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(54) **PHONE STAND USING A PLURALITY OF MICROPHONES**

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(51) **Int. Cl.**

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G10L 25/84	(2013.01)
G10L 21/0272	(2013.01)
G10L 21/0208	(2013.01)
H04R 1/40	(2006.01)
H04R 1/02	(2006.01)
G10L 15/22	(2006.01)
G06F 3/16	(2006.01)

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CPC ***G10L 21/0364*** (2013.01); ***G06F 3/165*** (2013.01); ***G10L 15/22*** (2013.01); ***G10L 21/0208*** (2013.01); ***G10L 21/0272*** (2013.01); ***G10L 25/84*** (2013.01); ***H04R 1/028*** (2013.01); ***H04R 1/403*** (2013.01); *G10L 2015/223* (2013.01); *H04R 2499/13* (2013.01)

(58) **Field of Classification Search**
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USPC 704/233
See application file for complete search history.

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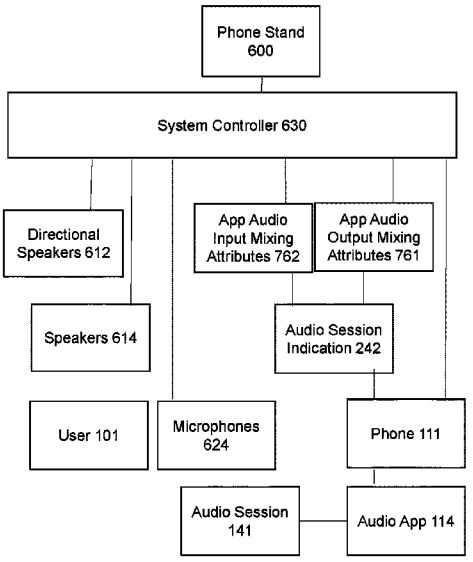
(57) **ABSTRACT**

A phone stand includes a phone holder for coupling to a phone for conducting an audio session, the audio session including at least one voice session conducted by an application executing on the phone and a plurality of microphones including a particular microphone closer to a location where a user is expected to be positioned than other microphones. The phone stand further includes a system controller configured to: receive sound signals from the particular microphone, the sound signals comprising the user's speech; separate the sounds signals into speech signals and non-speech signals; obtain one or more input mixing attributes for the speech signals and the non-speech signals; modify the speech signals and the non-speech signals based on the one or more input mixing attributes; generate mixed signals by combining the modified speech signals and the modified non-speech signals; and send the mixed signals to the phone.

21 Claims, 10 Drawing Sheets



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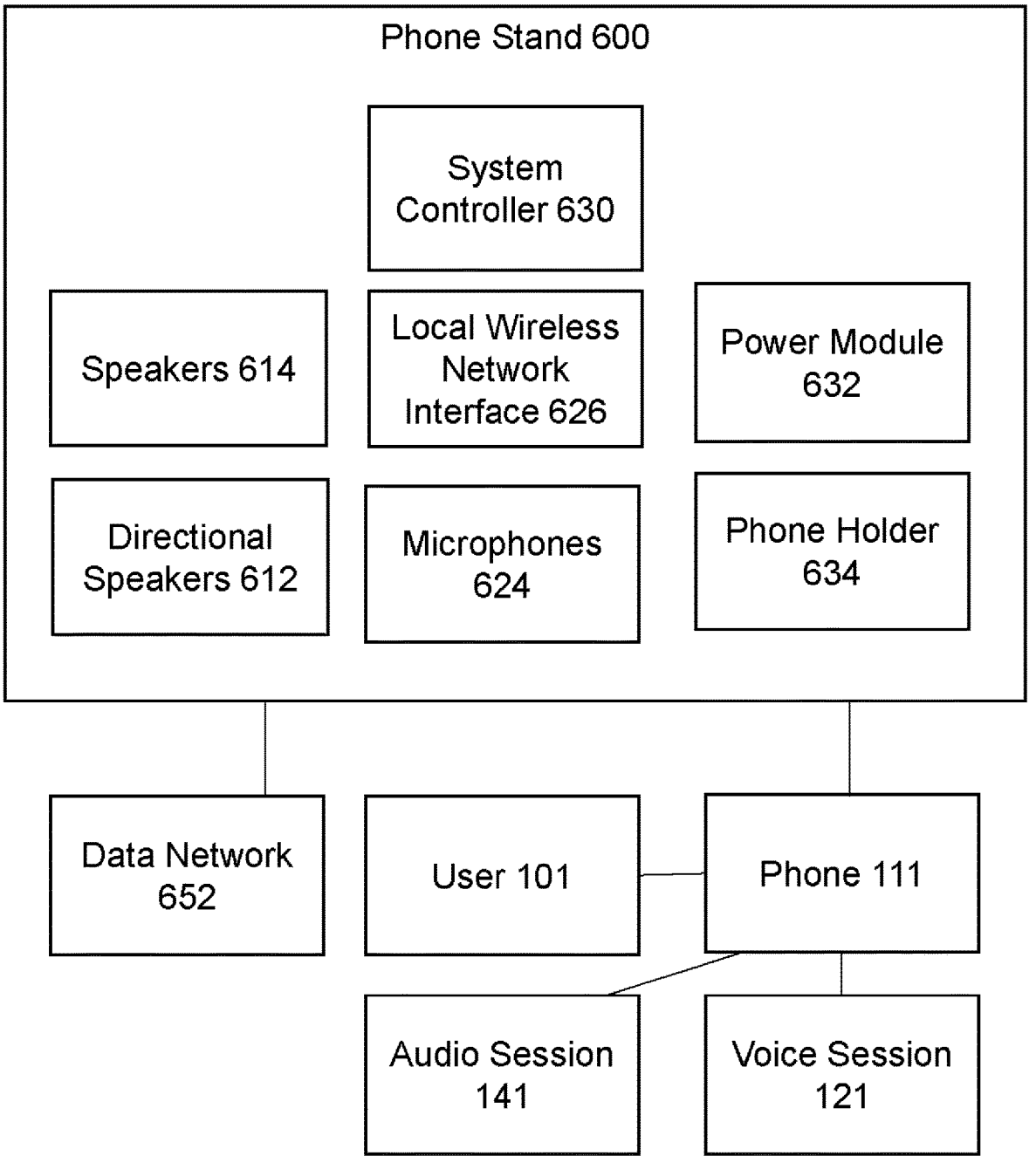
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System Controller 630
Speakers 614
Local Wireless Network Interface 626
Power Module 632
Directional Speakers 612
Microphones 624
Phone Holder 634
Data Network 652
User 101
Phone 111
Audio Session 141
Voice Session 121

FIG. 1

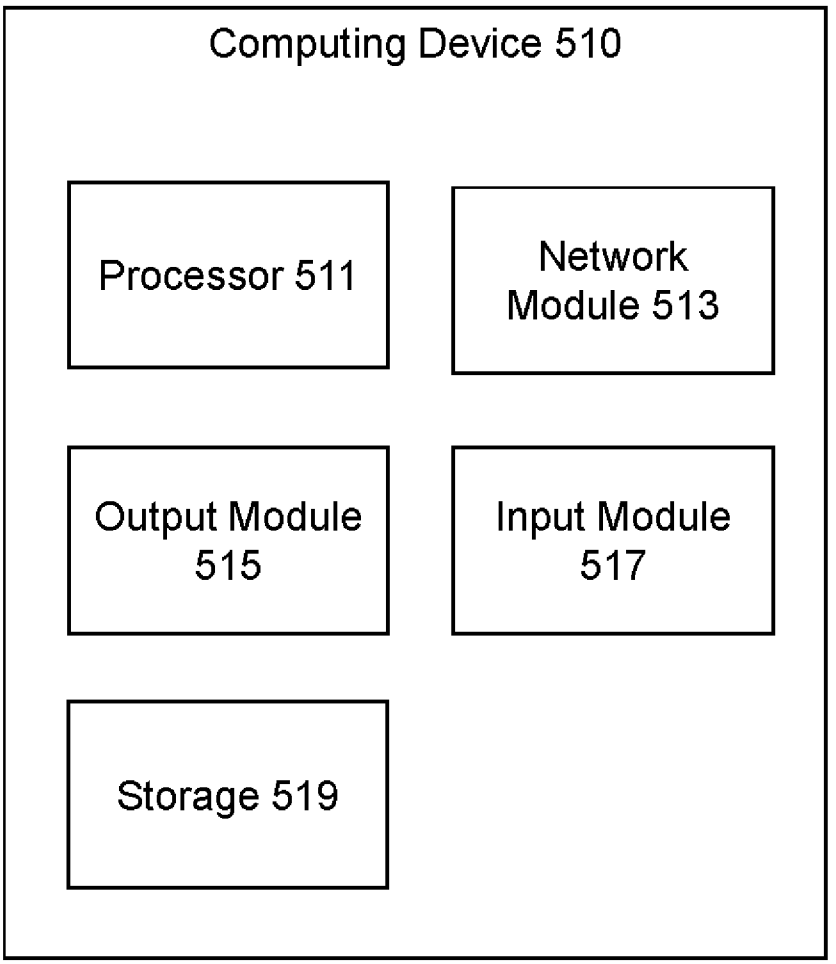
Computing Device 510
Processor 511
Network Module 513
Output Module 515
Input Module 517
Storage 519

