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## Intelligent Microphone Muting of a Device

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## Intelligent Microphone Muting of a Device

### Abstract:

This publication describes techniques for intelligent microphone muting of a device. The device first determines that an active application is using a microphone of the device and that a microphone input to the application is able to be muted (*e.g.*, a microphone mute function for an audio/video call). An output from the microphone is then monitored for an audio signal that matches an audio signature, the audio signature corresponding to an initiation of a hand of a user covering a lower portion of the device. When a matching audio signal is determined, a touch sensor is powered and an output from the touch sensor is monitored for a touch signal that matches a touch signature, the touch signature corresponding to the hand covering the lower portion of the device. When a matching touch signal is determined, the microphone input to the application is muted. Responsive to the matching touch signal no longer being detected, the microphone input to the application is unmuted.

### Keywords:

application, mute, intelligent muting, phone call, video call, audio signature, touch signature, covering microphone, covering touch sensor, lower portion, audio trigger, touch trigger, touchscreen, microphone input

### Background:

To mute the microphone input of a mobile device, especially during a phone call, many users instinctively cover a lower portion of the device. This is generally because older telephones

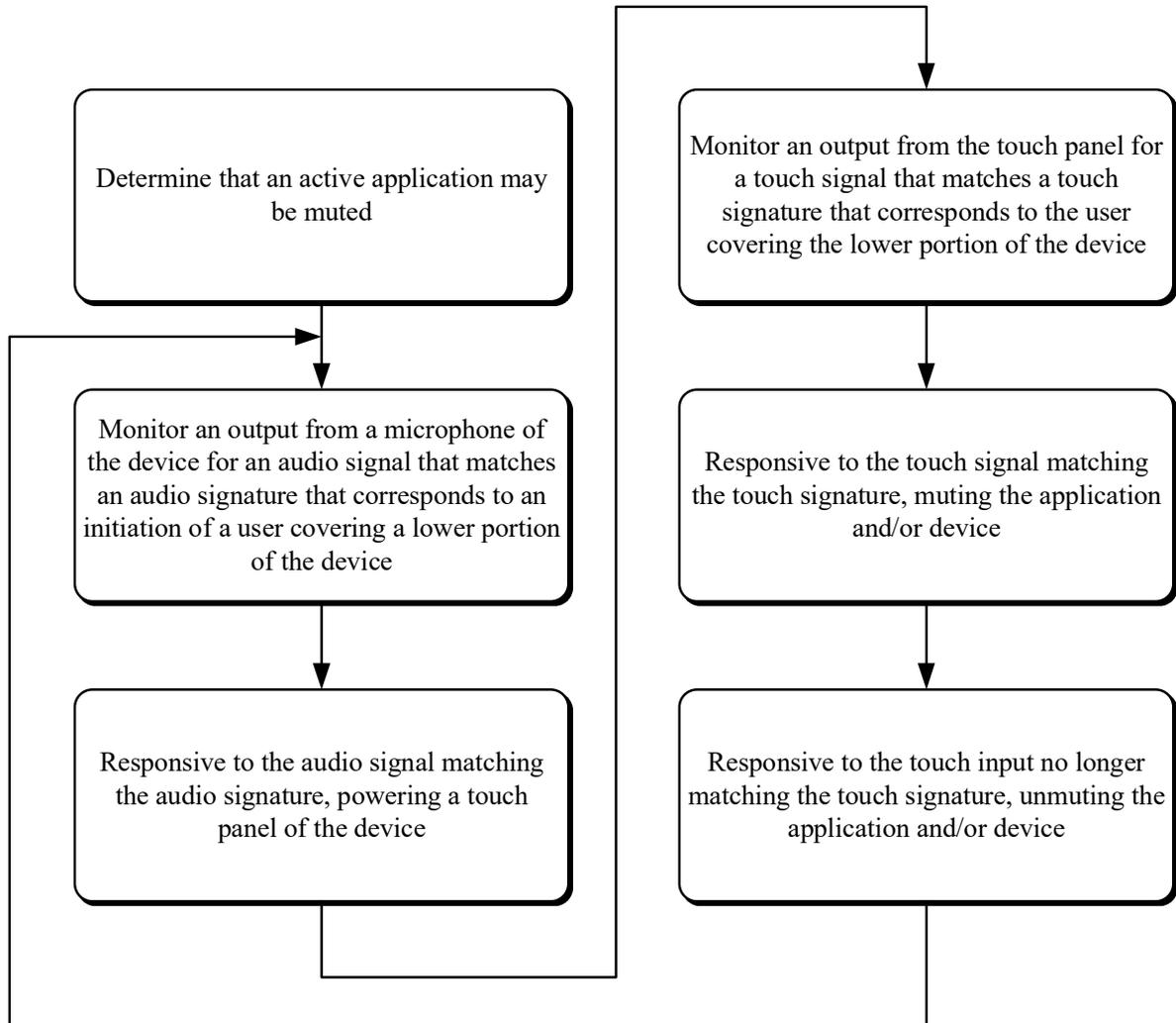
did not have microphone mute functions and were effectively muted by covering a microphone portion that was located in a lower portion of the telephone (*e.g.*, located in a mouthpiece of a telephone handset). However, because modern devices use multiple microphones placed at different locations around the devices, covering a lower section often fails to effectively mute microphone inputs. Therefore, it is desirable to have a device that can intelligently mute a microphone input when a user covers a lower portion of the device.

