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United States Patent [19]

Puthuff

[11] Patent Number: 6,112,103**[45] Date of Patent: Aug. 29, 2000****[54] PERSONAL COMMUNICATION DEVICE**

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5,452,361	9/1995	Jones .	
5,479,522	12/1995	Lindemann et al. .	
5,488,668	1/1996	Waldhauer .	
5,590,417	12/1996	Rydbeck	455/90
5,751,820	5/1998	Taenzer	455/66
5,983,100	9/1996	Johansson	455/426
6,021,207	3/1997	Puthuff et al.	455/575

Related U.S. Application Data

[63] Continuation of application No. 08/758,365, Dec. 3, 1996.

[51] **Int. Cl.**⁷ **H04Q 7/32**

[52] **U.S. Cl.** **455/557; 455/550; 455/563**

[58] **Field of Search** 455/68, 69, 70,
455/90, 575, 403, 550, 563, 568, 569, 66,
557; 379/67.1, 88.01, 88.02, 90.01, 93.05,
93.07, 93.15, 110.01; 381/312, 314, 315,
316, 330, 328; 704/275

[56] References Cited**U.S. PATENT DOCUMENTS**

4,882,761	11/1989	Waldhauer .	
4,882,762	11/1989	Waldhauer .	
4,949,374	8/1990	Ishii et al.	455/563
4,975,654	12/1990	Becker et al. .	
5,140,640	8/1992	Graupe et al. .	
5,278,912	1/1994	Waldhauer .	
5,353,376	10/1994	Oh et al.	381/46
5,363,444	11/1994	Norris	379/430
5,390,254	2/1995	Adelman .	

FOREIGN PATENT DOCUMENTS

4321304 A1 3/1995 Germany H04Q 9/00

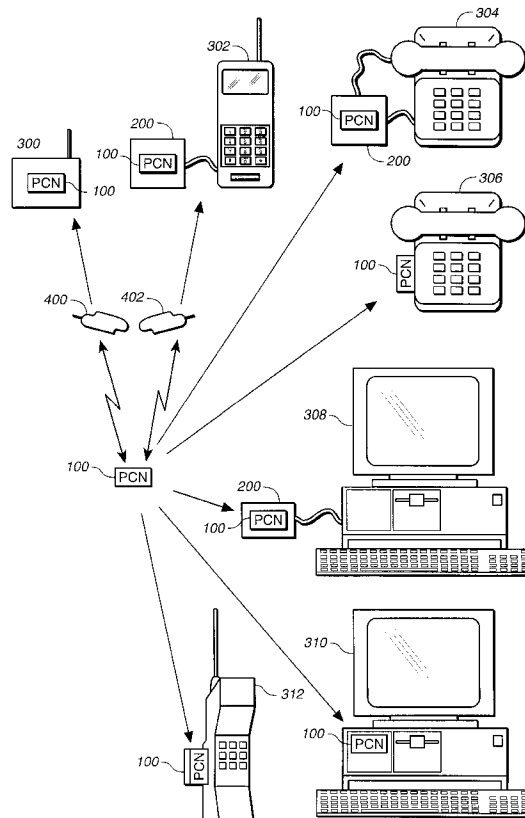
Primary Examiner—William G. Trost

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L.L.P.

[57] ABSTRACT

A communication system provides two-way wireless communication between a user and at least one remote device. The communication system comprises at least one earpiece worn by the user and a personal communication device for receiving and transmitting signals over a wireless link to and from the earpiece. The personal communication device includes voice recognition circuitry which recognizes and interprets voice commands of the user. The personal communication device is configured to determine a remote device to receive each of the voice commands, and transmits the appropriate voice commands to the remote device, accordingly.