FIG. 2

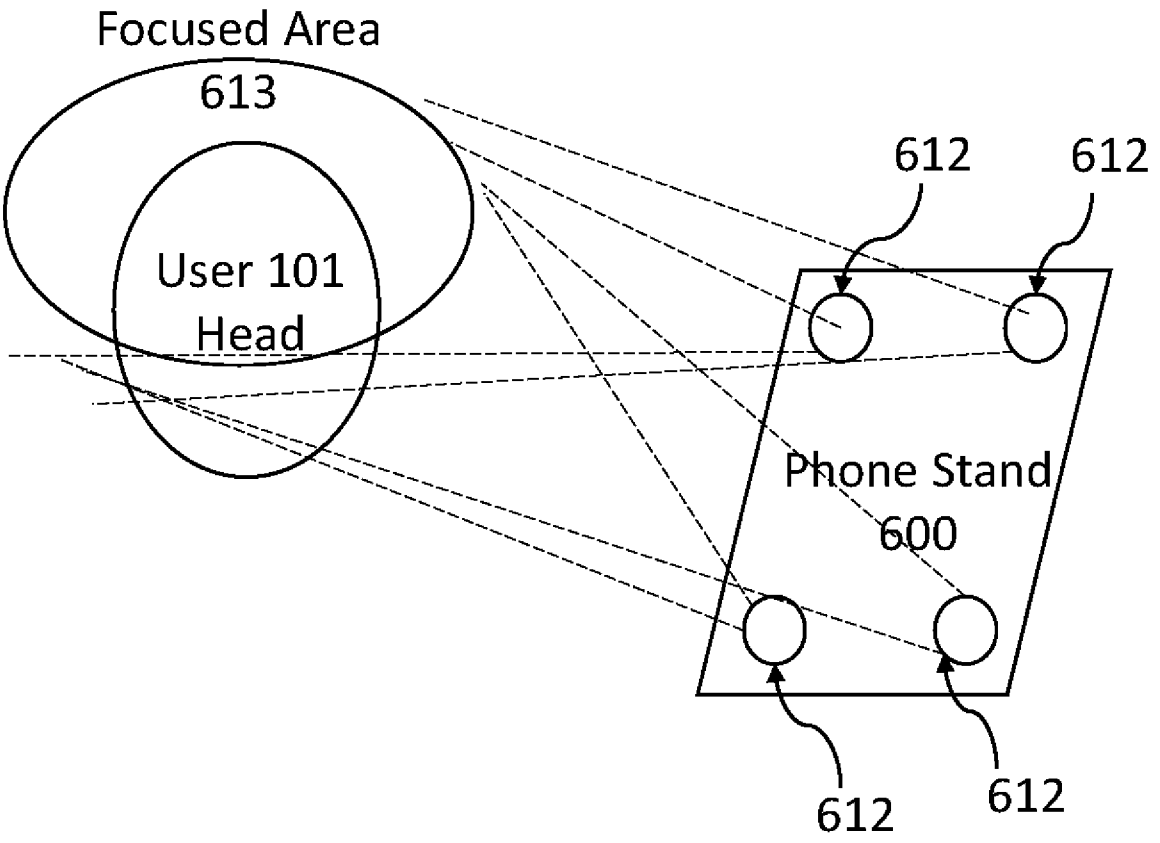
Focused Area
613
User 101
Head
612
612
Phone Stand
600
612
612

FIG. 3a

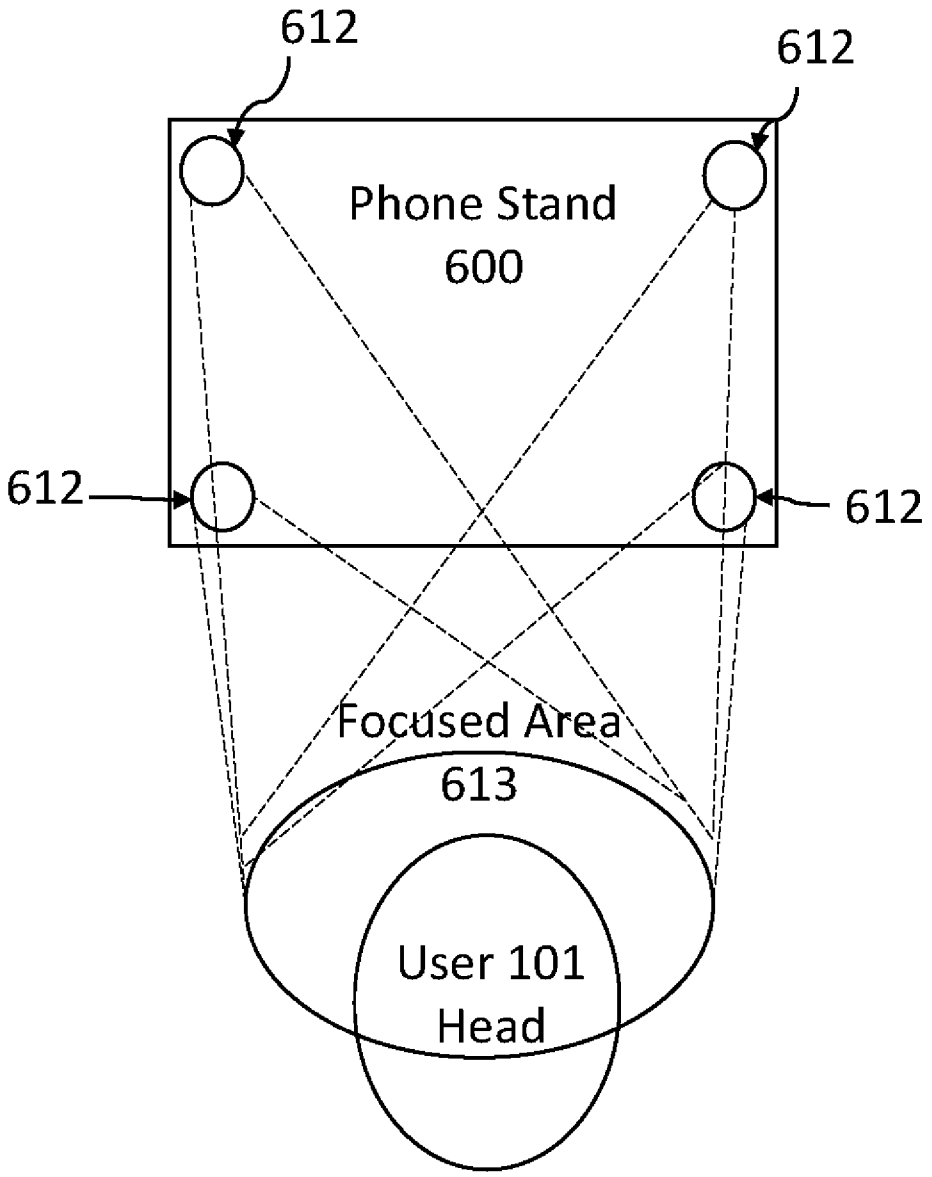
612
612
Phone Stand
600
612
612
Focused Area
613
User 101
Head

FIG. 3b

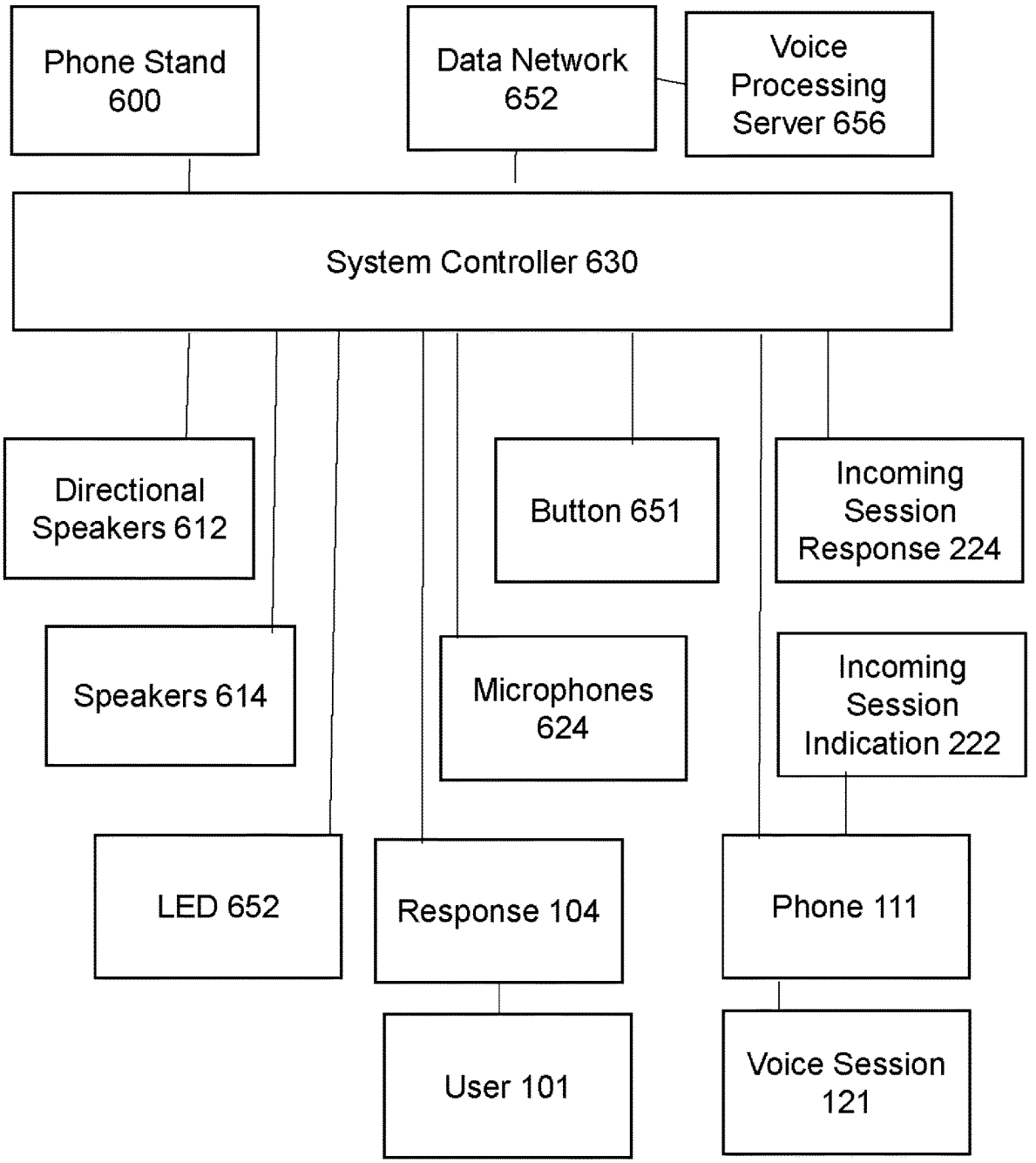
Phone Stand 600
Data Network 652
Voice Processing Server 656
System Controller 630
Directional Speakers 612
Button 651
Incoming Session Response 224
Speakers 614
Microphones 624
Incoming Session Indication 222
LED 652
Response 104
Phone 111
User 101
Voice Session 121

