-mode 218 following or along with the session transfer module 526 transferring the navigation session 204. The mode control module 528 can have the device-mode 218 associated with the transfer condition 216.

For example, the transfer condition 216 of airplane cabin door closing can have the device-mode 218 for setting the first device 102 to airplane mode as defined by the first-mode module 520. Also, for example, the transfer condition 216 that transfers the navigation session 204 to vehicles can have the device-mode 218 to suspend the route calculating and

guiding functions on the first device 102 or to use a local navigation tool, such as an accelerometer or an altimeter.

The mode control module 528 can assign the name or value of the associated action to be the value of the device-mode 218. The mode control module 528 can set the device-mode 218 by performing the associated action on the first device 102 or by commanding the first device 102 to perform the action associated with the transfer condition 216.

The mode control module 528 can use the first control unit 412 on the first device 102, the first control unit on the further device 103, the second control unit 434, or a combination thereof to access the device-mode 218 associated with the transfer condition 216. The mode control module 528 can use the first control unit 412 on the first device 102 to set the device-mode 218.

It has been discovered that the present invention provided the navigation system 100 that provide improved usability for the user. The device-mode 218 gives rise to the benefits by specifying the appropriate settings of the first device 102 for different situations where the navigation session 204 is transferred. The transfer of the navigation session 204 and setting the device-mode 218 can eliminate the user from having to repeatedly activate or terminate a function or software on the first device 102.

For example, the user will not be required to turn off the navigation application on the handset when driving and turn it back on when the user gets out of the car. Also for example, the user will not be required to turn off the phone or put the phone into airplane mode when the user enters a plane and turn the phone back on when the user leaves the plane.

The purpose of the accommodation module 512 is to update and adjust the transportation service 212 as the user travels. The accommodation module 512 adjusts the transportation service 212 upon transferring the navigation session 204. The accommodation module 512 can adjust the transportation service 212 by notifying the service provider when the navigation session 204 is transferred along the user's travel.

Also, based on when the navigation session 204 is transferred, the accommodation module 512 can calculate the time when the next transfer of the navigation session 204 will occur. The accommodation module 512 can calculate the time of the next transfer by dividing the distance on the travel-route 205 between the device-location 302 and the location for the transportation service 212.

The navigation session 204 can add the calculated time to the current time to calculate when the navigation session 204 will be transferred to the transportation service 212. The

accommodation module 512 can adjust the transportation service 212 by sending the calculated time of transfer to the service provider.

The accommodation module 512 can use the first control unit 412, the second control unit 434, or a combination thereof to adjust the transportation service 212. The accommodation module 512 can use the first control unit 412, the second control unit 434, or a combination thereof to calculate the time when the navigation session 204 will be transferred to the transportation service 212. The accommodation module 512 can use the first communication unit 416, the second communication unit 436, the communication path 104, or a combination thereof to contact the service provider of the transportation service 212.

The navigation system 100 can be partitioned between the first device 102 and the second device 106. For example, the navigation system 100 can be partition into the functional units of the first device 102, the second device 106, or a combination thereof. The first-mode module 520 and the session creator module 502 can be on the first device 102 and the condition module 504 and the session transfer module 526 can be on the second device 106.

The navigation system 100 can also be implemented as additional functional units in the first device 102, the second device 106, or a combination thereof. For example, the session creator module 502 can be an additional functional unit in the first device 102 and the session transfer module 526 can be additional functional unit in the second device 106.

Thus, it has been discovered that the navigation system with session transfer mechanism of the present invention furnishes important and heretofore unknown and unavailable solutions, capabilities, and functional aspects for navigating and routing.

Referring now to FIG. 6, therein is shown a flow chart of a method 600 of operation of the navigation system 100 in a further embodiment of the present invention. The method 600 includes: establishing a navigation session for routing from a starting point to a destination on a device in a block 602; setting a transfer condition for continuing the navigation session between the device and a further device in a block 604; and transferring the navigation session when the transfer condition is satisfied for routing with the further device for displaying on the further device in a block 606.

The resulting method, process, apparatus, device, product, and/or system is straightforward, cost-effective, uncomplicated, highly versatile, accurate, sensitive, and

effective, and can be implemented by adapting known components for ready, efficient, and economical manufacturing, application, and utilization.

Another important aspect of the present invention is that it valuably supports and services the historical trend of reducing costs, simplifying systems, and increasing performance.

