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Sleep and Wake Commands for Voice-Activated Devices

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Abstract:

Voice-activated devices continue to increase in popularity, availability, and functionality. To use a voice-activated device, a user will speak a particular keyword or hot word. In order to respond to a command at all times, the voice-activated device actively monitors the surrounding environment for the keyword or hot word using a microphone or other device, which means that the microphone of the voice-activated device hears all sound received while active. Although active monitoring may increase user interaction or satisfaction with the voice-activated device, audio monitoring may raise privacy concerns. To address these concerns, voice-activated devices can be equipped with a deep-sleep or suspended mode. Upon receiving a deep-sleep command, the voice-activated device can deactivate microphones or other devices capable of recording audio sound and disconnect itself from the Internet. To exit the deep-sleep or suspended mode, the voice-activated device may respond to a particular sound combination received by an audio transducer capable of receiving, but not recording, simple sound. Having received the exit deep-sleep sound combination, the voice-activated device can confirm that the user wants the voice-activated device to begin actively monitoring audio in the surrounding environment.

Keywords:

Smart device, WiFi, Bluetooth, Internet-of-Things, voice-activated, assistant, audible command, voice, voice activation, electronic assistant, smart home, automation, privacy, hacking, hack, hacker, voice recognition, security, sleep mode.

Background:

As the Internet-of-Things expands, smart devices continue to proliferate. Internet-connected thermostats, appliances, vehicles, lights, and machines are found in all areas of life, including home, work, business, recreation, and school. In particular, many voice-activated smart devices respond to audible commands. To use a voice-activated device, a user will speak a particular keyword or hot word. Upon receiving the keyword, the voice-activated device enters a command-reception or instruction-receipt mode. The user may issue instructions, commands, or make requests of the voice-activated device. In some circumstances, a manufacturer, a user, a school, a business, or other entity may prefer a deep-sleep or suspended command that will deactivate the active audio monitoring and disconnect the voice-activated device from the Internet or other communication network for privacy or other reasons.

Description:

Voice-activated devices continue to increase in popularity, availability, and functionality. To use a voice-activated device, a user will speak a particular keyword or hot word. In order to respond to a command at all times, the voice-activated device actively monitors the surrounding environment for the keyword or hot word using a microphone or other device, which means that the microphone of the voice-activated device hears all sound received. Although active monitoring may increase user interaction or satisfaction with the voice-activated device, audio monitoring may raise privacy concerns. To address these concerns, voice-activated devices can be equipped with a deep-sleep or suspended mode. Upon receiving a deep-sleep command, the voice-activated device can deactivate microphones or other devices capable of recording audio sound and disconnect itself from the Internet. To exit the deep-sleep or suspended mode, the voice-activated device may respond to a particular sound combination received by an audio

transducer capable of receiving, but not recording, simple sound. Having received the exit deep-sleep sound combination, the voice-activated device can confirm that the user wants the voice-activated device to begin actively monitoring audio in the surrounding environment.

Smart devices include things like thermostats, home assistants, ovens, refrigerators, cameras, lights, switches, security systems, monitors, appliances, mobile phones, tablets, or home theater components. A smart device can be directly connected to the Internet or indirectly connected to the Internet via a communication hub. The smart devices can be accessed and manipulated using a web browser, an application on a mobile device, a local remote, or programing system (*e.g.*, voice commands, home automation systems). The smart devices can also connect and interact with one another. For example, a home theater system that is turning on could send a signal that instructs the lights in the room to dim after a certain amount of time.

Smart devices include voice-activated devices that respond to voice commands or instructions. For example, Figure 1 shows smart devices in a kitchen, such as a thermostat, home assistant, slow-cooker appliance, oven, microwave, and refrigerator. Any one of these smart devices could be a voice-activated device and include a microphone or other device for receiving voice commands, which is represented by the “listening” bubbles of each device.