FIG. 4

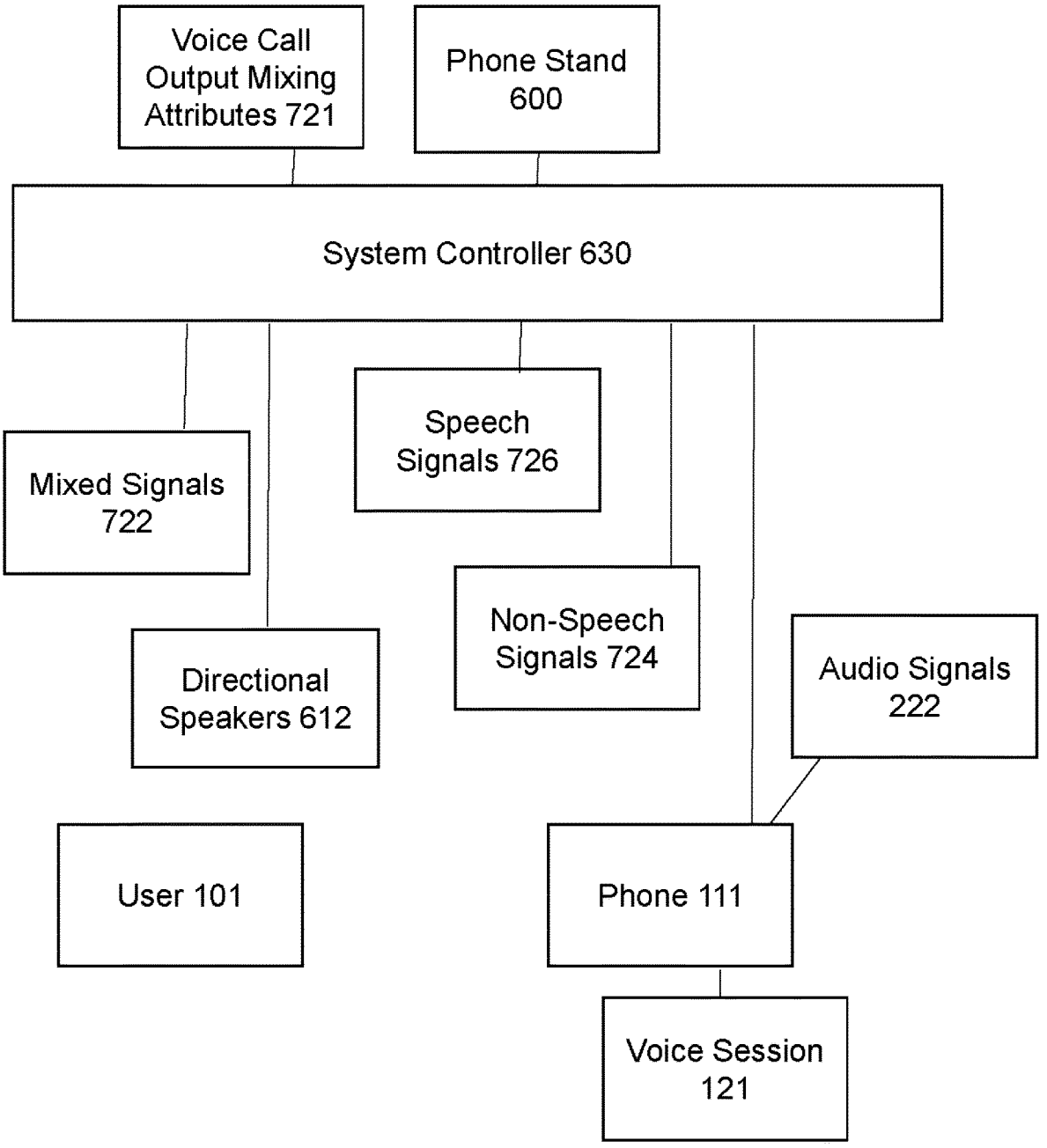
Voice Call Output Mixing Attributes 721
Phone Stand 600
System Controller 630
Mixed Signals 722
Speech Signals 726
Non-Speech Signals 724
Audio Signals 222
Directional Speakers 612
User 101
Phone 111
Voice Session 121

FIG. 5

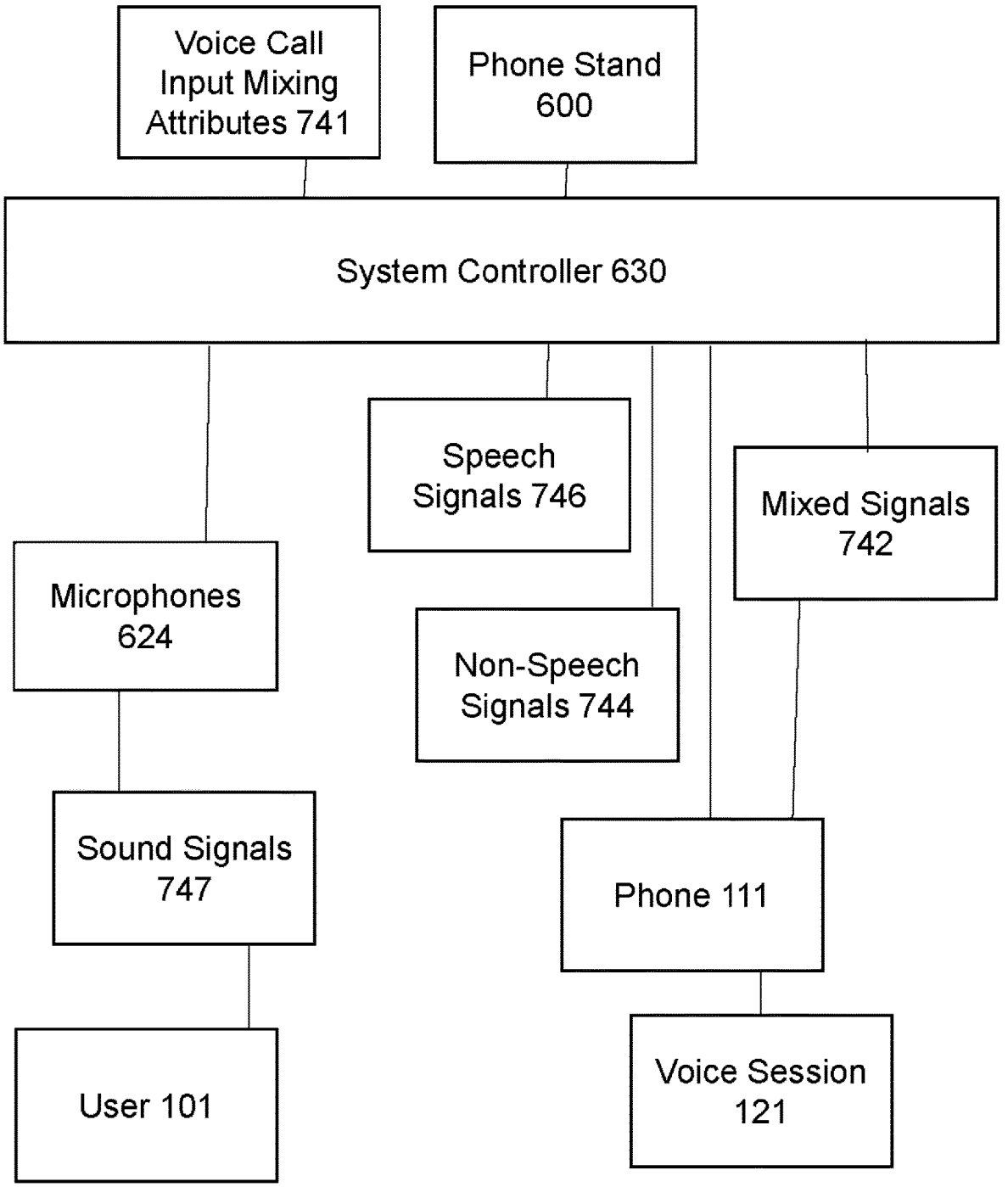
Voice Call Input Mixing Attributes 741
Phone Stand 600
System Controller 630
Speech Signals 746
Mixed Signals 742
Microphones 624
Non-Speech Signals 744
Sound Signals 747
Phone 111
User 101
Voice Session 121

FIG. 6

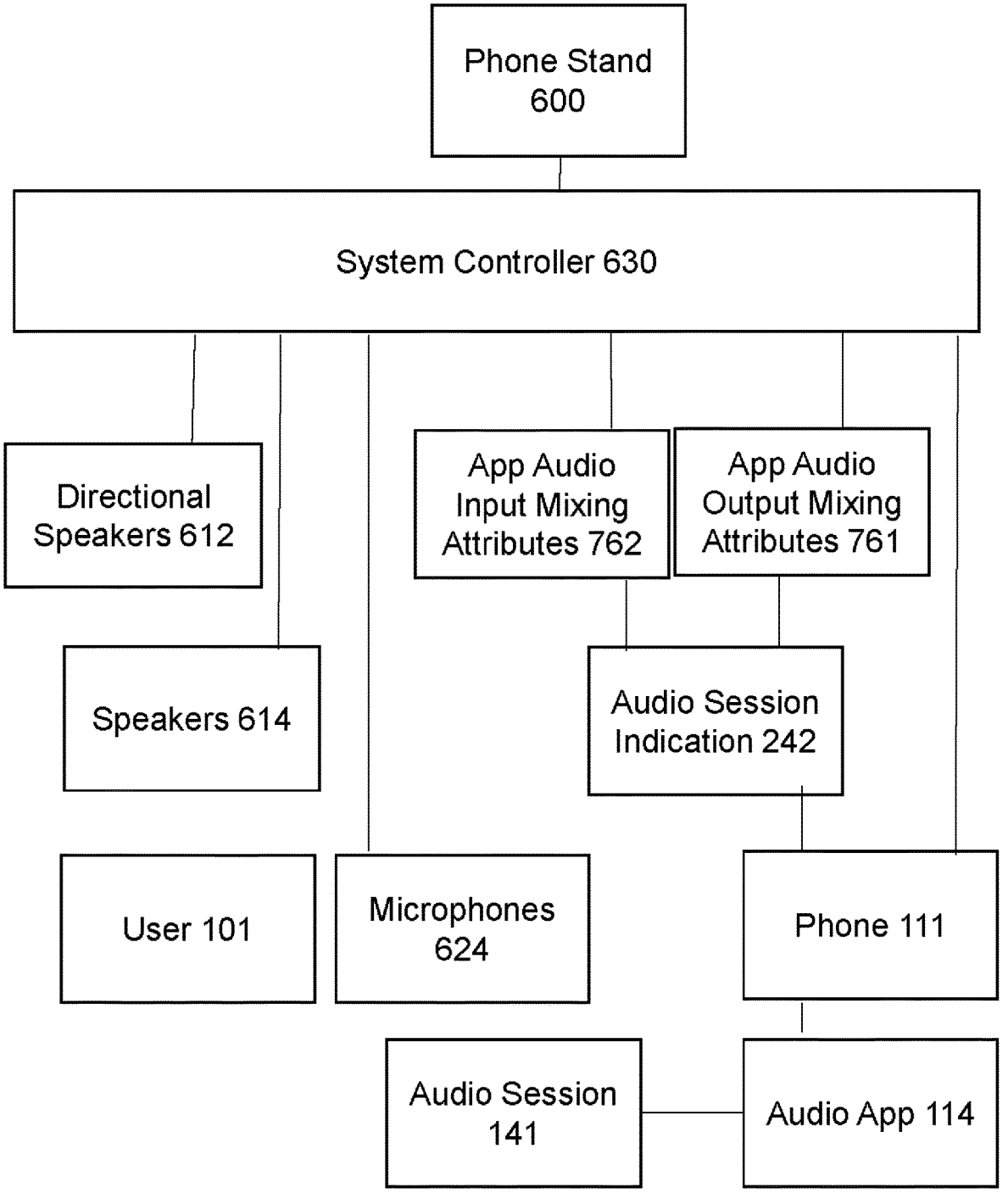
Phone Stand 600
System Controller 630
Directional Speakers 612
Speakers 614
App Audio Input Mixing Attributes 762
App Audio Output Mixing Attributes 761
Audio Session Indication 242
User 101
Microphones 624
Phone 111
Audio Session 141
Audio App 114