6 Claims, 6 Drawing Sheets

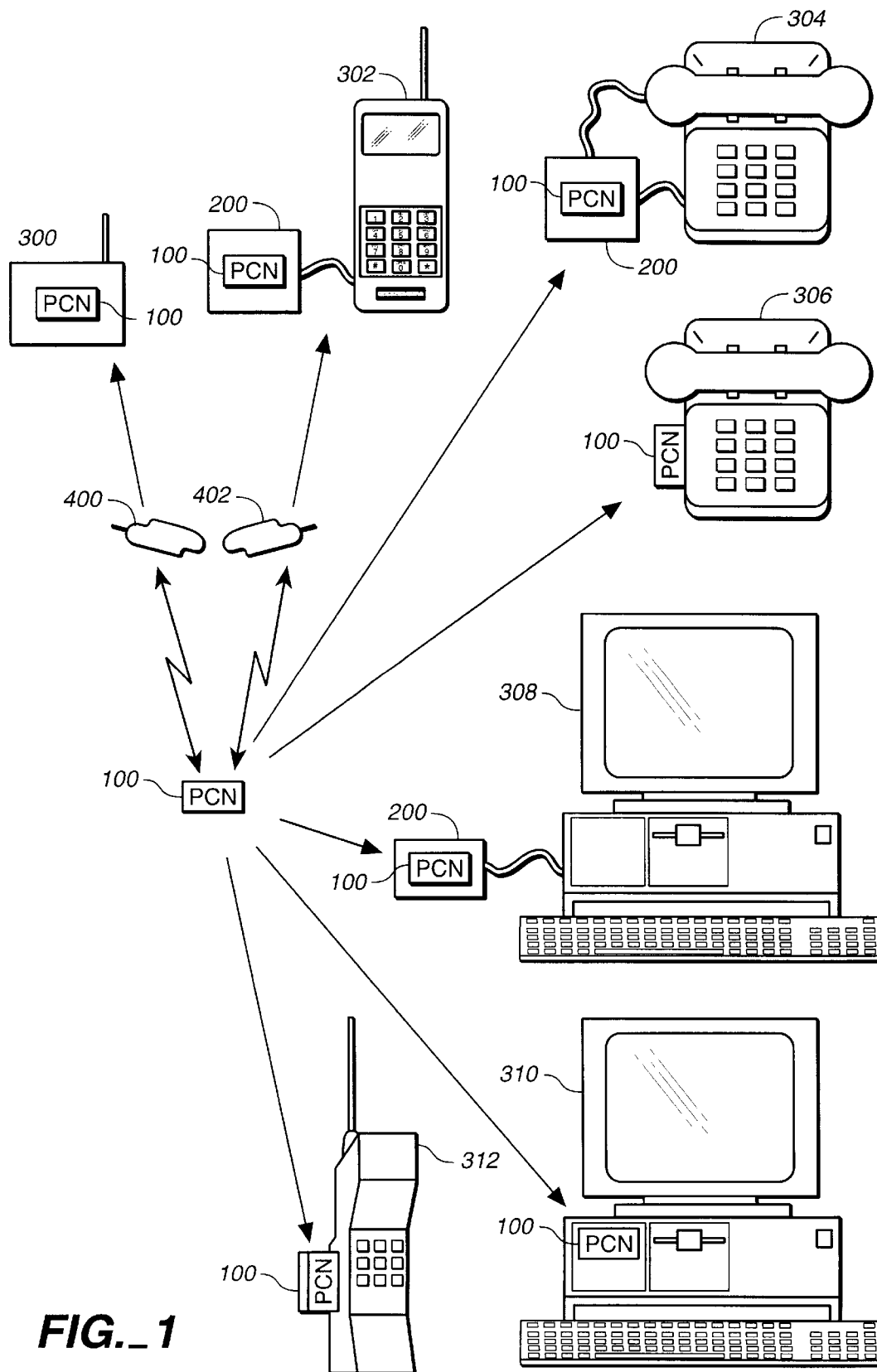


FIG. 1

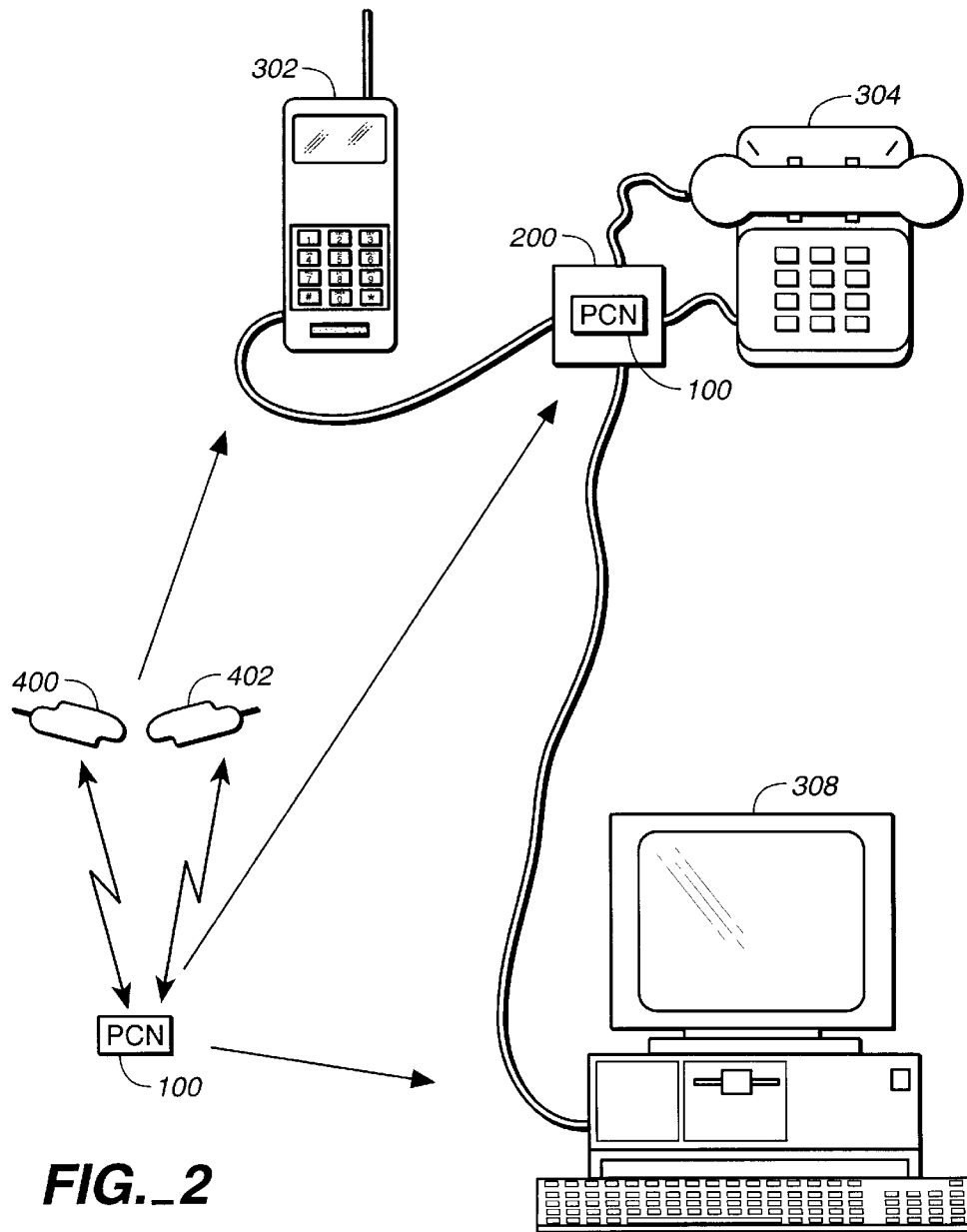


FIG._2

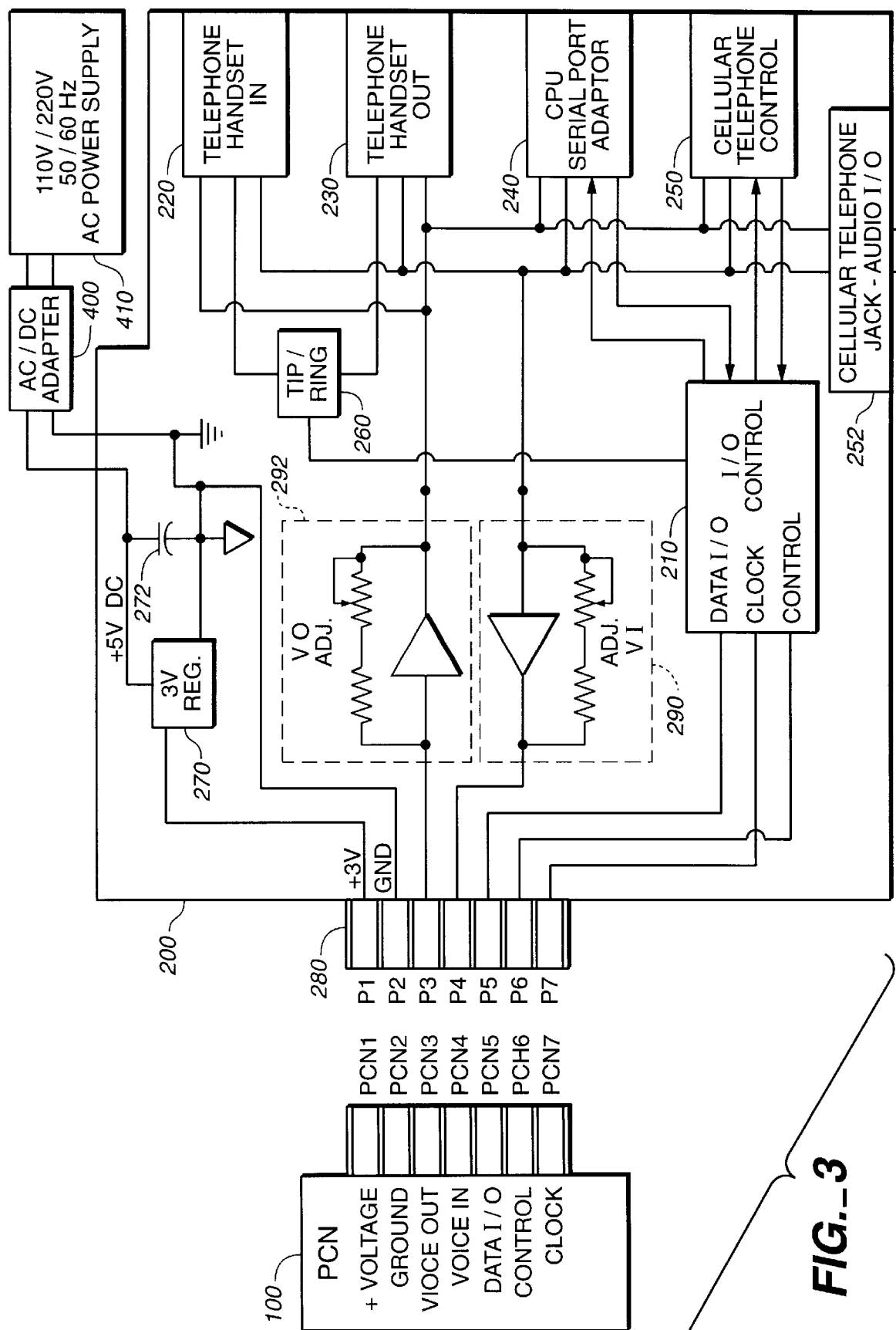


FIG. 3

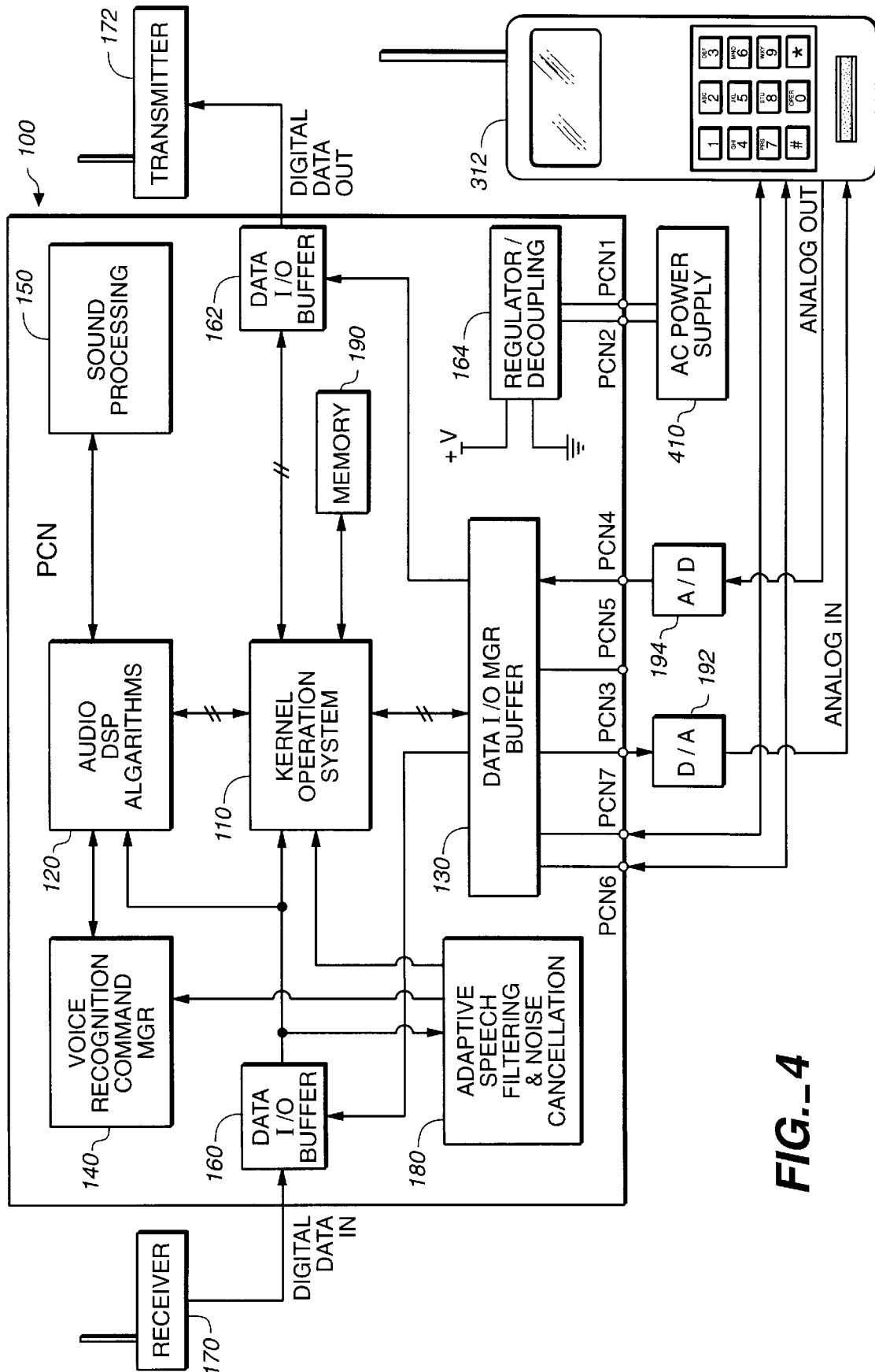


FIG. 4

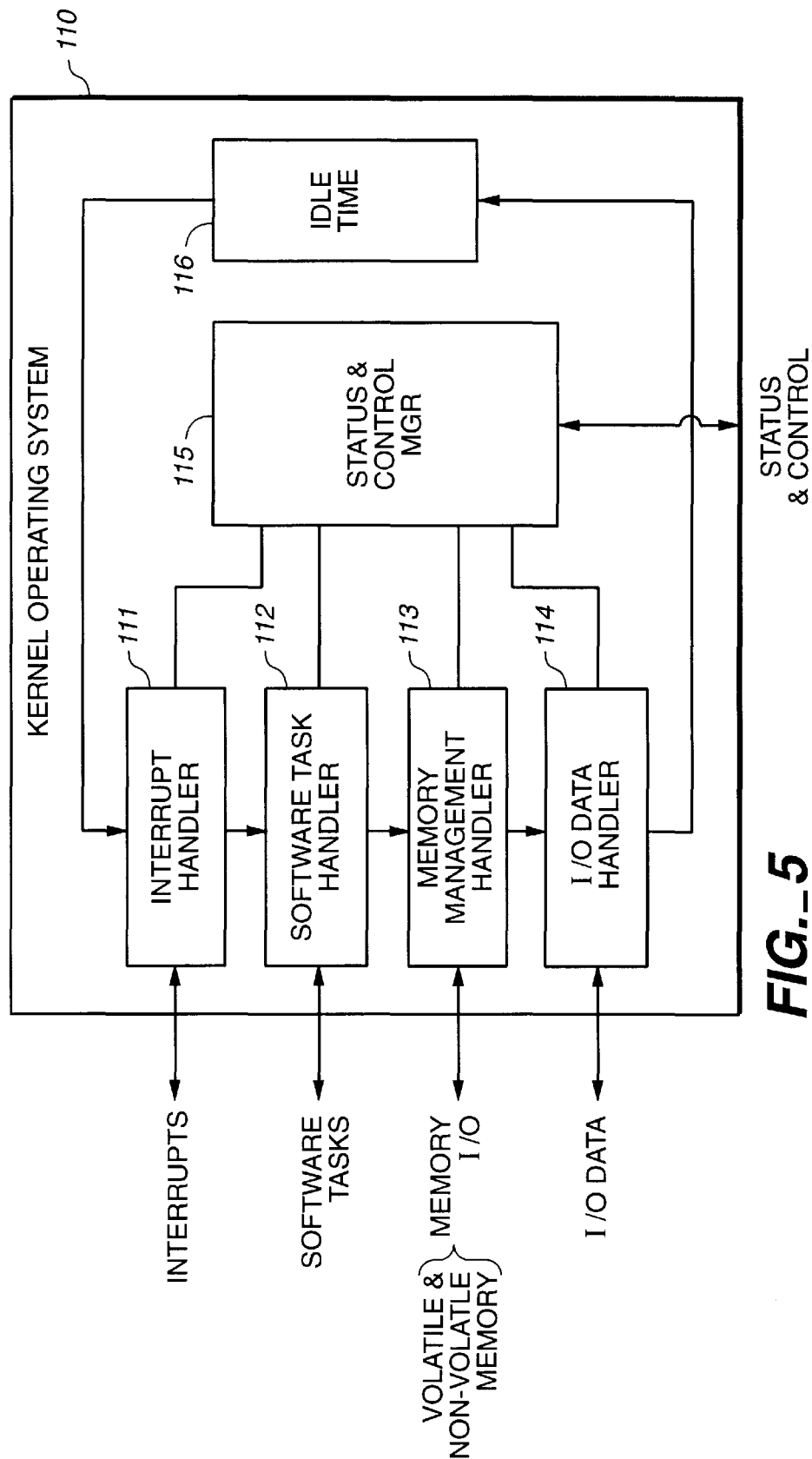
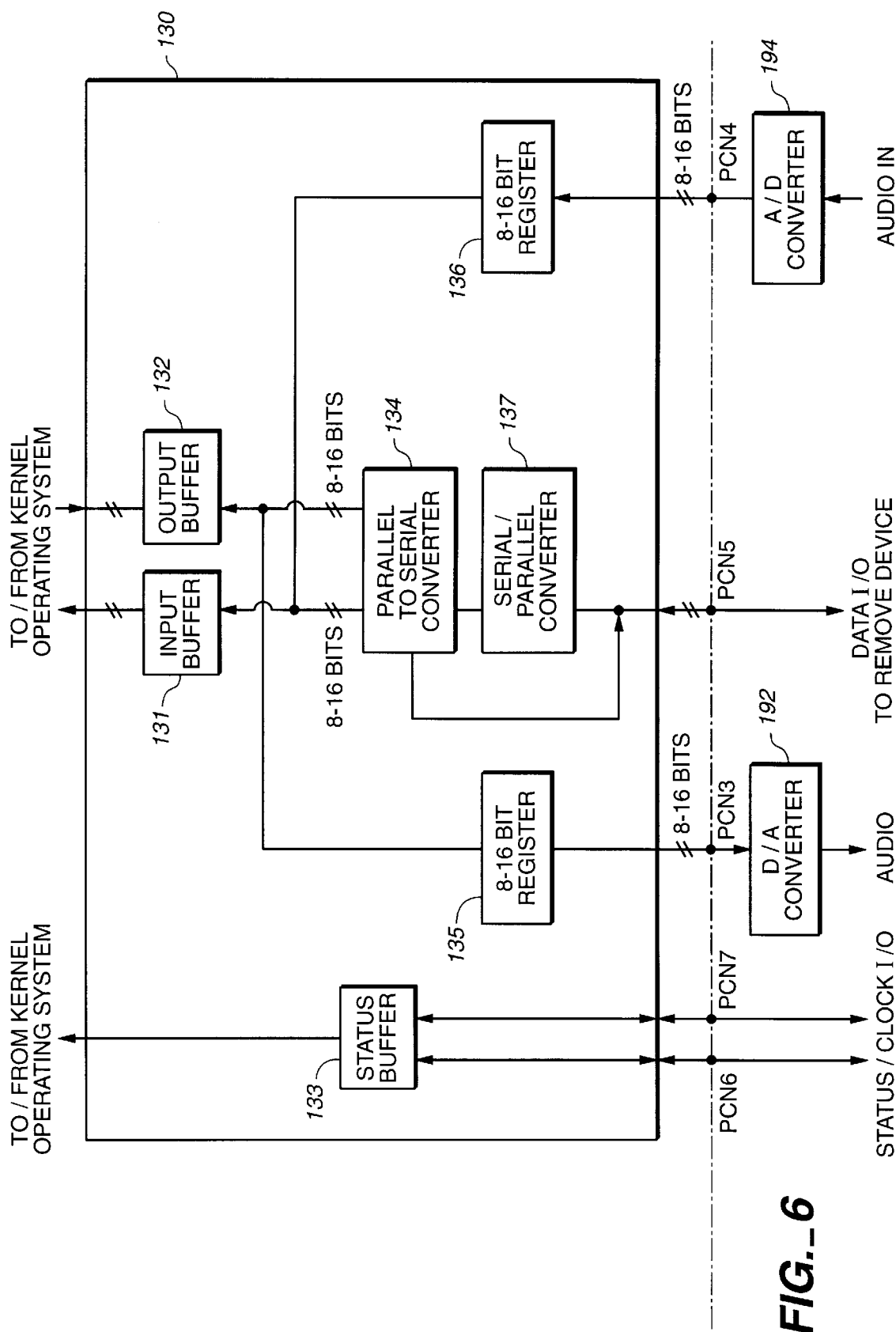


FIG._5



PERSONAL COMMUNICATION DEVICE

The present application is a continuation of U.S. application Ser. No. 08/758,365, filed Dec. 3, 1996, and entitled "PERSONAL COMMUNICATION DEVICE", the priority of which is hereby claimed under 35 U.S.C. §120.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to a communication system for two-way wireless communication. More particularly, the present invention is directed to a communication system including a personal communication device which is universally adaptable to at least one remote device for two-way wireless communication between a user and the remote device.