These and other valuable aspects of the present invention consequently further the state of the technology to at least the next level.

While the invention has been described in conjunction with a specific best mode, it is to be understood that many alternatives, modifications, and variations will be apparent to those skilled in the art in light of the aforegoing description. Accordingly, it is intended to embrace all such alternatives, modifications, and variations that fall within the scope of the included claims. All matters hithertofore set forth herein or shown in the accompanying drawings are to be interpreted in an illustrative and non-limiting sense.

What is claimed is:

1. A method of operation of a navigation system comprising:

establishing a navigation session for routing from a starting point to a destination on a device;

setting a transfer condition for continuing the navigation session between the device and a further device; and

transferring the navigation session when the transfer condition is satisfied for routing with the further device for displaying on the further device.

2. The method as claimed in claim 1 further comprising transferring the navigation session when the transfer condition is satisfied for routing with the device for displaying on the device.

3. The method as claimed in claim 1 further comprising determining a current transportation mode based on the transfer condition satisfied for transferring the navigation session.

4. The method as claimed in claim 1 further comprising:

identifying a device-location for locating the device; and

wherein:

setting the transfer condition includes setting a control zone for identifying a geographic area encompassing the further device; and

transferring the navigation session includes comparing the device-location to the control zone to determine when the transfer condition is satisfied.

5. The method as claimed in claim 1 further comprising:

determining a session status for monitoring the progress of the navigation session; and

wherein:

transferring the navigation session includes transferring the session status between the device and the further device.

6. A navigation system comprising:

a session creator module for establishing a navigation session for routing from a starting point to a destination on a device;

a condition module, coupled to the session creator module, for setting a transfer condition for continuing the navigation session between the device and a further device; and

a session transfer module, coupled to the condition module, for transferring the navigation session when the transfer condition is satisfied for routing with the further device for displaying on the further device.

7. The system as claimed in claim 6 wherein the session transfer module is for transferring the navigation session when the transfer condition is satisfied for routing with the device for displaying on the device.

8. The system as claimed in claim 6 further comprising a current-mode module, coupled to the session transfer module, for determining a current transportation mode based on the transfer condition satisfied for transferring the navigation session.

9. The system as claimed in claim 6 wherein:

the condition module is for setting a control zone for identifying a geographic area encompassing the further device; and

further comprising:

a location unit, coupled to the session transfer module, for identifying a device-location for locating the device; and

a condition verification module, coupled to the session transfer module, for comparing the device-location to the control zone to determine when the transfer condition is satisfied.

10. The system as claimed in claim 6 further comprising:

a progress module, coupled to the condition module, for determining a session status for monitoring the progress of the navigation session; and

wherein:

the session transfer module is for transferring the session status between the device and the further device.