FIG. 7

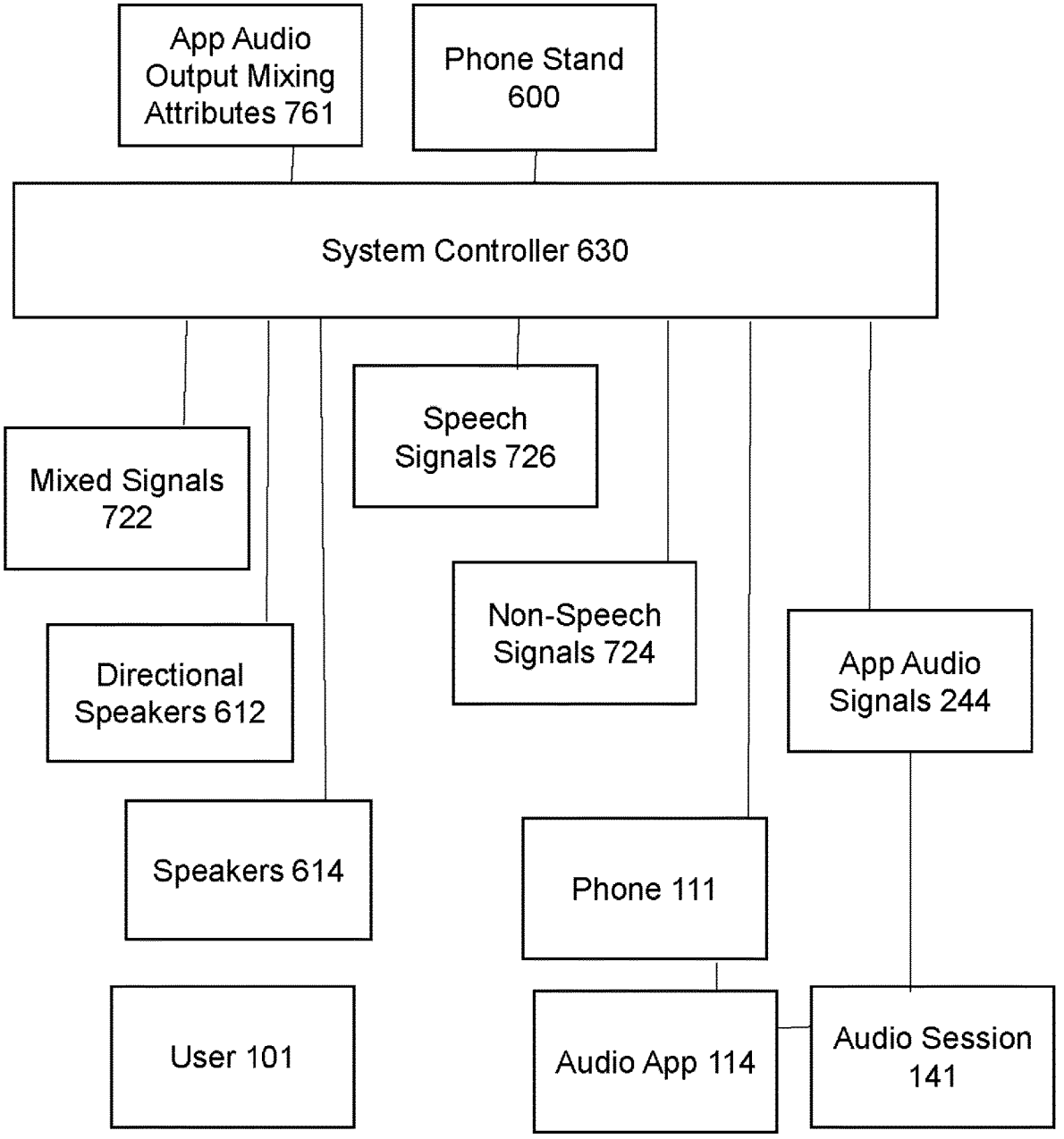
App Audio Output Mixing Attributes 761
Phone Stand 600
System Controller 630
Mixed Signals 722
Speech Signals 726
Non-Speech Signals 724
App Audio Signals 244
Directional Speakers 612
Speakers 614
Phone 111
User 101
Audio App 114
Audio Session 141

FIG. 8

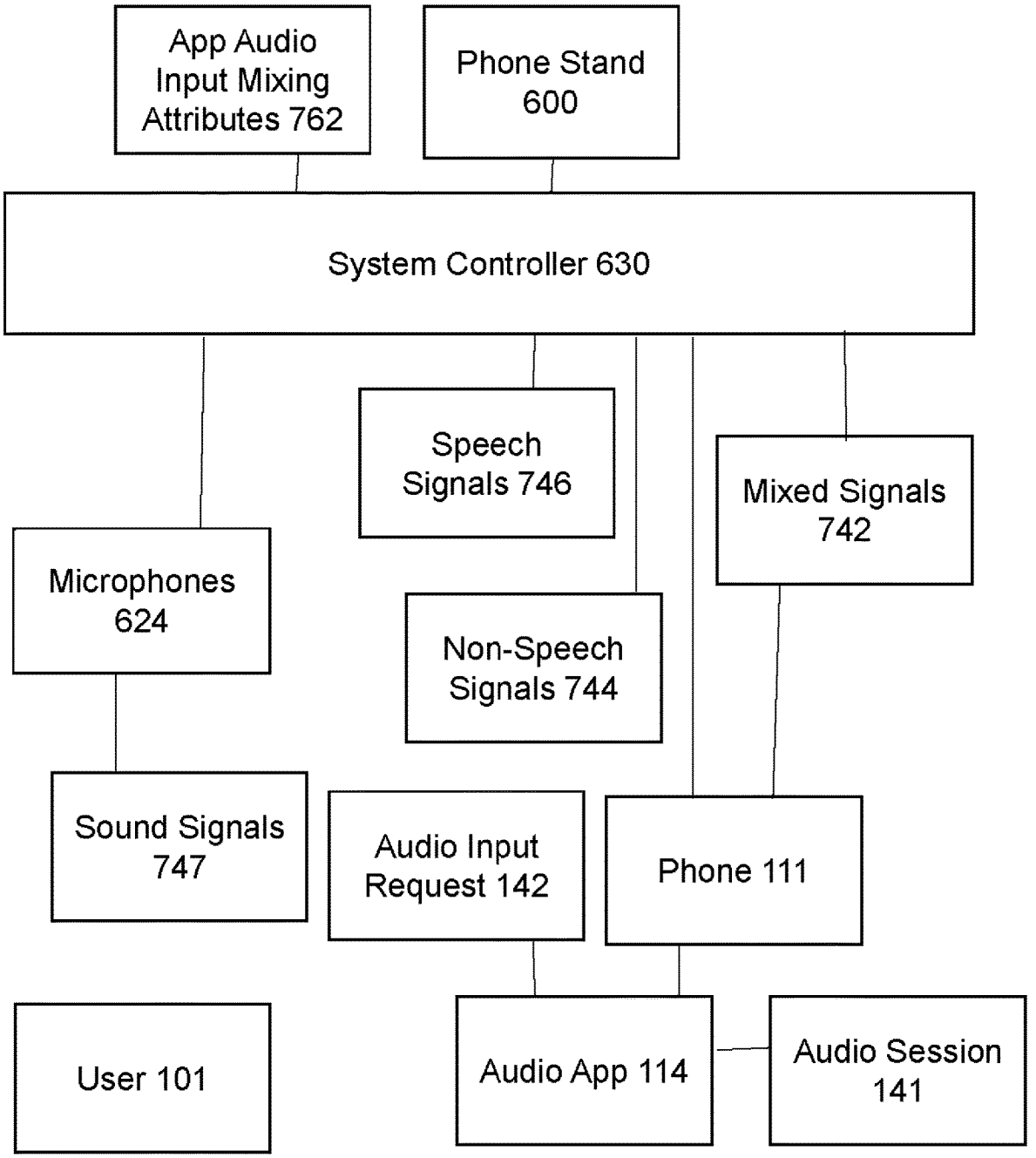
App Audio Input Mixing Attributes 762
Phone Stand 600
System Controller 630
Speech Signals 746
Mixed Signals 742
Microphones 624
Non-Speech Signals 744
Sound Signals 747
Audio Input Request 142
Phone 111
User 101
Audio App 114
Audio Session 141

FIG. 9

PHONE STAND USING A PLURALITY OF MICROPHONES

BACKGROUND OF THE INVENTION

Field

This invention relates generally to a phone stand, and more specifically a voice-oriented conversation microphone system based on a plurality of microphones.