2. State of the Art

Two-way wireless communication systems are well known. For example, one known two-way wireless communication system is described in copending U.S. patent application Ser. No. 08/479,629, filed on Jun. 7, 1995 in the name of Jim Anderson, and entitled "Hearing Aid With Wireless Remote Processor", the contents of which are herein incorporated by reference in their entirety. In this system, audio signals are picked up by a microphone in an earpiece worn by a user, transmitted over a wireless link to a remote processor in which they can be processed to enhance the signal quality and then: (1) returned to the earpiece for output to the wearer; or (2) processed for transmission to a secondary unit (e.g., a cellular phone network). In a similar manner, signals from the secondary unit can be received by the remote processor, processed, and then transmitted to the earpiece.

A problem with this known system is that it is not universally adaptable to any type of secondary unit. Connecting a particular secondary unit to the remote processor requires special adaptation circuitry. This makes it prohibitively expensive and complex to connect the remote processor to many different types of secondary units.

Thus, there is a need for a communication system which permits two-way wireless communication between a user and at least one remote device which is universally adaptable to a variety of remote devices, and which can be connected to a single remote device or to a plurality of different remote devices at the same time or at different times in a simple manner.

SUMMARY OF THE INVENTION

The present invention is directed to a two-way wireless communication system between a user and at least one remote device which is universally adaptable to a variety of remote devices. Further, the present invention is directed to a two-way wireless communication system between a user and a plurality of remote devices which can be connected to the plurality of remote devices at the same time or at different times in a simple manner. In addition, the present invention is directed to a two-way wireless communication system between a user and at least one remote device which enables the user to control the remote device and/or to communicate with a third party via the remote device.

According to exemplary embodiments of the present invention, the foregoing objects, as well as other objects are met by a communication system comprising at least one earpiece worn by a user and a personal communication device for receiving and transmitting signals over a wireless

link to and from the earpiece. The personal communication device includes voice recognition means which recognizes and interprets voice commands of the user. The personal communication device is configured to determine a remote device which is to receive each of the voice commands. The voice commands are used to control the remote device, and the user can communicate with a third party via the remote device.

According to one embodiment of the present invention, the personal communication device is connected to one remote device at a time, either directly or via an adaptor. The adaptor universally connects the personal communication device to a variety of remote devices. The personal communication device is configured to determine voice commands that are to be sent to the remote device and sends these commands to the remote device, accordingly.

According to a second embodiment of the present invention, the personal communication device is connected to a plurality of remote devices at the same time or at different times, via, for example, a universal adaptor. The personal communication device is configured to determine which remote device the voice commands are to be sent to, and sends the commands to the appropriate remote device, accordingly.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and advantages of the present invention will be understood by reading the following detailed description in conjunction with the drawings, wherein like elements are identified by like reference numbers, and wherein:

FIG. 1 illustrates a communication system according to a first embodiment of the present invention;

FIG. 2 illustrates a communication system according to a second embodiment of the present invention;

FIG. 3 illustrates in detail an exemplary universal adapter which can be implemented in the communication system shown in FIGS. 1 and 2;

FIG. 4 illustrates a personal communication device which can be implemented in the communication system shown in FIGS. 1 and 2;

FIG. 5 illustrates in detail an exemplary Kernel Operating System which can be implemented in the personal communication device shown in FIG. 4; and

FIG. 6 illustrates in detail an exemplary Data I/O Manager Buffer which can be implemented in the personal communication device shown in FIG. 4.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a communication system according to one embodiment of the present invention. Referring to FIG. 1, a personal communication device, referred to as a personal communication node (PCN) 100, is connected via wireless links to earpieces 400 and 402 worn by a user. The wireless links can, for example, be radio frequency links such as that described in the above-referenced U.S. patent application Ser. No. 08/479,629. Further, the earpieces 400 and 402 can, for example, be configured as described in the aforementioned copending U.S. patent application. Although two earpieces are shown and can be worn by the user, one skilled in the art will appreciate that it may be desirable for the user to wear only one earpiece.

The PCN 100 permits a user to control at least one remote device and communicate wirelessly with a third party via the remote device simply by issuing voice commands. The PCN

100 recognizes and interprets the voice commands of the user, determines whether the commands are to be sent to a given remote device to which it is connected, and forwards the voice commands to the appropriate remote device, accordingly. As shown by the arrows in FIG. 1, the PCN **100** can be coupled to several different types of remote devices, either directly or through a universal adapter **200**.

For example, the PCN **100** can be connected directly to a cellular telephone **300** that is adapted for connection to the PCN. As shown in FIG. 1, the cellular telephone **300** has no keyboard or LED display and is instead controlled solely by voice commands from the user as described in more detail below. Alternately, the PCN **100** can be connected to a cellular telephone or pager **302** via an adapter **200**. FIG. 1 also shows the PCN **100** connected directly to a cellular phone **312** that is adapted for connection to the PCN **100**. The cellular phone **312** can be used in a normal manner by entering commands via a keyboard or in response to voice commands forwarded by the PCN **100**. Using the PCN **100** connected to the cellular telephones **300**, **302**, and/or **312** the user can answer calls, initiate calls, receive or send messages, and so on, simply by issuing voice commands.

The PCN **100** can also be connected via the adapter **200** to a fixed wireline telephone **304**. The adapter **200** is connected between the handset of the telephone **304** and the telephone body. Alternately, the PCN **100** can be connected directly to a fixed wireline telephone **306** that is adapted to be connected to the PCN. With the PCN **100** connected to the fixed wireline telephones **304** or **306**, the user controls the TIP and RING functions of the telephone to dial a number to initiate a call or to answer a call, respectively, simply by issuing voice commands.

The PCN **100** can also be connected to a personal computer **308** via the adapter **200** through a parallel or serial port on the personal computer **308**. Alternately, the PCN **100** can be connected directly to a personal computer **310** that includes I/O jacks for connection to the PCN. With the PCN **100** connected either directly or via the adapter **200**, the user can use the personal computers **308** and **310** for Internet applications, to update schedules, to input data, to control calls, to dictate information, for intelligent applications, and so on, simply by issuing voice commands.