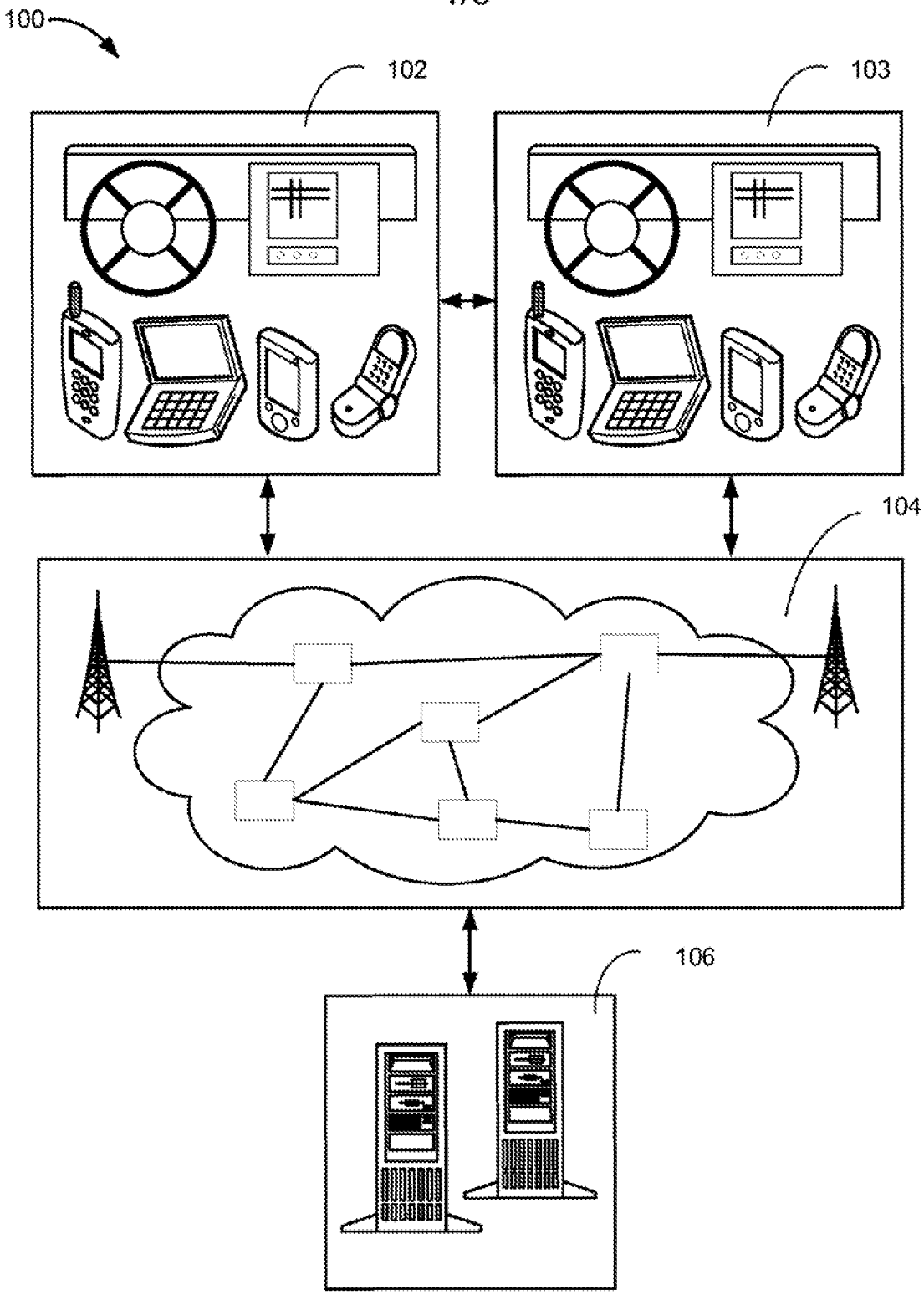


FIG. 1

2/5

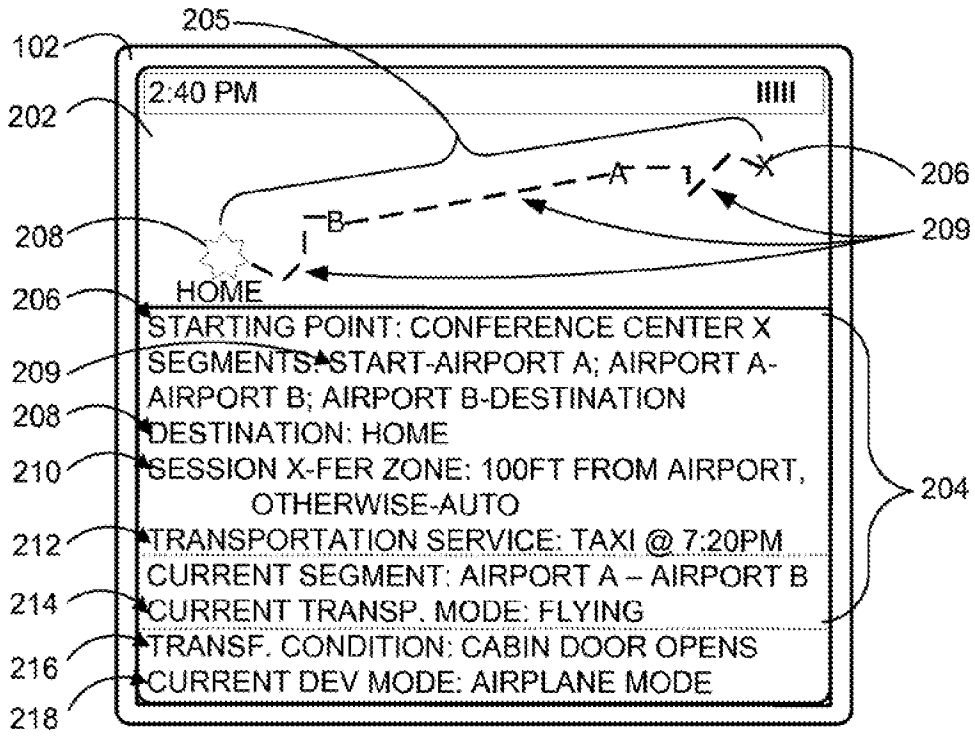

102
205
202
2:40 PM
A
X
206
B
208
209
HOME
206
STARTING POINT: CONFERENCE CENTER X
209
SEGMENTS: START-AIRPORT A; AIRPORT A-AIRPORT B; AIRPORT B-DESTINATION
208
DESTINATION: HOME
210
SESSION X-FER ZONE: 100FT FROM AIRPORT, OTHERWISE-AUTO
204
212
TRANSPORTATION SERVICE: TAXI @ 7:20PM
CURRENT SEGMENT: AIRPORT A – AIRPORT B
214
CURRENT TRANSP. MODE: FLYING