Related Art

Uses of audio in a vehicle had been limited in the past. Drivers listened to radios and cassette tape or CD players; while operators of transportation vehicles used special voice devices for announcements and communication. With advances in mobile computing and digital radio, today's drivers engage a much larger number of activities involving voice and audio. They use in-car digital and often interactive entertainment system, high definition digital radio, voice-activated navigation system, in-car voice assistants, cell phones for phone calls, voice recording, voice messaging, voice mail and notification retrieval, music streaming and other voice and audio-based phone applications ("apps").

Despite the increase of voice and audio usage, a vehicle fundamentally is noisy, due in part to wind, engine noise, echo and external noise. When a driver is engaged in a phone call using speaker phone of her cell phone, she can hardly hear the sound of the other caller, while her voice is drowned in the ambient noise when picked up by the phone's microphone. The driver constantly adjusts the volume of the radio or speakers to be louder to drown the noise. He may miss a turn announced by the navigation system, or gets frequently frustrated when the in-car system's voice assistant repeatedly fails to understand his commands or questions.

A noisy environment is not unique to a car or bus. Workers often find similar situations in a work area. Using a voice or audio device such as a phone in a noisy work place is difficult and frustrating.

The above scenarios illustrate the need for a phone stand that assists a phone in providing voice and audio clarity.

BRIEF SUMMARY OF THE INVENTION

Disclosed herein is a phone stand using a plurality of microphones and a corresponding method and computer readable medium as specified in the independent claims. Embodiments of the present invention are given in the dependent claims. Embodiments of the present invention can be freely combined with each other if they are not mutually exclusive.

According to one embodiment of the present invention, a phone stand includes: a phone holder for coupling to a phone, the phone for conducting an audio session, the audio session including at least one voice session conducted by an application executing on the phone, and a plurality of microphones including a particular microphone closer to a location where a user is expected to be positioned than other microphones of the plurality of microphones. The phone stand further includes a system controller configured to: (a) receive sound signals from the particular microphone, the sound signals comprising the user's speech; (b) separate the sounds signals into speech signals and non-speech signals; (c) obtain one or more input mixing attributes for the speech signals and the non-speech signals; (d) modify the speech signals and the non-speech signals based on the one or more input mixing attributes; (e) generate mixed signals by combining the modified speech signals and the modified non-speech signals; and (f) send the mixed signals to the phone.

In one aspect of the present invention, the receive (a) and the modify (d) includes: (a1) receive sound signals from the particular microphone and at least one of the other microphones; (d1) identify speech signals in the sound signals from the particular microphone; (d2) identify non-speech signals in the sound signals from the least one of the other microphones; and (d3) modify the speech signals and the non-speech signals based on the one or more input mixing attributes.

In one aspect of the present invention, the application sends the mixed signals to a remote device over the voice session.

In one aspect of the present invention, the phone stand and the plurality of microphones reside within a vehicle.

In one aspect of the present invention, the one or more input mixing attributes include one or more of the following: increasing a volume of the speech signals; reducing a volume of the non-speech signals; and eliminating the non-speech signals.

In one aspect of the present invention, the particular microphone is a directional microphone facing the location where the user is expected to be positioned.

In one aspect of the present invention, the system controller is further configured to: receive an audio session indication message from the phone stand, the audio session indication message comprising an input mixing attribute identity associated with the application; and retrieve the one or more input mixing attributes associated with the audio input mixing attribute identity.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE FIGURES

FIG. **1** illustrates an exemplary embodiment of a phone stand computing system according to the present invention.

FIG. **2** illustrates an exemplary embodiment of a computing device according to the present invention.

FIGS. **3***a*-**3***b* illustrate exemplary embodiments of directional speakers of the phone stand according to the present invention.

FIG. **4** illustrates an exemplary embodiment of a process for receiving an incoming voice session according to the present invention.

FIG. **5** illustrates an exemplary embodiment of a process for processing audio signals received from the phone according to the present invention.

FIG. **6** illustrates an exemplary embodiment of a process for sending audio signals to the phone according to the present invention.

FIG. **7** illustrates an exemplary embodiment of a process for interworking with an audio-based phone application according to the present invention.

FIG. **8** illustrates an exemplary embodiment of a process for processing audio signals received from an audio-based phone application according to the present invention.

FIG. **9** illustrates an exemplary embodiment of a process for sending audio signals to an audio-based phone application according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The following description is presented to enable one of ordinary skill in the art to make and use the present invention

and is provided in the context of a patent application and its requirements. Various modifications to the embodiment will be readily apparent to those skilled in the art and the generic principles herein may be applied to other embodiments. Thus, the present invention is not intended to be limited to the embodiment shown but is to be accorded the widest scope consistent with the principles and features described herein.

Reference in this specification to "one embodiment", "an embodiment", "an exemplary embodiment", or "a preferred embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Moreover, various features are described which may be exhibited by some embodiments and not by others. Similarly, various requirements are described which may be requirements for some embodiments but not other embodiments. In general, features described in one embodiment might be suitable for use in other embodiments as would be apparent to those skilled in the art.

FIG. **1** illustrates an exemplary embodiment of a phone stand computing system according to the present invention. In one embodiment, phone stand **600** coupled to or physically holds a phone **111** and assists in the use of a phone **111** by processing a voice session **121** or an audio session **141**. In one embodiment, phone stand **600** includes local wireless network interface **616** through which the phone stand **600** is able to wirelessly connect directly to phone **111** when phone **111** is within connection range of the phone stand **600**. In one embodiment, phone stand **600** includes a phone holder **634** which includes a clip, cradle, magnetic mount, or other similar device, to physically hold phone **111**. In one embodiment, phone holder **634** connects to power module **632**, included in phone stand **600**, such that phone holder **634** can electrically charge phone **111** when phone **111** is held by phone holder **634**. In one embodiment, power module **632** of phone stand **600** provides power to one or more components of phone stand **600**. In one embodiment, phone stand **600** includes a plurality of directional speakers **612** which are placed on phone stand **600** and provides a focused audio area when audio signals are played using directional speakers **612**. In one embodiment, the focused audio area is a physical location or area where a user **101** is expected to be positioned in order to listen to the audio output of phone stand **600**. In one embodiment, phone stand **600** includes one or more additional speakers **614**, which may or may not be directional speakers. In one embodiment, speakers **614** includes non-directional speakers. In one embodiment, phone stand **600** uses directional speakers **612** for voice session **121** and audio session **141**. In one embodiment, phone stand **600** uses directional speakers **612** and optionally speakers **614** for audio session **141**. In one embodiment, phone stand **600** includes one or more microphones **624** to receive sound signals for processing voice session **121** and/or audio session **141**. A voice session, as used herein, refers to a span of time defined by a start marker (such as a start time or start command) and an end marker (such as an end time or an end command) during which voice signals are processed. An audio session, as used herein, refers to a span of time defined by a start marker (such as a start time or start command) and an end marker (such as an end time or an end command) during which non-voice signals are processed. The system controller **630** may be a computing device, as described below with reference to FIG. **2**.

In one embodiment, phone stand **600** includes a system controller **630**, which includes a hardware processor configured with processing capabilities and a storage for storing computer programming instructions, which when executed by the processor of system controller **630**, allows system controller **630** to control directional speakers **612**, speakers **614**, phone holder **634**, power module **632**, microphones **624** and local wireless network interface **626**. In one embodiment, system controller **630** interacts with phone **111** over one or more data communication sessions via local wireless network interface **626** to phone **111** to process voice session **121** and audio session **141**. A communication session, as used herein, refers to a series of interactions between two communication end points that occur during the span of a single connection.

In one embodiment, phone stand **600** connects to a data network **652**. In one embodiment phone **111** connects to data network **652**.

FIG. **2** illustrates an exemplary embodiment of hardware components of a computing device which can be used for a controller, a network computer, a server or a phone. In one embodiment, computing device **510** includes a hardware processor **511**, a network module, an output module **515**, an input module **517**, a storage **519**, or some combination thereof. In one embodiment, the hardware processor **511** includes one or more general processors, a multi-core processor, an application specific integrated circuit based processor, a system on a chip (SOC) processor, an embedded processor, a digital signal processor, or a hardware- or application-specific processor. In one embodiment, output module **515** includes or connects to a display for displaying video signals, images or text, one or more speakers to play sound signals, or a lighting module such as an LED. In one embodiment, output module **515** includes a data interface such as USB, HDMI, DVI, DisplayPort, thunderbolt or a wire-cable connecting to a display, or one or more speakers. In one embodiment, output module **515** connects to a display or a speaker using a wireless connection or a wireless data network. In one embodiment, input module **517** includes a physical or logical keyboard, one or more buttons, one or more keys, or one or more microphones. In one embodiment, input module **517** includes or connects to one or more sensors such as a camera sensor, an optical sensor, a night-vision sensor, an infrared (IR) sensor, a motion sensor, a direction sensor, a proximity sensor, a gesture sensor, or other sensors that is usable by a user to provide input to computing device **510**. In one embodiment, input module **517** includes a physical panel housing one or more sensors. In one embodiment, storage **519** includes a storage medium, a main memory, a hard disk drive (HDD), a solid state drive (SSD), a memory card, a ROM module, a RAM module, a USB disk, a storage compartment, a data storage component or other storage component. In one embodiment, network module **513** includes hardware, software, or a combination of hardware and software, to interface or connect to a wireless data network such as a cellular network, a mobile network, a Bluetooth network, a NFC network, a personal area network (PAN), a WiFi network, or a Li-Fi network. Storage **519** stores executable instructions, which when read and executed by the processor **511** of computing device **510**, implements one or more functionalities of the current invention.