FIG. 2 illustrates a communication system according to a second embodiment of the present invention. As in FIG. 1, the PCN **100** is connected via wireless links to earpieces **400** and **402** worn by a user. In FIG. 2, however, the PCN **100** is connected to a plurality of different remote devices at the same time or at different times through a universal adapter **200**. For example, as shown in FIG. 2, the PCN **100** can be connected to a cellular telephone **302**, a fixed wireline telephone **304**, and a personal computer **308** at the same time or at different times via the universal adapter **200**. The connection of the adapter **200** to these remote devices is the same as that described above with reference to FIG. 1. The PCN **100** shown in FIG. 2 is configured to determine which of the remote devices a voice command is to be sent to and forwards the voice command to the appropriate device, accordingly. This is described in more detail below.

Although FIGS. 1 and 2 show the PCN **100** connected to remote devices directly or through an adapter **200**, the PCN **100** can also be connected to the remote devices directly or through an adapter **200** via another device such as a LAN, a bidirectional FM device, or an infrared device. Such devices extend the distance through which the PCN **100** can communicate with or control remote devices. In addition, although the PCN **100** and the adapter **200** are shown in

FIGS. 1 and 2 as separate devices, they can be incorporated into a single device.

FIG. 3 illustrates in detail an exemplary universal adapter which can be implemented in the communication system shown in FIGS. 1 and 2. The universal adapter **200** is connected to the PCN **100** via a connector **280**. The connector **280** includes ports P1–P7 connected to respective ports PCN1–PCN7 of the PCN **100**. For example, port P1 is connected to a positive voltage port PCN1, port P2 is connected to a ground port PCN2, port P3 is connected to a voice out port PCN3, port P4 is connected to a voice in port PCN4, port P5 is connected to a data I/O port PCN5, port P6 is connected to a control port PCN6, and port P7 is connected to a clock port PCN7. Remote devices configured for connection directly to the PCN **100** are connected through the ports PCN1–PCN7 of the PCN **100**.

The universal adapter **200** also includes various ports for connection to remote devices. For example, the universal adapter **200** includes ports **220** and **230** for connection to a telephone handset IN and OUT. These ports can include, for example, standard RJ-11 connectors. The universal adapter **200** also includes a Serial Adapter port **240** for connection to a serial port of a CPU, and ports **250** and **252** for connection to cellular telephone control and a cellular telephone audio I/O jack, respectively.

The universal adapter **200** includes an I/O Control Unit **210** for controlling the flow of data and control signals through the adapter between the PCN **100** and the remote devices in response to, for example, voice commands received via connector **280**. Control and clock signals for the CPU received via PCN ports P6 and P7 are transferred under the control of the I/O Control Unit **210** directly to the CPU via the Serial Adapter port **240**. Control and clock signals for the telephone handset are transmitted from the I/O Control Unit **210** to the TIP/RING Unit **260** which controls the TIP/RING functions of the telephone handset in response to, for example, voice commands received via connector **280**. Control and clock signals for the cellular telephone are also transmitted from the I/O Control Unit **210** to the cellular telephone via the port **250**.

The universal adapter **200** receives and transmits digital data from and to the PCN **100** via the ports PCN5 and P5. Digital data is transmitted to and received from the CPU via the I/O control unit **210** and the Serial Adapter port **240**.

The universal adapter **200** receives digital voice information from the PCN **100** via the ports PCN3 and P3 and transmits digital voice information from a remote device to the PCN **100** via the ports P4 and PCN4. Voice data received at port P3 is processed in a voice output circuitry **292** (e.g., an analog operational amplifier with adjustable feedback resistance) and transmitted to the cellular phone via the audio I/O jack **252**, to the telephone handset via the port **230**, and/or to the CPU via the Serial Adapter port **240**. Voice data received from the cellular phone via audio I/O jack **252**, from the telephone handset via the port **220**, and from the CPU via the Serial Adapter port **240** is processed by the voice input circuitry **290** (i.e., similar to the voice output circuitry), and delivered to the PCN **100**.

According to an exemplary embodiment, the universal adapter **200** need not include an internal power supply, but rather can be connected to an external AC power supply **410** via an AC/DC Adapter **400**. The universal adapter **200** includes a voltage regulator **270** and a decoupling capacitor **272** for this purpose. The voltage regulator **270** regulates voltage supplied to the PCN **100** via the ports P1 and PCN1. In the case of a PCN **100** connected directly to a remote

device, the voltage regulator **270** and decoupling capacitor **272** can be included in the PCN **100**, as shown in FIG. **4** below.

FIG. **4** illustrates a personal communication node according to an exemplary embodiment of the present invention. For illustrative purposes, the PCN **100** is depicted in FIG. **4** as connected to a single remote device, the cellular telephone **312**, adapted for connection directly to the PCN **100**.

Referring to FIG. **4**, the PCN **100** processes signals received via the earpiece(s) worn by the user, including voice commands to control the cellular telephone **312** as well as voice data to be conducted over the cellular telephone network, and transmits appropriate signals to the cellular telephone **312**. The PCN **100** also processes signals from the telephone **312** and transmits these signals to the earpiece(s). To perform these functions, the PCN **100** includes a Kernel Operating System **110**, an Audio Digital Signal Processing (DSP) Algorithms Unit **120**, a Data Input/Output (I/O) Manager (Mgr) Buffer **130**, a Voice Recognition Command Manager **140**, a Sound Processing System **150**, Data I/O Buffers **160** and **162**, an Adaptive Speech Filtering and Noise Cancellation Unit **180**, and a Memory Unit **190**.

The Kernel Operating System **110** includes software for scheduling software tasks, handling interrupt requests, scheduling data input/output, and allocating memory for various applications in the PCN **100**. FIG. **5** illustrates in detail an exemplary Kernel Operating System which can be implemented in the personal communication device shown in FIG. **4**. A Status and Control Manager (Mgr) **115** of the Kernel Operating System **110** handles status (clock) and control information received from and transmitted to the Data I/O Mgr Buffer **130**. Scheduling of data input/output from various elements in the PCN **100** is handled by the FIG. **5** I/O Data Handler **114** under the control of the Status and Control Mgr **115**. The Memory Management Handler **113** allocates memory from the Memory Unit **190** for various tasks in the PCN **100** under the control the Status and Control Mgr **115**. Memory is allocated and data I/O is scheduled according to software task and interrupt requests.

Software task requests from various elements in the PCN **100**, such as the FIG. **4** Audio DSP Algorithms Unit **120**, are handled by the FIG. **5** Software Task Handler **112**. The Software Task Handler **112** issues software task instructions under the control of the Status and Control Mgr **115**.