216
TRANSF. CONDITION: CABIN DOOR OPENS
218
CURRENT DEV MODE: AIRPLANE MODE

FIG. 2

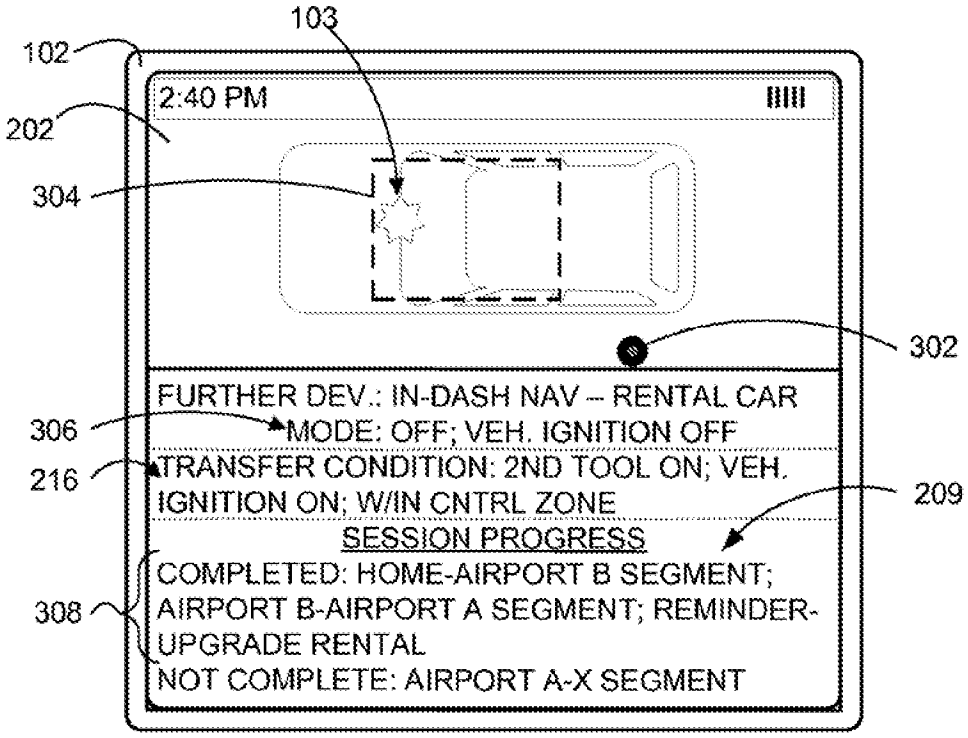

103
102
202
2:40 PM
304
302
FURTHER DEV.: IN-DASH NAV – RENTAL CAR
306
MODE: OFF; VEH. IGNITION OFF
216
TRANSFER CONDITION: 2ND TOOL ON; VEH. IGNITION ON; W/IN CNTRL ZONE
209
SESSION PROGRESS
308
COMPLETED: HOME-AIRPORT B SEGMENT; AIRPORT B-AIRPORT A SEGMENT; REMINDER-UPGRADE RENTAL
NOT COMPLETE: AIRPORT A-X SEGMENT