FIGS. **3***a*-**3***b* illustrate exemplary embodiments of directional speakers of the phone stand according to the present invention. In one embodiment, directional speakers **612**

include a plurality of speakers or one or more speaker arrays. In one embodiment, directional speakers **612** includes two or more parametric speakers. In one embodiment, directional speakers **612** includes two or more small speakers. Each of the speakers of directional speakers **612** are positioned in a certain direction such that directional speakers **612** project sound to a small focused area **613** corresponding to a location where the head of user **101** is expected to be positioned in order to clearly hear sound produced by directional speakers **612**. In one embodiment, directional speakers **612** create a sound interference to aggregate the sound waves from the directional speakers **612** so that the sound is louder or amplified in the focused area **613**. In one embodiment, each of the speakers in directional speakers **612** is mounted in the phone stand **600** so that each speaker narrowly projects sound in the direction of the focused area **613**. In one embodiment, the focused area **613** is about 18-30 inches away from phone stand **600**. In one embodiment, the focused area **613** is about 6-15 inches above or below phone stand **600**. In one embodiment, the focused area **613** includes an area away from a dashboard, an area away from a passenger side compartment box, or an area behind the head rest of a seat in a vehicle. In one embodiment, the focused area **613** includes an area away from a laptop or a computer monitor. In one embodiment, the focused area **613** includes an area away from a piece of equipment, operator controls, or monitors.

Returning to FIG. **1**, in one embodiment, power module **632** includes a charging unit to charge phone **111**. In one embodiment, the charging unit includes a wireless charging unit or a charging connector. In one embodiment, power module **632** includes a battery. In one embodiment, power module **632** connects to an external power source.

In one embodiment, local wireless network interface **626** connects to one or more of a NFC network, a Bluetooth network, a PAN network, an 802.11 network, an 802.15 PAN network, a ZeeBee network a LiFi network, and a short distance wireless network connecting two close-by networking devices.

In one embodiment, data network **652** includes a cellular network, a mobile data network, a WiFi network, a LiFi network, a WiMAX network, an Ethernet, or any other data network.

In one embodiment, phone **111** can be a mobile phone, a cell phone, a smartphone, an office desk phone, a VoIP phone, a cordless phone, a professional phone used by a train operator, bus driver, or a truck driver.

In one embodiment, voice session **121** is a voice call session, a telephone call session, a teleconference session, a voice message exchange session, a VoIP call session, a voice over instant messaging (IM) session, a session with a voice assistant application such as Apple Siri, Google Now, Amazon Alexa, Microsoft Cortana, or other voice assistant. In one embodiment, voice session **121** is a voice recording session, a text to speech session, an audio book reading session, playing a podcast, or a voice announcement.

In one embodiment, audio session **141** includes a voice session, a music playing session, a session playing radio, a video session playing audio, a session where audio clip is played. In one embodiment, audio session **141** includes a plurality of combined voice sessions and other audio sessions.

In one embodiment, user **101** is a car driver, a bus driver, a vehicle passenger, a pilot, an operator operating a bus, a train, a truck, a ship, or a vehicle. In one embodiment, user **101** is an office clerk, a receptionist, or an office worker. In one embodiment, user **101** stays in a noisy environment where user **101** is to conduct a voice session **121** or audio session **141** with clarity.

FIG. **4** illustrates an exemplary embodiment of a process for receiving an incoming voice call or voice session according to the present invention. In one embodiment, phone **111** receives a voice session **121** request from a caller or establishes voice session **121** to another user. In one embodiment, phone **111** is configured to use phone stand **600** as a speakerphone for voice session **121**. In one embodiment, phone **111** sends an incoming session indication **222** to system controller **630**, which notifies the system controller **630** of an incoming voice session **121**. In one embodiment, system controller **630** receives incoming session indication **222** and announces the incoming session indication **222**. In one embodiment, in announcing the incoming session indication **222**, system controller **630** plays a ring tone using directional speakers **612**. In one embodiment, incoming session indication **222** includes a plurality of audio signals for a ring tone, and system controller **630** plays the plurality of audio signals of incoming session indication **222** over directional speakers **612**. In one embodiment, incoming session indication **222** includes a ring tone identity, and system controller **630** retrieves a ring tone matching the ring tone identity from a storage of phone stand **600**, and plays the retrieved ring tone over directional speakers **612**. In one embodiment, system controller **630** plays the ring tone using speakers **614**. In one embodiment, phone stand **600** includes an LED **622**, and system controller **630** lights up LED **652** as a notification of an incoming session.

In one embodiment, user **101** notices the announcement of incoming session indication **222** through lit-up LED **652**, or ring tone played on directional speakers **612** or speakers **614**. In one embodiment, user **101** responds to the indication **222** with a response **104** to accept, reject or disconnect voice session **121**. In one embodiment, the response **104** includes the user **101** speaking into microphones **624** or pressing a button **651** on phone stand **600**. In one embodiment, response **104** indicates an acceptance of the voice session **121**. In one embodiment, user **101** speaks "answer the call", "accept", "yes", "hello", or another spoken phrase to accept to voice session **121**. Microphones **624** captures sound signals corresponding to response **104** and sends response **104** to system controller **630**. In one embodiment, system controller **630** processes response **104** using natural language processing and recognizes the spoken words of user **101**. System controller **630** matches the spoken words to one or more pre-stored words or sequences of words in an ontology database (not shown) to determine that response **104** to indicates an acceptance of the voice session **121**. System controller **630** sends the acceptance in an incoming session response **224** message to phone **111**. In one embodiment, system controller **630** includes the sound signals of the response **104**, as captured by microphones **624**, into incoming session response **224**, and sends the incoming session response **224** to phone **111**. The phone **111** processes the sounds signals in the incoming session response **224** to determine if response **104** indicates an acceptance, a rejection or a disconnection of the voice session **121**. In one embodiment, system controller **630** sends response **104** to a voice process server **656** over data network **652** to determine if response **104** indicates an acceptance, a rejection or a disconnection of the voice session **121**.

In one embodiment, user **101** does not need to do anything to accept, decline or disconnect voice session **121**. Phone **111** automatically continues or discontinues voice session **121**. In one embodiment, phone **111** is configured to auto-

matically accept the voice session **121** after a pre-determined period of time, or after a pre-determined number of rings. In one embodiment, phone **111** receives a disconnect indication over the voice session **121**. In one embodiment, voice session **121** is a voice call and phone **111** receives a disconnect indication after the remote caller or system disconnects the voice call. In one embodiment, voice session **121** is to play a voice message and phone **111** discontinues voice session **121** after playing the voice message.

In one embodiment, the pressing of a button **651** indicates an acceptance of a voice call. System controller **630** detects the pressing of the button **651** and sends an incoming session response **224** indicating an acceptance of the voice session **121** to phone **111**.

In one embodiment, user **101** wants to decline or disconnect voice session **121**. In one embodiment, user **101** says "no", "decline", "hang up", "bye", "disconnect" or other word or word phrase to indicate rejection of voice session **121**. In one embodiment, microphones **624** captures sound signals corresponding to response **104**. In one embodiment, system controller **630** receives the captured sound signals from microphones **624** and processes the sound signals using natural language processing to determine that the response **104** indicates a rejection of voice session **121**. System controller **630** includes an indication to drop the voice session **121** in the incoming session response **224** and sends the incoming session response **224** to the phone **111**. In one embodiment, the indication includes a command, a message, a flag, an integer, or a tag. In one embodiment, system controller **630** sends captured sound signals corresponding to the response **104** to phone **111**, and the phone **111** then processes the sound signals to determine whether the response **104** indicates a rejection of the voice session **121**.

In one embodiment, the pressing of the button **651** declines a call. System controller **630** detects the pressing of the button **651** and sends an incoming session response **224** indicating a rejection of the voice session **121** to phone **111**.

In one embodiment, phone **111** receives incoming session response **224**. In one embodiment, phone **111** determines that the incoming session response **224** is a rejection of the voice session **121**, and in response, phone **111** rejects voice session **121**. In one embodiment, phone **111** rejects the voice session **121** by disconnecting the voice session **121**. In one embodiment, phone **111** sends a rejection indication over voice session **121** to the caller. In one embodiment, phone **111** determines that the incoming session response **224** is an acceptance of the voice session **121**, and in response, the phone **111** sends an acceptance indication over voice session **121** to the caller or the callee.

FIG. **5** illustrates an exemplary embodiment for a processing of audio signals received from the phone during a voice session according to the present invention. In this embodiment, phone **111** receives audio signals **222** over voice session **121**, established as described above with reference to FIG. **4**. Phone **111** sends audio signals **222** to phone stand **600**. In one embodiment, system controller **630** receives audio signals **222** from phone **111**. System controller **630** processes audio signals **222** and separates audio signals **222** into speech signals **726** and non-speech signals **724**. In one embodiment, audio signals **222** includes a first indication labeling a first portion of the audio signals **222** as speech signals **726** and a second indication labeling a second portion of the audio signals **222** as non-speech signals **724**. In one embodiment, audio signals **222** includes a channel for speech signals **726** and a channel for non-speech signals **724**. In one embodiment, system controller **630** identifies audio signals **222** as speech signals **726** and determines there are no non-speech signals **724** in the audio signals **222**. In one embodiment, system controller **630** includes one or more voice call output mixing attributes **721**. System controller **630** generates mixed signals **722** by combining speech signals **726** and non-speech signals **724** according to output mixing attributes **721**. In one embodiment, output mixing attributes **721** includes one or more attributes for increasing the volume of speech signals **726**, for reducing the volume of non-speech signals **724**, for eliminating non-speech signals **724**, for maintaining a volume of non-speech signals **724** if speech signals **726** are absent, for eliminating non-speech signals **724** if speech signals **726** are present, or some combination thereof. System controller **630** generates mixed signals **722** according to the output mixing attributes **721** such that the clarity for speech signals **724** is increased. Upon generating mixed signals **722**, system controller **630** plays mixed signals **722** via directional speakers **612**. In one embodiment, output mixing attributes **721** includes a mixed signal volume adjustment attribute. In one embodiment, system controller **630** adjusts the volume of mixed signals **722** according to the mixed signal volume adjustment attribute such that the volume is not too loud for user **101**, who is assumed to be positioned in the focused area of directional speakers **612** and listening to the sound of mixed signals **722**. In one embodiment, output mixing attributes **721** adjusts volume of speech signals **726** higher than non-speech signals **724**. In one embodiment, mixed signals **722** are sent over to directional speakers **612** such that speech signals **726** is played louder than non-speech signals **724**. In one embodiment, speech signals in mixed signals **722** are sent over to directional speakers **612** and non-speech signals in mixed signals **722** are sent over to speakers **614**.