Interrupt requests from various elements in the PCN **100**, such as the FIG. **4** Data I/O Mgr Buffer **130** and the Audio DSP Algorithms Unit **120**, are handled by the FIG. **5** Interrupt Handler **111**, which issues interrupt instructions under the control of the Status and Control Mgr **115**. The Interrupt Handler **111** includes a prioritized list of applications, which indicates which applications can interrupt other applications. As those skilled in the art will appreciate, this list can be selectively prioritized in any manner desired by the user. For example, the Interrupt Handler **111** can assign higher priority to incoming data from a CPU than to processing of an ongoing telephone call (or vice versa). Thus, when the Interrupt Handler **111** receives a request to interrupt from the FIG. **4** Data I/O Mgr Buffer **130** based on receipt of data from the CPU, the Interrupt Handler responds by interrupting operation of the Sound Processor **150**. The Interrupt Handler **111** bases interrupt instructions on idle time reports from the Idle Time Unit **116**, and does not issue interrupt instructions if the reports indicate that the PCN **100** is idle. The Idle Time Unit **116** bases the idle time reports on information from the I/O

Data Handler **114** which indicates the schedule of data I/O at a given time.

Referring again to FIG. **4**, the Sound Processing Unit **150** includes basic software used, for example, in a hearing aid to enhance signal quality. The Sound Processing Unit **150** can be implemented with a remote processor such as that described in the above-referenced copending U.S. patent application Ser. No. 08/479,629.

The Voice Recognition Command Manager **140** includes software which interprets voice commands from the user. For example, a voice command can be interpreted as a command to direct the cellular telephone **312** of FIG. **4** to perform a certain function. The Voice Recognition Command Manager **140** can be implemented with any conventional voice recognition software, such as Motorola's Lexicus Microbrain or the Voice Dialer, Model VCS 2060 of Voice Control Systems Inc. in Dallas, Tex. The Voice Recognition Command Manager **140** is "trained" ahead of time during a set up phase to recognize the voice of a specific user. For example, the user simply speaks a series of selected words, and the Voice Recognition Command Manager **140** becomes programmed (i.e., trained) in known fashion to recognize any word spoken by the user based on these selected words. The Voice Recognition Command Manager **140** can, for example, be language-independent. That is, it can be trained to recognize a user's voice in any language. Once the Voice Recognition Command Manager **140** is trained to the voice of the user, it need not be trained again.

The Voice Command Manager **140** matches a voice command to a particular control function in a library or look-up table of memory **190**. The voice command is also matched, via the look-up table, to a particular remote device. After matching the voice command to a particular control function and a particular remote device, the Voice Recognition Command Manager **140** then issues an appropriate control code to, for example, control gating of commands and/or data to one or more remote devices via the FIG. **4** Kernel Operating System and, where the adapter **200** is used, the FIG. **3** I/O control **210**. If the voice command does not match a control function in the library or look-up table, no control code is issued. Also, if the voice command corresponds to a remote device to which the PCN **100** is not connected, no control code is issued.

The Audio DSP Algorithms Unit **120** provides digital sound processing algorithms for the Voice Recognition Command Mgr **140** and the Sound Processing Unit **150** under the control of the Kernel Operating System **110**. The Audio DSP Algorithms Unit **120** can be implemented in accordance with features described in U.S. Pat. No. 5,479,522 (Lindemann et al.), the contents of which are hereby incorporated by reference in their entirety.

The Data I/O Mgr Buffer **130** temporarily stores data, voice, and control signals. FIG. **6** illustrates in detail an exemplary Data I/O Manager Buffer which can be implemented in the personal communication node shown in FIG. **4**. The Data I/O Mgr Buffer **130** includes input and output buffers **131** and **132** for outputting and receiving, respectively, digital data, digital voice information, and clock and control signals to and from the Kernel Operating System **110**. Digital data from the Output Buffer **132** is converted into serial form in a Parallel to Serial Converter **134** and delivered to the remote device via the port PCN5. Digital data from the remote device is converted into parallel form in the Serial to Parallel converter **137** and delivered to the Kernel Operating System **110** via the Input Buffer **131**. The digital voice data is transmitted across, for example, 8

to 16 bit buses. Digital voice data is delivered from the Output Buffer **132** to an 8 to 16 bit register **135**, converted into analog form in the D/A converter **192**, and transmitted to the remote device. Digital voice data received from the remote device is converted into digital form in the A/D converter **194**, stored in the 8 to 16 bit register **136**, and delivered to the Input Buffer **131** for output to the Kernel Operating System **110**. The Data I/O Mgr Buffer **130** also includes a Status Buffer **133** for storing clock and control information transferred between the Kernel Operating System **110** and the remote device.

Referring again to FIG. 4, the personal communication device also includes an Adaptive Speech Filtering and Noise Cancellation Unit **180** which enhances signal quality by filtering and cancelling noise in the signal. The Adaptive Speech Filtering and Noise Cancellation Unit **180** can be implemented in accordance with, for example, U.S. Pat. No. 5,140,640 (Graupe et al.) and/or U.S. Pat. No. 5,452,361 (Jones) entitled "Reduced VLF Overload Susceptibility Active Noise Cancellation Headset" assigned to Noise Cancellation Technology (NCT), the contents of which are hereby incorporated by reference in their entireties.

In the exemplary embodiment illustrated, the PCN **100** need not include a power supply, but rather can be connected to an external AC power supply **410** via a voltage regulator and decoupling unit **164**. Although shown as a separate element, the AC power supply **410** can, for example, be the same power supply used to power the cellular telephone **312**. The voltage regulator and decoupling unit **164** can include the voltage regulator **270** and the decoupling capacitor **272** shown in FIG. 3. Power is supplied from the external power supply and regulated by the voltage regulator and decoupling unit **164** in the same manner described above with reference to FIG. 3.

In an exemplary embodiment, the PCN **100** communicates wirelessly with the earpiece(s), although wired communication can of course be used. In the FIG. 4 embodiment, the PCN **100** receives signals from the earpieces via the Receiver **170** and stores the signals in a Data I/O Buffer **160**, and the PCN **100** transmits signals to the earpiece(s) after being stored in the Data I/O buffer **162** via the Transmitter **172**. Signals are converted into analog form and forwarded to the cellular telephone **312** via the D/A converter **192**. Signals are received from the cellular telephone **312** and converted into digital form in the A/D Converter **194**. The Data I/O Buffers **160** and **162**, the Receiver **170**, the Transmitter **172**, and the converters **192** and **194** can be implemented with any suitable conventional devices.

According to an exemplary embodiment, the PCN device **100** operates in the following manner. When the cellular telephone **312** rings to indicate an incoming call, the ring signal can be transmitted directly to the user, for example via the microphone in the earpiece(s), or transmitted to the user via the PCN **100** and the earpiece(s). If the ring signal is an audible signal, the user can, of course, respond to it by commanding that the telephone be picked up. However, if the user has a hearing impairment, the audible ring signal can be transmitted via the earpiece microphone and speaker. That is, the audible ring of the telephone can be detected by the earpiece(s) and passed to the user (e.g., a hearing impaired user) after signal enhancement is performed by the PCN **100**. Alternately, if the ring signal is a non-audible signal, it can be transmitted by the PCN **100** to the earpiece. In such a case, the analog ring signal is converted into digital form in the A/D converter **194** and forwarded to the Data I/O Manager Buffer **130** which temporarily stores the ring signal.