FIG. 3

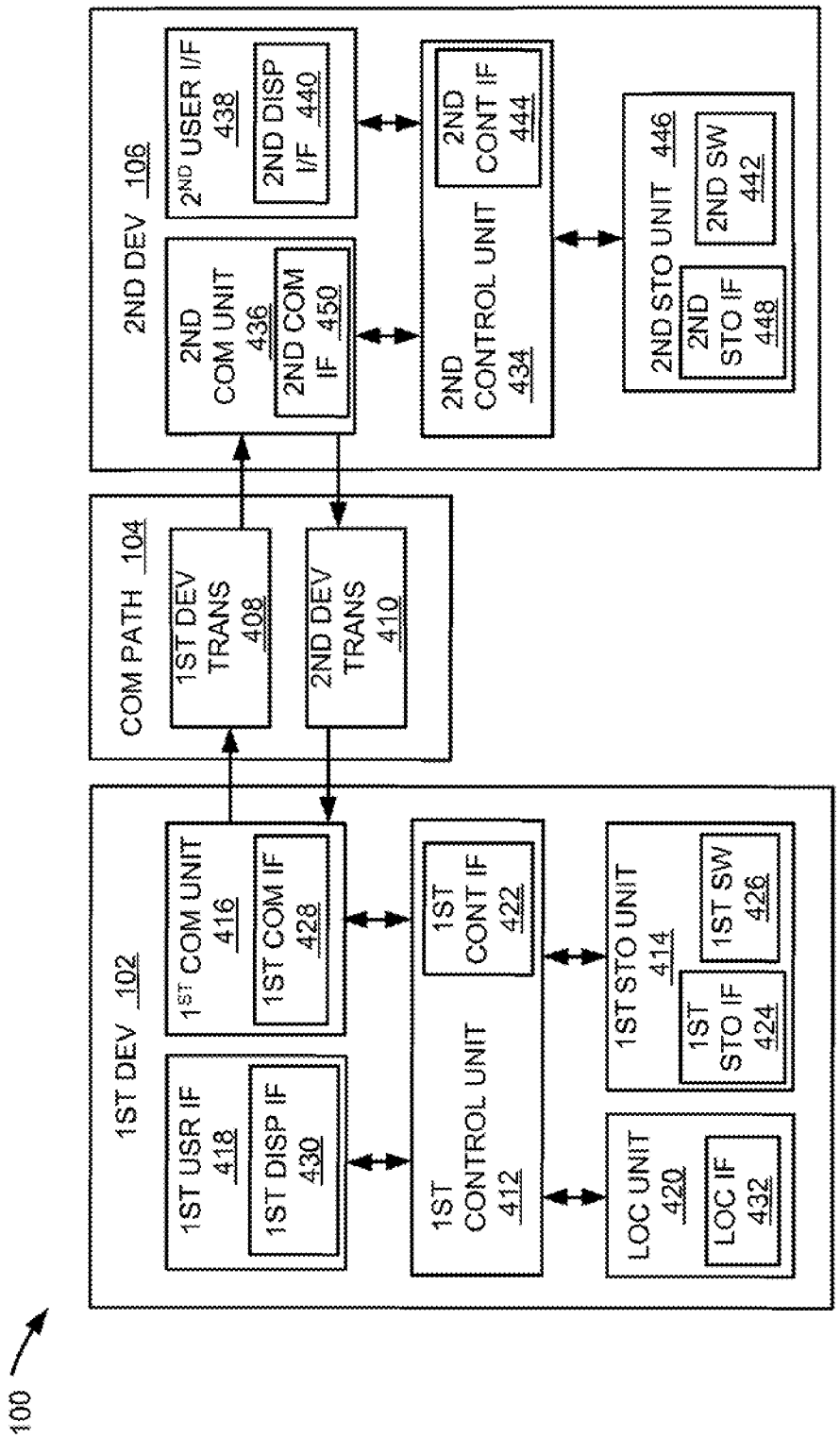

100
1ST DEV 102
1ST USR IF 418
1ST DISP IF 430
1ST COM UNIT 416
1ST COM IF 428
1ST CONTROL UNIT 412
1ST CONT IF 422
1ST STO UNIT 414
1ST STO IF 424
1ST SW 426
LOC UNIT 420
LOC IF 432
COM PATH 104
1ST DEV TRANS 408
2ND DEV TRANS 410
2ND DEV 106
2ND USER I/F 438
2ND DISP I/F 440
2ND COM UNIT 436
2ND COM IF 450
2ND CONTROL UNIT 434
2ND CONT IF 444
2ND STO UNIT 446
2ND STO IF 448
2ND SW 442

