OUTPUT AWARE VOLUME CONTROLS

ABSTRACT

A device is described that determines when an audio system has been connected via an audio output port of the device, and in response automatically determines a volume level to use for outputting requested audio based on context of the device, such as context that indicates a type of audio system having been connected. For example, the type of audio system may be headphones or an external speaker or other playback system. The device adjusts its volume level settings to the determined level so as to output the audio in accordance with the context.

BACKGROUND

Devices such as mobile phones, tablets, and other computing devices may have distinct volume settings for (1) when sound is playing through the device's built-in speaker and (2) when something is plugged into the device's headphone jack. This may allow users to listen to the built-in speaker at one volume level, but maintain a different volume level when listening via the headphone jack without having to manually adjust the volume. One of the primary use cases of this feature may be to allow people to turn up the volume on their device's built-in speaker, but maintain a safe listening volume when they plug in headphones.

Although some devices may detect whether something is plugged into a headphone jack, the devices may not necessarily differentiate between what items are plugged into the headphone jack (e.g., whether headphones or an external playback system/speaker are plugged into the headphone jack). When a user connects a playback system other than headphones to the headphone jack of such a device, the user may choose to turn the volume control of the device to a maximum level (e.g., 100%) and attenuate the volume level of the audio output using the volume control of the playback system. If the user later unplugs the playback system, the device may revert back to its built-in speaker's volume level. Subsequently, if the user plugs headphones into the headphone jack rather than the playback system that was previously plugged into the headphone jack, the device may automatically revert back to the maximum volume level that the device was previously set to when the playback system was being used. Unfortunately, automatically setting the volume level of the device to a maximum level when headphones are plugged in may cause the audio output from the headphones to be too loud for the user to
withstand. This unexpected and sudden high volume audio output may cause hearing damage or at a minimum, be unpleasant to the user.

DESCRIPTION

In general, this disclosure describes a system that provides automatic adjustment to discrete volume levels for an audio output port of a device depending on whether the audio output port is connected to headphones or an external speaker. A device automatically determines whether the device is connected to headphones or external speakers and adjusts the volume level accordingly to prevent unexpected loud bursts of sound from headphones. The device determines when an audio system has been connected via an audio output port of the device, and in response automatically determines a volume level to use for outputting requested audio based on context of the device, such as context that indicates a type of audio system having been connected. The device adjusts its volume level settings so as to output the audio in accordance with the determined volume level. Accordingly, the system may ensure that audio output is provided at a safe listening level whether the audio output is played from headphones or from an external speaker system that requires the device to provide the audio output at maximum volume (e.g., ideal for best signal quality) letting the user attenuate the volume level from the external speaker system using the speaker system's controls.

Throughout the disclosure, examples are described where devices and systems analyze contextual information associated with users and their devices; it should be understood that the devices and systems only analyze such contextual information if the devices and systems receive explicit permission from the users to analyze the information. For example, in situations discussed below in which a device or system analyzes contextual information, the user may be provided with an opportunity to control whether the device and/or system can collect and make use of the contextual information. Additionally, certain data may be treated in one or more ways before the devices and systems store or use the contextual information so that any personally-identifiable information is removed before storage or use. As such, the individual users maintain control over how contextual information is collected about the user and how the information is used by the device and/or system.

Consider the example system 1 shown in FIG. 1 which is configured to provide output-aware volume controls in accordance with the techniques described herein. System 1 includes devices 10A–10N (collectively, “devices 10”), any of which may be connected to audio
headphones 18 or playback system 20 by audio cables 22. Although described as being implemented by devices 10, in some examples the techniques described herein could be implemented as part of any combination of one or more devices or servers communicating across a network (not shown).

FIG. 1 illustrates how any of devices 10 may be connected to audio headphones 18 or playback system 20, although typically not all devices 10 would be connected to audio headphones 18 or playback system 20 at the same time.

Devices 10 represent any type of computing device or other device that supports sound output. Examples of devices 10 include mobile phones, tablet computers, compact disc players, cassette tape players, wearable devices (e.g., computerized eyewear, wristwatches, and fitness trackers), laptop computers, and automobiles. Additional examples of device 10 include non-mobile devices, such as desktop computers, servers, televisions, home automation devices, set-top-boxes, media players, and the like. Device 10 can be a personal, a corporate, an organizational, or a government owned device. Devices 10 may be made by any device
manufacturer that creates hardware with headphone ports and microphones, and may operate using a software platform or operating system that supports sound with a headphone jack, for example.