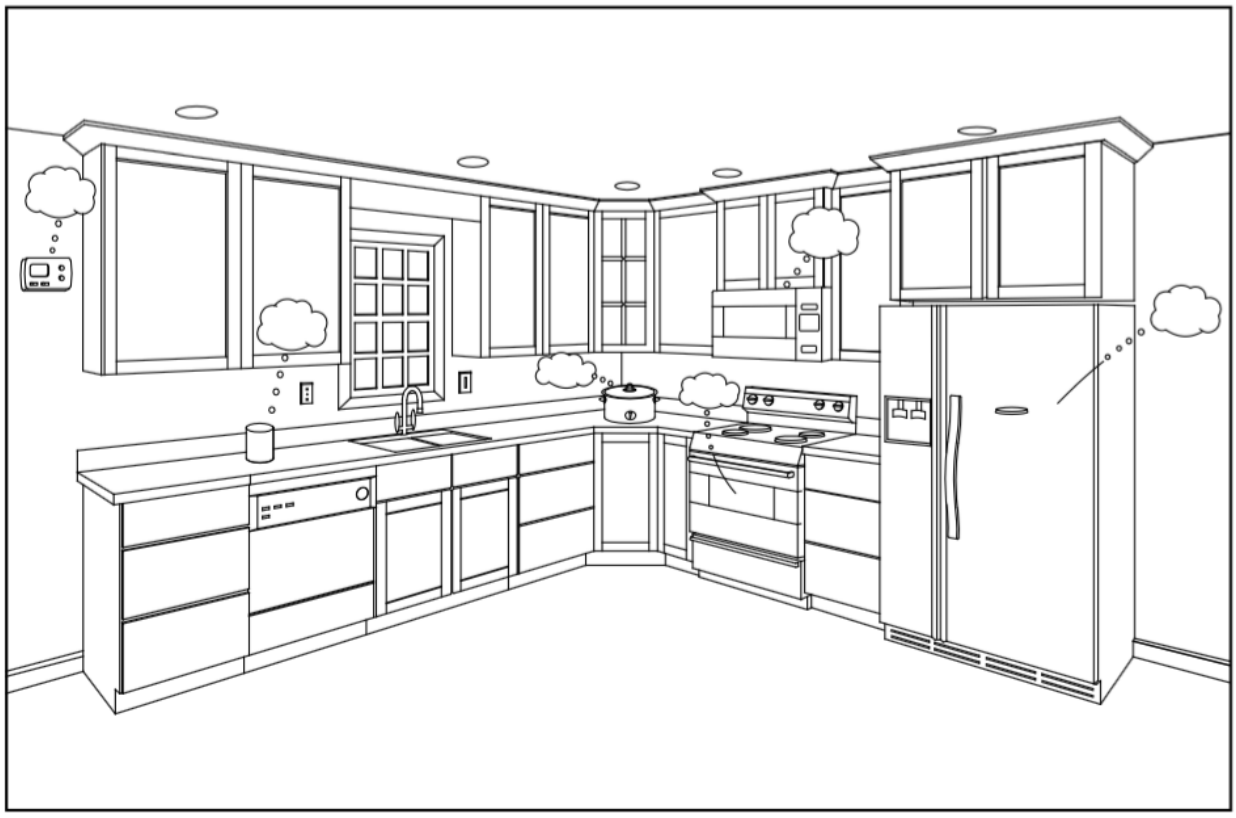

Figure 1

For example, Figure 2 shows a larger version of the slow-cooker appliance. The slow-cooker appliance may enter a command reception mode after receiving a hot word or other keyword received through a microphone. The slow-cooker appliance responds to voice commands, such as turning on, turning off in four hours, querying an online database for appropriate cooking times for a particular recipe, or maintaining a certain temperature. Although it only actively listens for the key word when not in the command reception mode initiated by the keyword, the microphone of the slow-cooker appliance always listens to the surrounding environment. A user may not want all voice-capable devices listening simultaneously to avoid sending commands to the incorrect device or may desire to disable recording for other reasons.

Figure 2

Although some smart devices feature secondary switches that disable active listening modes, the requirement of engaging a physical switch may be cumbersome, inconvenient, and defeat the purpose of having a voice-activated smart device or assistant. The additional steps of locating the smart device, finding the disabling switch, activating the disabling switch, and reversing the process to reactivate the smart device may dissuade some users from deactivating the active-listening mode. Disconnecting and reconnecting a smart device from a network connection or power source can be even more cumbersome.

However, Figure 2 illustrates an additional capability of the slow-cooker appliance that can reduce active-listening concerns. The slow-cooker appliance also includes an audio transducer (shown at the bottom left of the slow-cooker appliance). When in the active mode (*e.g.*, the mode in which the slow-cooker appliance can receive the hot word that initiates the command reception mode), the microphone of the slow-cooker appliance listens to and analyzes the surrounding environment for the hot word, and when hearing the hot word, listens for commands.

A verbal command received in the active mode that disables the smart device can be much more convenient and easier for a user to use. For example, if the slow-cooker appliance

receives a verbal "deep-sleep" command, the slow-cooker appliance can disable the microphone and enable the audio transducer. As the deep-sleep command disables the ability of the slow-cooker appliance to respond to voice commands, the deep-sleep command may require confirmation or a secondary command to confirm that a user wants the slow-cooker appliance to stop listening for the hot word. Figure 3 illustrates the slow-cooker appliance in the deep-sleep mode.