FIG. 4

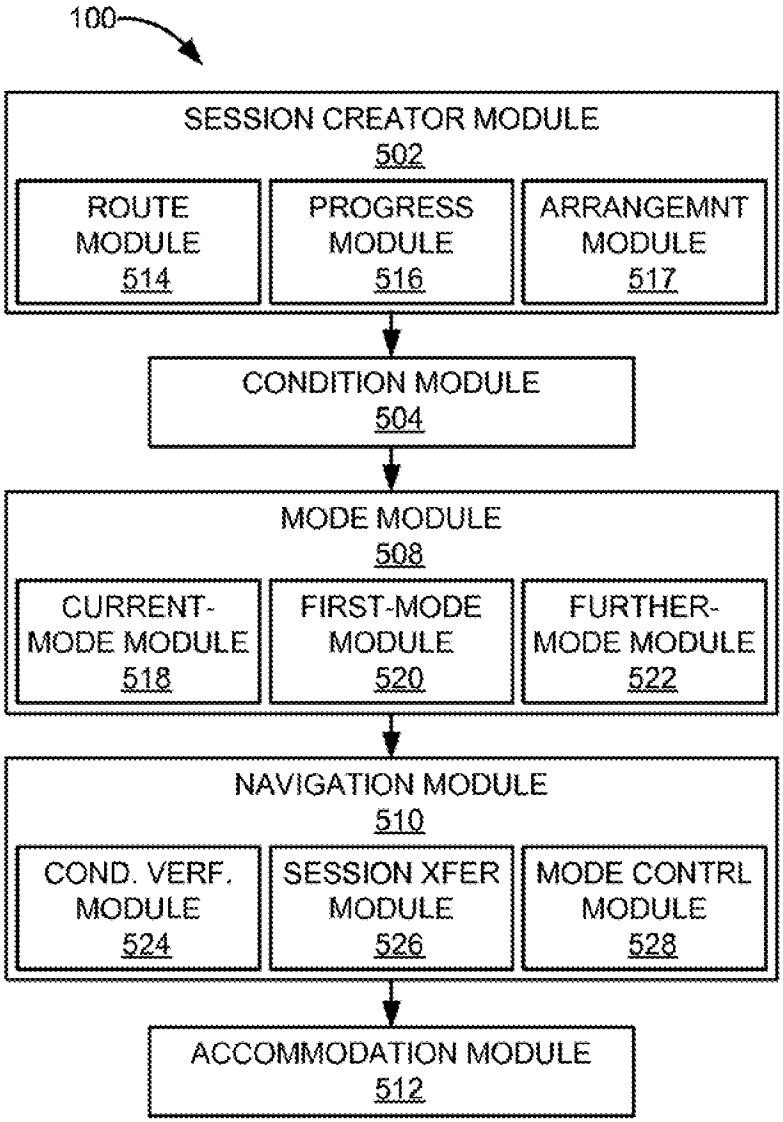

100
SESSION CREATOR MODULE
502
ROUTE MODULE
514
PROGRESS MODULE
516
ARRANGEMNT MODULE
517
CONDITION MODULE
504
MODE MODULE
508
CURRENT-MODE MODULE
518
FIRST-MODE MODULE
520
FURTHER-MODE MODULE
522
NAVIGATION MODULE
510
COND. VERF. MODULE
524
SESSION XFER MODULE
526
MODE CONTRL MODULE
528
ACCOMMODATION MODULE
512