Audio headphones 18 are audio headphones that may couple to an audio output port of any of devices 10. In some examples, audio headphones 18 may be wireless headphones that connect to devices 10 via a wireless communication protocol (e.g., Bluetooth®). Playback system 20 may be any kind of external playback system/speaker, such as a high fidelity (hifi) sound system, portable speaker, cassette adapter (which plays audio through car speakers), for example. Playback system 20 may likewise wirelessly connect to devices 10 in some examples. In these examples, a wireless link may take the place of audio cables 22.

Audio output port 14 of device 10A allows an audio cable 22 of audio headphones 18 or playback system 20 to be connected to device 10A. Audio signals generated by device 10A may then be sent to a connected one of audio headphones 18 or playback system 20 via one of audio cables 22. Audio output port 14 may be a 3.5mm (1/8 inch) jack port, for example, or other size such as 2.5 mm, 6.5 mm, 8 mm. Typically, a device 10 will have a single audio output port 14, to which only one of audio headphones 18 or playback system 20 may be coupled at a given time. The audio cable 22 of audio headphones 18 is shown in FIG. 1 as a dashed line to indicate this relationship. In some examples, audio output port 14 may be a wireless audio output port configured to output audio signals wirelessly to devices 10.

Volume control module 12 may be a part of an operating system or platform of device 10A or may be a part of or subcomponent of an application executing at device 10A. Operation of volume control module 12 will be described with respect to device 10A for purposes of example, although devices 10B–10D may also include a similar volume control module 12.

When volume control module 12 determines that an audio system has been connected via audio output port 14, volume control module 12 may automatically determine a volume level to use for outputting requested audio based on a context of device 10A and adjust a volume level at which device 10A will output the audio to match the determined volume level. Volume control module 12 may store to volume settings 16 data indicating a pre-defined volume level at which device 10A should output audio for each detected state (e.g., headphones in, playback system with no headphones). For example, the volume level set for the “headphones” state may be lower than a volume level set for the “playback system” state. The pre-defined volume levels of
volume settings 16 may be configured at a default volume level by a manufacturer of devices 10, and may in some examples be configurable by a user of devices 10. In response to determining that a certain type of audio system such as audio headphones 18 or playback system 20 has been connected via audio output port 14, volume control module 12 may consult volume settings 16 and determine the volume level based on volume settings 16.

Volume control module 12 may be configured to assess context of device 10A to determine a volume level at which to play requested audio. In response to determining that an audio listening device such as headphones 18 or playback system 20 has been connected to device 10A (wirelessly or via audio output port 14), volume control module 12 may use any of various techniques to determine whether an audio listening device 20 connected to device 10A by audio output port 14 is a headphone device or an external speaker device. For example, volume control module 12 may cause device 10A to emit a short audio fingerprint when a connection is plugged into or out of audio output port 14 or when the volume setting of device 10A is manually changed. In this example, in some aspects the audio fingerprint could be high frequency and not audible to humans, such as supersonic audio. In other aspects, the audio fingerprint could be audible to let the user know device 10A is determining what it is plugged into. Volume control module 12 of device 10A may then use a built-in microphone to listen for the audio fingerprint. If volume control module 12 detects the audio fingerprint via the microphone of device 10A, volume control module 12 determines the device is connected to an external speaker (e.g., playback system 20). If volume control module 12 does not the audio fingerprint via the microphone of device 10A, volume control module 12 determines the device is connected to headphones (e.g., audio headphones 18). Volume control module 12 then changes volume states to correspond to the correct output device (headphones or speakers). In other examples, volume control module 12 may be configured to include other context of device 10A in determining a volume level at which to play requested audio.

In this way, instead of requiring the user to manually adjust the volume level to compensate for listening on audio headphones 18 versus an external speaker system such as playback system 20, devices 10 store discrete volume settings 16 for each situation and automatically adjusts the volume based on the stored volume settings 16 after determining what type of equipment is plugged in to the device. Devices 10 do not require the user to manually select the system the user is listening on. Instead, devices 10 may, for example, use an onboard
microphone to analyze audio cues and make an intelligent decision about the situation of the user of devices 10.

The techniques described herein may include one or more advantages. For example, the techniques of this disclosure may eliminate the need for a user to manage different volume settings, and prevent the device from accidentally projecting audio output at a high level volume, from headphones, while allowing the user to enjoy the convenience of having the device automatically output a strong signal when playing on an external speaker system. The techniques described herein may not require changes to the hardware of existing devices and instead may only require software and/or firmware changes. The techniques of this disclosure may avoid the need to build a device with multiple physical outputs. That is, rather than designate one output as the headphone output and another as an external speaker output, the device may include a single output and automatically determine whether headphones or an external speaker system are connected to the output and differentiate the volume level of audio output accordingly.