In one embodiment, phone **111** generates audio signals **222** to include: a first indication labeling a first portion of the audio signals **222** as speech signals **726** or a first channel for speech signals **726**; and a second an indication labeling a second portion of the audio signals **222** as non-speech signals **724** or a second channel for non-speech signals **724**. In one embodiment, phone **111** receives audio signals **222** from voice session **121**, and the received audio signals **222** includes: a first indication labeling a first portion of the audio signals **222** as speech signals **726** or a first channel for speech signals **726**; and a second indication labeling a second portion of audio signals **222** as non-speech signals **724** or a second channel for non-speech signals **724**. In one embodiment audio signals **222** includes a Dolby multi-channel format for encoding speech signals **726** into a dialogue channel and non-speech signals **724** into a non-dialogue channel. In one embodiment, the system controller **630** plays the dialogue channel over the directional speakers **612** and plays the non-dialogue channel over the speakers **614**. In one embodiment, audio signals **222** includes a different multi-channel or multiple sub-sessions formats to encode speech signals **726** and non-speech signals **724**.

FIG. **6** illustrates an exemplary embodiment of a process for sending audio signals to the phone according to the present invention. In this embodiment, user **101** speaks into microphones **624** during voice session **121**. In one embodiment, microphones **624** capture the user's speech as sound signals **747** and sends the sound signals **747** to system controller **630**. System controller **630** processes sound signals **747** and separates sound signals **747** into speech signals **746** and non-speech signals **744**. In one embodiment, system controller **630** stores or has access to a storage with one or more voice call input mixing attributes **741**. System con-

troller **630** generates mixed signals **742** by combining speech signals **746** and non-speech signals **744** according to input mixing attributes **741**. In one embodiment, input mixing attributes **741** includes one or more attributes for increasing the volume of speech signals **746**, for reducing the volume of non-speech signals **744**, for eliminating non-speech signals **744**, for eliminating non-speech signals **744** if speech signals **746** are absent, for eliminating non-speech signals **746** if speech signals **746** are present, or some combination thereof. System controller **630** generates mixed signals **742** according to the input mixing attributes **741** such that the clarity of speech signals **746** are increased. Upon generating mixed signals **742**, system controller **630** sends mixed signals **742** to phone **111**. In one embodiment, phone **111** receives mixed signals **742** and sends mixed signals **742** over voice session **121**. In one embodiment, mixed signals **742** includes a first indication labeling a first portion of mixed signals **742** as speech signals **746** and a second indication labeling a second portion of mixed signals **742** as non-speech signals **744**. In one embodiment, mixed signals **742** includes a multi-channel format to encode speech signals **746** and non-speech signals **744**. In one embodiment, sound signals **747** includes only speech signals **746**.

In one embodiment, microphones **624** include a directional microphone facing an assumed position of user **101**, or a particular microphone closer to the assumed position of the user **101** than the other microphones. System controller **630** identifies the speech signals **746** that are in sound signals **747** received from the directional or particular microphone. In one embodiment, microphones **624** include a particular microphone located further away from the assumed position of the user **101**, and optionally where the particular microphone is shielded from sound made by user **101**. System controller **630** identifies the non-speech signals **744** in sound signals **747** received from the particular microphone.

In one embodiment, input mixing attributes **741** includes a mixed signal volume adjustment attribute **742**. In one embodiment, system controller **630** increases the volume of mixed signals **742** prior to sending mixed signals **742** to phone **111** according to the mixed signal volume adjustment attribute **742**.

FIG. **7** illustrates an exemplary embodiment of a process for interworking with an audio-based phone application according to the present invention. In this embodiment, phone **111** executes an audio application ("app") **114**. In one embodiment, app **114** includes a smartphone app, a tablet app, an iOS™ app, an Android™ app, a Windows™ app, an Apple™ CarPlay™ app, a Google™ Android Auto app, or any app of a mobile, in-car, or embedded system. In one embodiment, app **114**, when executed by phone **111**, conducts an audio session **141**. In one embodiment, app **114** includes a media player, a music player, a video player, a voice assistant, a phone dialer, a voice messenger, a voice mail controller, a VoIP client, a voice chat, teleconferencing or group conferencing functionality, an audio-book reader, a radio, or text-to-speech functionality. In one embodiment, audio app **114** starts an audio session **141**, and notifies phone **111** to start audio session **141**. In one embodiment, phone **111** sends an audio session indication **242** message to phone stand **600**. In one embodiment, audio session indication **241** includes a start marker. In one embodiment, audio session indication **242** includes a speaker choice indicating either a choice of directional speakers **612** or speakers **614** are to be used for the audio session **141**. In one embodiment, audio session indication **242** includes one or more app audio output mixing attributes **761** for mixing audio signals to be outputted by the app **114** and optionally one or more app audio input mixing attributes **762** for mixing of audio signals inputted to the app **114**. In one embodiment, system controller **630** receives audio session indication **242**, optionally retrieves and stores speaker choice indication, and optionally retrieves and stores app audio input mixing attributes **762** and app audio output mixing attributes **761**. In one embodiment, system controller **630** stores or has access to storage with app audio input mixing attributes **762** and app audio output mixing attributes **761**. Phone **111** includes an audio input mixing attribute identity in audio session indication **242** to allow system controller **630** to select the app audio input mixing attributes **762** or app audio output mixing attributes **761** based on the identity in audio session indication **242**. In one embodiment, system controller **630** uses app audio output mixing attributes **761** with speakers **614** and directional speakers **612**, as described below. In one embodiment, system controller **630** uses app audio input mixing attributes **762** with microphones **624**, as described below.

In one embodiment, audio app **114** instructs phone **111** to end audio session **141**, and in response, phone **111** sends audio session indication **242** to include an ending indication. In one embodiment, the indication comprises a command, a message, a flag, an integer, or a tag. In one embodiment, system controller **630** receives the ending indication, and in response, stops applying mixing the audio signals to be outputted by the app **114** or inputted to the app **114**.

In one embodiment, system controller **630** announces audio session indication **242** using speakers **614**, directional speaker **612**, or an LED light.

FIG. **8** illustrates an exemplary embodiment of a process for processing audio signals received from an audio-based phone app according to the present invention. In this embodiment, audio app **114** conducts an audio session **141**, of which the system controller **630** of phone stand **600** is notified by phone **111**, as described above with reference to FIG. **7**. In one embodiment, audio app **114** generates app audio signals **244** during audio session **141**. Audio app **114** sends phone **111** of app audio signals **244**. In one embodiment, phone **111** sends app audio signals **244** to system controller **630**. System controller **630** receives app audio signals **244**, and processes app audio signals **244** according to previously stored app audio output mixing attributes **761**. In one embodiment, output mixing attributes **761** contain an attribute value indicating that no processing of app audio signals **244** is to be performed by the system controller **630**. System controller **630** plays app audio signals **244** over directional speakers **612** or speakers **614** according to output mixing attributes **761**.

In one embodiment, output mixing attributes **761** contains an attribute value indicating that app audio signals **244** are to be separated into speech signals **726** and non-speech signals **724**. Based on the output mixing attributes **761**, system controller **630** processes app audio signals **244** and separates audio signals **244** into speech signals **726** and non-speech signals **724**. System controller **630** then combines speech signals **726** and non-speech signals **724** according to output mixing attributes **761** to generate mixed signals **722**. In one embodiment, output mixing attributes **761** includes one or more attributes for increasing the volume of speech signals **726**, for reducing the volume of non-speech signals **724**, for eliminating non-speech signals **724**, for maintaining volume of non-speech signals **724** if speech signals **726** are absent, for eliminating non-speech signals **724** if speech signals **726** are present, or some combination thereof. In one embodiment, system controller **630** generates

mixed signals **722** according to the output mixing attributes **761** such that the clarity of speech signals **724** or the audio quality for non-speech signals **726** is increased. In one embodiment, system controller **630** plays mixed signals **722** over directional speakers **612** or speakers **614** as specified by the output mixing attributes **761**. In one embodiment, system controller **630** plays mixed signals **722** using directional speakers **612** when system controller **630** determines that the speech signals **726** in the mixed signals **722** are of better quality than the non-speech signals **724**. In one embodiment, system controller **630** plays mixed signals **722** using speakers **614** when system controller **630** determines that the non-speech signals **724** in the mixed signals **722** are of better quality than the speech signals **726**. In one embodiment, system controller **630** plays the speech signals **726** in mixed signals **722** using directional speakers **612**. In one embodiment, system controller **630** plays the non-speech signals **724** in mixed signals **722** using speakers **614**.

In one embodiment, system controller **630** determines directional speakers **612** are to be used to play mixed signals **722**. In one embodiment, output mixing attributes **761** includes a volume adjustment attribute. System controller **630** adjusts the volume of mixed signals **722** or app audio signals **244** according to the volume adjustment attribute so that the volume is not too loud for user **101**, who is assumed to be positioned in the focused area of directional speakers **612**.

In one embodiment, app audio signals **244** include: a first indication labeling a first portion of app audio signals **244** as speech signals **726** or a first channel for speech signals **726**; and a second indication labeling a second portion of app audio signals **244** as non-speech signals **724** or a second channel for non-speech signals **724**. In one embodiment, phone **111** modifies app audio signals **244** to include such indications or channels. In one embodiment, audio signals **244** received from audio session **141** include such indications or channels. In one embodiment, audio app **144** generates app audio signals **244** to include such indications or channels. In one embodiment, app audio signals **244** uses Dolby multi-channel format to indicate speech signals **726** in a dialogue channel and non-speech signals **724** in a non-dialogue channel. In one embodiment, app audio signals **244** uses a different channel or sub-session separation for speech signals **726** and non-speech signals **724**.

FIG. **9** illustrates an exemplary embodiment of a process for sending audio signals to an audio-based phone app according to the present invention. In this embodiment, during an audio session **141**, audio app **114** sends an audio input request **142** to phone **111**, and in response, the phone **111** forwards audio input request **142** to system controller **630**. In one embodiment, system controller **630** receives audio input request **142** and instructs microphones **624** to capture sound signals **747**. In one embodiment, system controller **630** receives captured sound signals **747** from microphones **624**. System controller **630** processes sound signals **747** according to app audio input mixing attributes **762** to generate mixed signals **742**. In one embodiment, input mixing attributes **762** includes attribute values that indicate that no processing of the sound signals **747** is to be performed. System controller **630** copies sound signals **747** to mixed signals **742**. In one embodiment, input mixing attributes **762** contain attribute values that indicate that the sound signals **747** are to be separated into speech signals and non-speech signals. System controller **630** processes sound signals **747** to separate sound signals **747** into speech signals **746** and non-speech signals **744**. System controller **630** then combines speech signals **746** and non-speech signals **744** according to the input mixing attributes **762** to generate mixed signals **742**. In one embodiment, input mixing attributes **762** includes one or more attributes for increasing the volume of speech signals **746**, for reducing the volume of non-speech signals **744**, for eliminating non-speech signals **744**, for eliminating non-speech signals **744** if speech signals **746** are absent, and for eliminating non-speech signals **724** if speech signals **746** are present, or some combination thereof. In one embodiment, system controller **630** generates mixed signals **742** such that the clarity of speech signals **746** or the quality of non-speech signals **744** in sound signals **747** are increased.