FIG. 5

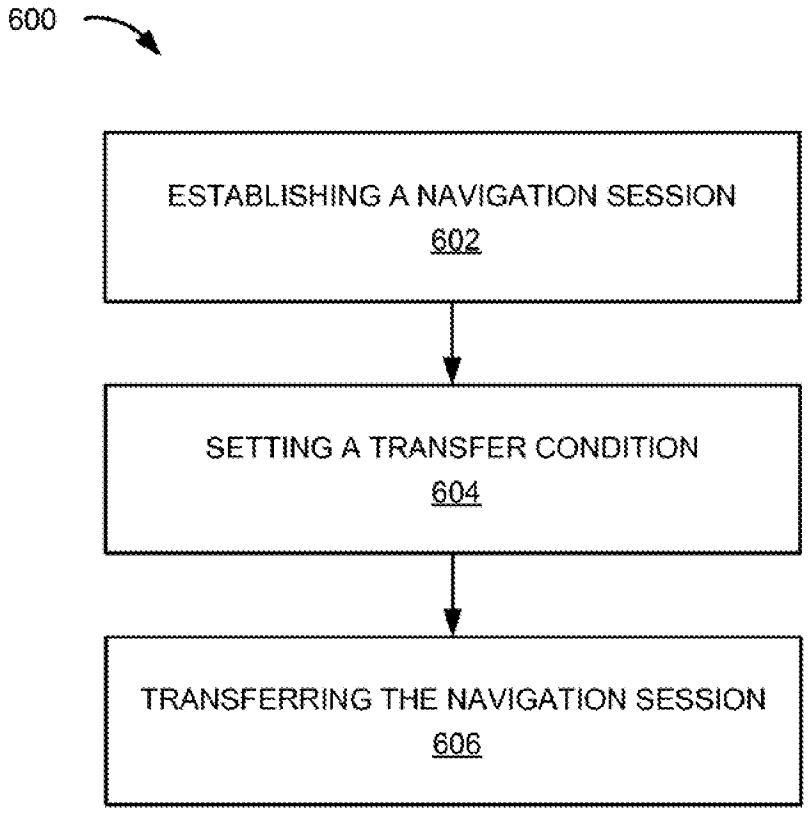

600
ESTABLISHING A NAVIGATION SESSION
602
SETTING A TRANSFER CONDITION
604
TRANSFERRING THE NAVIGATION SESSION
606

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 11/57834

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G01C 21/20 (2012.01)
USPC - 701/410
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
USPC: 701/410

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 701/400,408,410,516,517 (keyword limited; terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Electronic Database Searched: PubWEST(PGPB, USPT, EPAB, JPAB), Google Scholar
Search Terms Used: navigation, GPS, global, position, device, method, establish, generate, create, produce, display, output, session, route, directions navigation, instruction, map, transfer, transmit, send, move, copy, switch, second, another different, further, condit

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 2008/0114541 A1 (SHINTANI et al.) 15 May 2008 (15.05.2008), see entire document (especially para [0019]-[0027], [0034]-[0035], [0037]-[0041], [0045]-[0050], [0056], [0058], [0071],[0073], FIG. 1, 2, 5)	1-3, 5-8, 10 --- 4, 9
Y	US 6,874,037 B1 (ABRAM et al.), 29 March 2005 (29.03.2005), (col 4, ln 61-67, col 5, ln 1-11, FIG. 4)	4, 9
A	US 6,816,782 B1 (WALTERS et al.) 09 November 2004 (09.11.2004), see entire document	1-10
A	US 2009/0300219 A1 (YAUSSY et al.) 03 December 2009 (03.12.2009), see entire document	1-10
A	US 2003/0236615 A1 (KURODA et al.) 25 December 2003 (25.12.2003), see entire document	1-10

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 March 2012 (03.03.2012)	16 MAR 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

Electronic Acknowledgement Receipt

EFS ID:	34147762
Application Number:	16144338
International Application Number:	
Confirmation Number:	3503
Title of Invention:	Power Control for Battery Powered Personal Area Network Device System and Method
First Named Inventor/Applicant Name:	Eric Christian Hirsch
Customer Number:	133690
Filer:	Kyle S. Coleman/Ashlyn Nguyen
Filer Authorized By:	Kyle S. Coleman
Attorney Docket Number:	BRAGI GmbH-P0017C2
Receipt Date:	29-OCT-2018
Filing Date:	27-SEP-2018
Time Stamp:	16:22:53
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Non Patent Literature	Wikipedia_Gamebook_efs.pdf	2961997 6c1d7c2d32713ea0e5b62858ff784e026d9eb3a2	no	5

Warnings:

Information:					
2	Non Patent Literature	Wikipedia_Kinect_efs.pdf	10695132 1132157bf1fee5f80e0ad8c4b6a37a9ed0697951	no	18
Warnings:					
Information:					
3	Non Patent Literature	Wikipedia_Wii-Balance-Board_efs.pdf	1540846 9b15bf9a15f84dd8e3beb63b14670f17c032e766	no	3
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8	Foreign Reference	CN204244472U_CN-version.pdf	636734 70310288b8487474aa33fe3b3a62a2acf4c5e5dd	no	5
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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.