The Data I/O Mgr Buffer **130** forwards the ring signal to the Audio DSP Algorithms Unit **120** and the Sound Processing Unit **150** via the Kernel Operating System **110**. The Sound Processing Unit **150** processes the ring signal to enhance its signal quality according to the Audio DSP Algorithms Unit **120** under the control of the Kernel Operating System **110**.

The processed ring signal is forwarded from the Sound Processing Unit **150** to the Data I/O Buffer **162** via the Kernel Operating System **110**. The Data I/O Buffer **162** delivers the processed ring signal to the Transmitter **172** which transmits the ring signal to the earpiece(s) worn by the user.

When the user hears the ring signal, either directly or through the earpiece(s), he or she simply commands the telephone **312** to go off-hook by issuing a voice command, such as "Pick-up cellular phone". This voice command is picked up by microphone(s) in the earpiece(s) and transmitted across the wireless link(s) to the Receiver **170**. The Receiver **170** forwards the voice command in digital form to the Kernel Operating System **110** via the Data I/O Buffer **160**. The voice command is also forwarded to the Adaptive Speech Filtering and Noise Cancellation Unit **180** which filters and cancels noise in the voice command and then forwards the voice command to the Voice Recognition Command Manager **140**.

The Voice Recognition Command Manager **140** matches the voice command to a particular control code and a particular remote device and forwards the control code to the Kernel Operating System **110** via the Audio DSP Algorithms Unit **120**. The Kernel Operating System **110** forwards the control code to the Data I/O Mgr Buffer **130** which, in turn, forwards the control code to the cellular telephone **312** via the port PCN6. For a plurality of remote devices connected to the PCN **100**, the control code is forwarded to the appropriate remote device from the Data I/O Mgr Buffer **130** and, where the FIG. 3 adapter **200** is used, via the I/O control **210**. The cellular telephone **312** recognizes the control code as a command to go off-hook and responds accordingly. In this manner, the voice command issued by the user causes the cellular telephone **312** to go off-hook.

The user can then begin a typical conversation on the telephone network by speaking normally. The user's voice is picked up by the microphone(s) in the earpiece(s), transmitted over the radio link to the Receiver **170**, and processed by the PCN **100** in the same manner as described above for the voice command, except that the voice information is processed by the Sound Processing Unit **150** according to the Audio DSP Algorithms before being forwarded to the Kernel Operating System **110**, and the voice information is delivered to the D/A converter **192** from the port PCN3 for conversion into analog form before being delivered to the cellular telephone **312**. Voice information and/or data from a third party caller is picked up by the cellular telephone **312**, converted into digital form by the A/D converter **194**, received at the port PCN4 and processed in the PCN **100**, and transmitted wirelessly to the speaker(s) in the earpiece(s) via the Transmitter **172** in the same manner described above for the ring signal.

When the user wants to terminate the call, he or she merely issues a voice command such as "Hang up". This voice command is transmitted to the PCN **100** and interpreted by the Voice Recognition Manager **140** as a command to terminate the call, and an appropriate control code is issued. The control code is forwarded to the cellular telephone **312** in the manner described above for the call

initiation voice command. In this manner, the voice command issued by the user causes the telephone **312** to go on-hook.

The operation described above for the cellular telephone **312** can also be used to issue commands to control and to communicate with other remote devices, such as fixed wireline phones, personal computers, and so on, connected directly or through, for example, the universal adaptor **200** to the PCN **100**. For a remote device such as a computer, digital data is processed in a similar manner, except that it is forwarded from and delivered to the PCN via the port PCN5 without conversion to digital or analog form.

The remote devices described in the embodiments above are shown for illustrative purposes only. One skilled in the art will appreciate that the PCN **100** can be connected to other types of remote devices. For example, the PCN **100** can be connected to a tapedeck for hands-free control of the speed and radio/tapedeck functions in, for example, an automobile. The PCN **100** can also be used to control other functions in an automobile, such as cruise control, temperature settings, or any other function conventionally controlled by hand. Similarly, the PCN **100** can be connected to control a stereo, a CD player, and a television or to program a VCR simply by stating the name, channel, and time of a program to be recorded verbally.

The PCN **100** can also be connected to a remote device in an operating room of a hospital. The remote device can be controlled by voice commands to monitor medical conditions such as heartbeat, blood pressure, temperature, and so on. Vital statistics of a patient can thus be monitored by known sensors, and used to supply information to the doctor on command. Alternately, the information can be delivered to a doctor wearing the earpiece(s), and then used to either automatically initiate medical procedures, or to initiate such medical procedures in response to voice commands of the doctor (e.g., medical procedures such as administering more medicine). In a similar manner, the PCN **100** can also be connected to control exercise equipment in response to verbal commands of the user or to supply audible output to the user in response to PCN monitoring of heart attack conditions, high blood pressure, high cholesterol, and other medical conditions detected by dedicated sensors worn by the user. Information gathered by the PCN from the various sensors can be provided directly to the individual or can be used to initiate automatic functions such as automatically dialing "911" in case of an emergency.

The PCN **100** can also be used in combination with other PCN devices to provide wireless communication between individuals, such as soldiers in the field.

From the examples provided above, it is apparent that the PCN can be used in many different applications to control remote devices and to communicate with third parties via the remote devices.

It will be appreciated by those of ordinary skill in the art that the present invention can be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The presently disclosed embodiments are therefore considered in all respects to be illustrative, and not restrictive. The scope of the invention is indicated by the appended claims, rather than the foregoing description, and all changes that come within the meaning and range of equivalence thereof are intended to be embraced therein.

What is claimed is:

1. A communication system for providing two-way wireless communication between a user and at least one remote device, the communication system comprising:

at least one earpiece worn by the user; and

a personal communication device for receiving and transmitting signals over a wireless link to and from said earpiece, wherein said personal communication device includes voice recognition means trainable to a user for recognizing and interpreting voice input of the user, said personal communication device being configured to determine which one of multiple remote devices is connected to the personal communication device to receive said voice input and to transmit appropriate signals to the remote device in response to said voice input.

2. The communication system of claim 1, wherein the personal communication device is connected to a plurality of remote devices at the same time or at different times.

3. The communication system of claim 1, wherein the personal communication device is connected to a single remote device.

4. The communication system of claim 1, further comprising an adapter for adapting the personal communication device to a plurality of different types of remote devices.

5. The communication system of claim 1, wherein the personal communication device transmits voice commands to the remote device to control functions of the remote device.

6. The communication system of claim 1, wherein the personal communication device transmits signals to the remote device which are transmitted by the remote device to a third party.

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