In one embodiment, upon generating mixed signals **742**, system controller **630** sends mixed signals **742** to phone **111**. In one embodiment, phone **111** sends mixed signals **742** to audio app **114**.

The present invention can take the form of an entirely hardware embodiment, an entirely software embodiment or an embodiment containing both hardware and software elements. In a preferred embodiment, the present invention is implemented in software, which includes but is not limited to firmware, resident software, microcode, etc.

Furthermore, the present invention can take the form of a computer program product accessible from a computer usable or computer readable storage medium providing program code for use by or in connection with a computer or any instruction execution system. For the purposes of this description, a computer usable or computer readable storage medium can be any apparatus that can contain, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device. The medium can be an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system (or apparatus or device) or a propagation medium. Examples of a computer-readable medium include a semiconductor or solid state memory, magnetic tape, a removable computer diskette, a random access memory (RAM), a read-only memory (ROM), a rigid magnetic disk and an optical disk. Current examples of optical disks include compact disk-read only memory (CD-ROM), compact disk-read/write (CD-R/W) and DVD. A computer readable storage medium, as used herein, is not to be construed as being transitory signals per se, such as radio waves or other freely propagating electromagnetic waves, electromagnetic waves propagating through a waveguide or other transmission media (e.g., light pulses passing through a fiber-optic cable), or electrical signals transmitted through a wire.

A data processing system suitable for storing and/or executing program code will include at least one processor coupled directly or indirectly to memory elements through a system bus. The memory elements can include local memory employed during actual execution of the program code, bulk storage, and cache memories which provide temporary storage of at least some program code in order to reduce the number of times code must be retrieved from bulk storage during execution.

Input/output or I/O devices (including but not limited to keyboards, displays, point devices, etc.) can be coupled to the system either directly or through intervening I/O controllers.

Network adapters may also be coupled to the system to enable the data processing system to become coupled to other data processing systems or remote printers or storage devices through intervening private or public networks. Modems, cable modem and Ethernet cards are just a few of the currently available types of network adapters.

The flowchart and block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods and computer program products according to various embodiments of the present invention. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of code, which comprises one or more executable instructions for implementing the specified local function(s). It should also be noted that, in some alternative implementations, the functions noted in the block may occur out of the order noted in the figures. For example, two blocks shown in succession may, in fact, be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts, or combinations of special purpose hardware and computer instructions.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

Although the present invention has been described in accordance with the embodiments shown, one of ordinary skill in the art will readily recognize that there could be variations to the embodiments and those variations would be within the spirit and scope of the present invention. Accordingly, many modifications may be made by one of ordinary skill in the art without departing from the spirit and scope of the appended claims.

What is claimed is:

1. A phone stand, comprising:

a phone holder for coupling to a phone, the phone for conducting a voice session and an audio session;

a plurality of microphones physically separated from the phone, comprising a particular microphone closer to a location where a user is expected to be positioned than other microphones of the plurality of microphones;

a system controller physically separated from the phone, configured to:

(a) receive sound signals from at least the particular microphone, the sound signals comprising the user's speech and audio signals from the audio session;

(b) separate the sounds signals into speech signals and non-speech signals;

(c) obtain one or more input mixing attributes from the phone for the speech signals and the non-speech signals;

(d) modify the speech signals and the non-speech signals based on the one or more input mixing attributes;

(e) generate mixed signals by combining the modified speech signals and the modified non-speech signals; and

(f) send the mixed signals to the phone for input into the voice session.

2. The phone stand of claim **1**, wherein the modify (d) comprises:

(d1) identify speech signals in the sound signals from the particular microphone;

(d2) identify non-speech signals in the sound signals from the least one of the other microphones; and

(d3) modify the speech signals and the non-speech signals based on the one or more input mixing attributes.

3. The phone stand of claim **1**, wherein the phone stand and the plurality of microphones reside within a vehicle.

4. The phone stand of claim **1**, wherein the one or more input mixing attributes comprise one or more of the following: increasing a volume of the speech signals; reducing a volume of the non-speech signals; and eliminating the non-speech signals.

5. The phone stand of claim **1**, wherein the particular microphone is a directional microphone facing the location where the user is expected to be positioned.

6. The phone stand of claim **1**, wherein the receive (a) and the obtain (c) comprise:

(a1) receive an audio session indication message from the phone, the audio session indication message comprising an input mixing attribute identity associated with the audio session;

(a2) instruct the plurality of microphones to capture the sound signals;

(a3) receive the sound signals from the particular microphone and at least one of the other microphones; and

(c1) retrieve, from the phone, the one or more input mixing attributes associated with the input mixing attribute identity for mixing audio signals to be inputted to the voice session.

7. The phone stand of claim **6**, further comprising one or more speakers, wherein the system controller is further configured to:

output the audio signals from the audio session over the one or more speakers, wherein the particular microphone and the at least one of the other microphones capture the sounds signals output from the one or more speakers.

8. A method for processing audio signals of an audio session to a phone, comprising:

(a) receiving sound signals comprising a user's speech and the audio signals of the audio session, by a system controller of a phone stand from a particular microphone of a plurality of microphones of the phone stand, the particular microphone being closer to a location where the user is expected to be positioned than other microphones of the plurality of microphones, the phone stand further comprising a phone holder for coupling to the phone, the phone for conducting a voice session and the audio session, wherein the plurality of microphones and the system controller are physically separated from the phone;

(b) separating, by the system controller, the sounds signals into speech signals and non-speech signals;

(c) obtaining, by the system controller from the phone, one or more input mixing attributes for the speech signals and the non-speech signals;

(d) modifying, by the system controller, the speech signals and the non-speech signals based on the one or more input mixing attributes;

(e) generating, by the system controller, mixed signals by combining the modified speech signals and the modified non-speech signals; and

(f) sending, by the system controller, the mixed signals to the phone for input into the voice session.

9. The method of claim **8**, wherein the modifying (d) comprises:

(d1) identifying speech signals in the sound signals from the particular microphone;

(d2) identifying non-speech signals in the sound signals from the least one of the other microphones; and

(d3) modifying the speech signals and the non-speech signals based on the one or more input mixing attributes.

10. The method of claim **8**, wherein the phone stand and the plurality of microphones reside within a vehicle.

11. The method of claim **8**, wherein the one or more input mixing attributes comprise one or more of the following: increasing a volume of the speech signals; reducing a volume of the non-speech signals; and eliminating the non-speech signals.

12. The method of claim **8**, wherein the particular microphone is a directional microphone facing the location where the user is expected to be positioned.

13. The method of claim **8**, wherein the receiving (a) and the obtaining (c) comprise:

(a1) receiving an audio session indication message from the phone, the audio session indication message comprising an input mixing attribute identity associated with the audio session;

(a2) instructing the plurality of microphones to capture the sound signals;

(a3) receiving the sounds signals from the particular microphone and at least one of the other microphones; and

(c1) retrieving, from the phone, the one or more input mixing attributes associated with the input mixing attribute identity for mixing audio signals to be inputted to the voice session.

14. The method of claim **13**, wherein the phone stand further comprises one or more speakers, wherein the method further comprises:

outputting the audio signals from the audio session over the one or more speakers, wherein the particular microphone and the at least one of the other microphones capture the sounds signals output from the one or more speakers.

15. A non-transitory computer readable medium embodied in a phone stand, the medium comprising computer readable program code embodied therein, wherein when executed by a processor causes the processor to:

(a) receive sound signals from a particular microphone of a plurality of microphones of the phone stand, the sound signals comprising a user's speech and audio signals from an audio session, the particular microphone being closer to a location where the user is expected to be positioned than other microphones of the plurality of microphones, the phone stand further comprising a phone holder for coupling to the phone, the phone for conducting a voice session and the audio session, wherein the plurality of microphones and the processor are physically separated from the phone;

(b) separate the sounds signals into speech signals and non-speech signals;

(c) obtain one or more input mixing attributes from the phone for the speech signals and the non-speech signals;

(d) modify the speech signals and the non-speech signals based on the one or more input mixing attributes;

(e) generate mixed signals by combining the modified speech signals and the modified non-speech signals; and

(f) send the mixed signals to the phone for input into the voice session.

16. The medium of claim **15**, wherein the modify (d) comprises:

(d1) identify speech signals in the sound signals from the particular microphone;

(d2) identify non-speech signals in the sound signals from the least one of the other microphones; and

(d3) modify the speech signals and the non-speech signals based on the one or more input mixing attributes.

17. The medium of claim **15**, wherein the phone stand and the plurality of microphones reside within a vehicle.

18. The medium of claim **15**, wherein the one or more input mixing attributes comprise one or more of the following: increasing a volume of the speech signals; reducing a volume of the non-speech signals; and eliminating the non-speech signals.

19. The medium of claim **15**, wherein the particular microphone is a directional microphone facing the location where the user is expected to be positioned.

20. The medium of claim **15**, wherein the receive (a) and the obtain (c) comprise:

(a1) receive an audio session indication message from the phone, the audio session indication message comprising an input mixing attribute identity associated with the audio session;

(a2) instruct the plurality of microphones to capture the sound signals;

(a3) receive the sound signals from the particular microphone and at least one of the other microphones; and

(c1) retrieve, from the phone, the one or more input mixing attributes associated with the input mixing attribute identity for mixing audio signals to be inputted to the voice session.

21. The medium of claim **20**, wherein the phone stand further comprises one or more speakers, wherein the system controller is further configured to:

output the audio signals from the audio session over the one or more speakers, wherein the particular microphone and the at least one of the other microphones capture the sounds signals output from the one or more speakers.

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