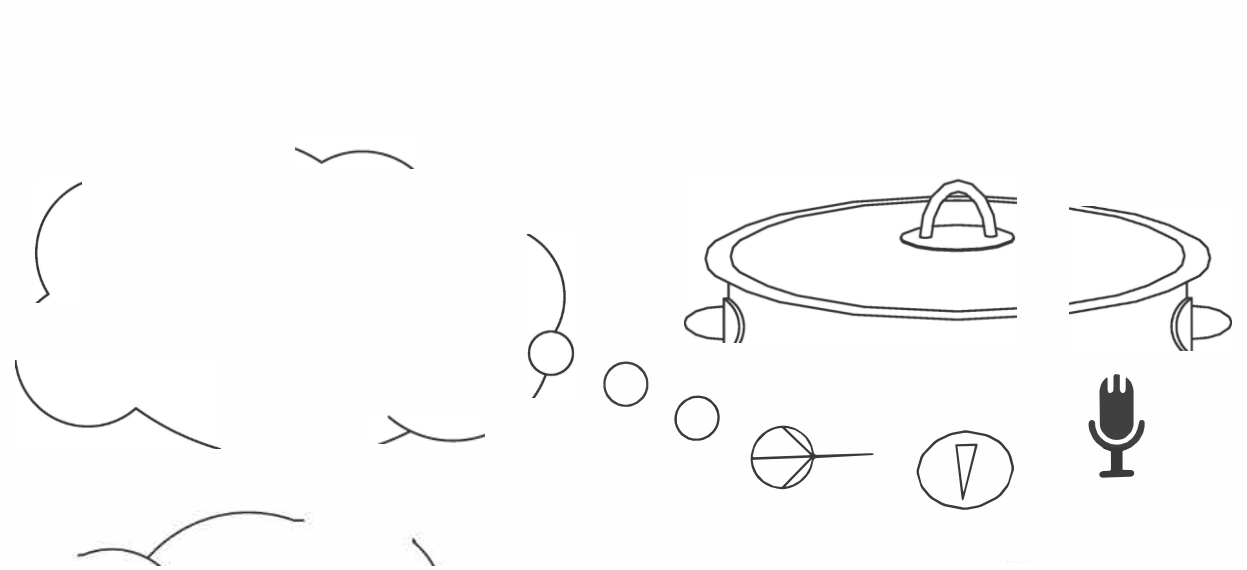

Figure 3

In Figure 3, the microphone of the slow-cooker appliance has been disabled and the audio transducer has been enabled (shown by the listening bubble no longer associated with the microphone and associated with the audio transducer). The microphone does not merely ignore the keyword or hot word but can be actually turned off, not sensing any sound, and disconnected from the Internet or other network. In effect, the slow-cooker appliance is now a normal appliance with one added feature: an audio transducer.

An audio transducer senses sound by converting acoustic energy to electrical energy but not in the way a microphone senses sound. A microphone of a voice-activated device, like the

slow-cooker appliance, senses actual sounds and can transmit, record, or react to the meaning of the words in the composition of the sound itself. An audio transducer responds in more of a binary fashion: is there sound or not. Examples of audio transducers include electromagnetic coils, piezoelectric crystals, and other substances in conjunction with electrical and circuitry components to transmit the presence of sound to the voice-activated smart device.

Further, the audio transducer can be tuned to respond to specific sound, but the specific sound is not as complex as a spoken hot word or keyword. For example, the slow-cooker appliance of Figure 3 has an audio transducer that responds only to a series of sharp sounds, like two snaps, two claps, or two sharp raps on a counter. Any variety of sound types, number of sounds, or sound combinations may be used to reactivate the smart device.

The audio transducer of Figure 3 requires a series of sounds to prevent the unintentional activation of the microphone, such as the case of a dropped object on a counter or the slamming of the kitchen door. Additionally, the initial activation of the audio transducer may require user confirmation to reenter the active-listening mode and reactivate the microphone. Such confirmation could be provided by repeating the specific sounds when asked (*e.g.*, the claps or snaps), verbally responding to an audible request (*e.g.*, "Do you want to reactivate the active-listening mode?"), or in other manners. If it does not receive the confirmation within an appropriate time, the slow-cooker appliance can reenter the sleep mode. If, however, the slow-cooker does receive confirmation, the system can restore power to the microphone, reconnect to the Internet or other network, and renter the active-listening mode. Once reactivated, the microphone begins to actively listen to the surrounding environment for the hot word or keyword. If so desired, the user can once again place the slow-cooker device into the sleep mode by issuing the appropriate command.

A voice-enabled or voice-activated deep-sleep mode that disables the active listening capabilities of voice-activated devices can make preserving privacy simpler and easier than mechanical switches or physically disconnecting a smart device from network connections or power sources.