**Description:**

Although the techniques described herein are directed towards a mobile device (*e.g.*, a mobile phone), the techniques may be applied to any device with the following components or to a combination of devices that are communicatively coupled (*e.g.*, a peripheral in combination with a computing device). The device includes a processor, a microphone, a touch sensor, and may include one or more of a display (*e.g.*, a touchscreen), a speaker, or a haptic mechanism. The microphone may be a single microphone or an array of microphones.

The device also includes a computer-readable medium (CRM). The CRM may include any suitable memory or storage device (*e.g.*, random-access memory (RAM), static RAM (SRAM), dynamic RAM (DRAM), non-volatile RAM (NVRAM), read-only memory (ROM), or flash memory). The CRM includes an intelligent microphone muting manager application that is executable by the processor to enable intelligent microphone muting. The device, having the microphone and the touch sensor, performs operations under the direction of the intelligent microphone muting manager application to intelligently mute a microphone input to an application when a user covers a lower portion of the device.

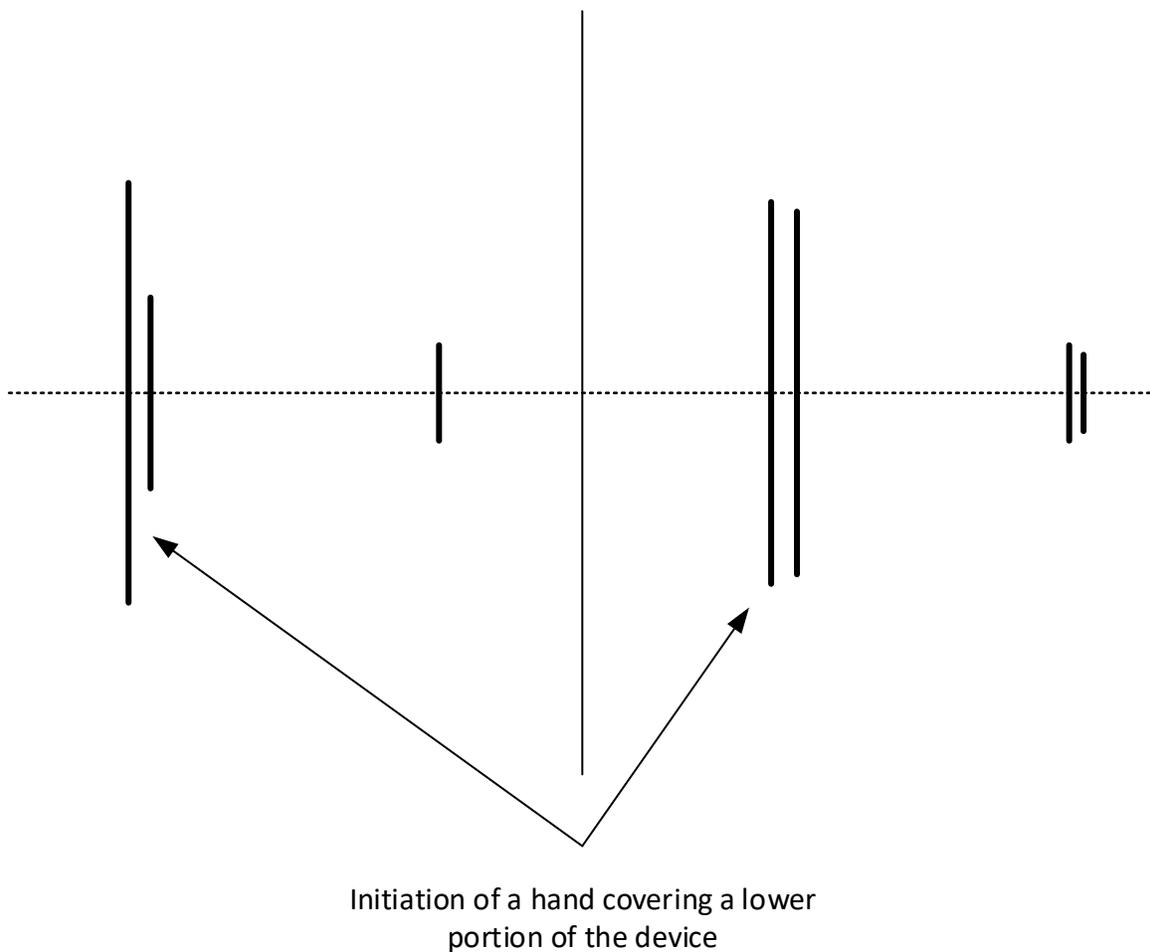
Figure 1, below, shows an example process flow-chart for intelligent microphone muting of a device.



**Figure 1: Example flow-chart for intelligent muting of a mobile device.**

First, the mobile device determines that an active application running on the device may have a microphone input muted (*e.g.*, a microphone mute function during an audio or video call). For example, the device may monitor active applications and determine that a particular application is currently using a microphone of the device. Alternatively, the device may determine that a voice or video data connection has been established.

Once the device determines that a microphone mutable application is running, an output from the microphone (or microphones) is monitored for an audio signal that matches a specific audio signature. The audio signature corresponds to an initiation of a user covering a lower portion of the device. The initiation is used because the majority of sound is created when the device is first touched (*e.g.*, little further “contact” sound is produced once the device is covered). Figure 2, below, shows an example audio signature.



**Figure 2: Example audio signature.**

Responsive to detecting a matching audio signal (*e.g.*, that matches the touch signature), a touch sensor of the device is powered (if not powered already) and an output from the touch sensor is monitored for a touch signal that matches a specific touch signature. The touch signature

corresponds to the user covering the lower portion of the device. The touch sensor may be part of the touchscreen of the device or a separate component. Figure 3, below, shows an example touch signature, including a representation of a user's fingers covering the lower portion of the device.

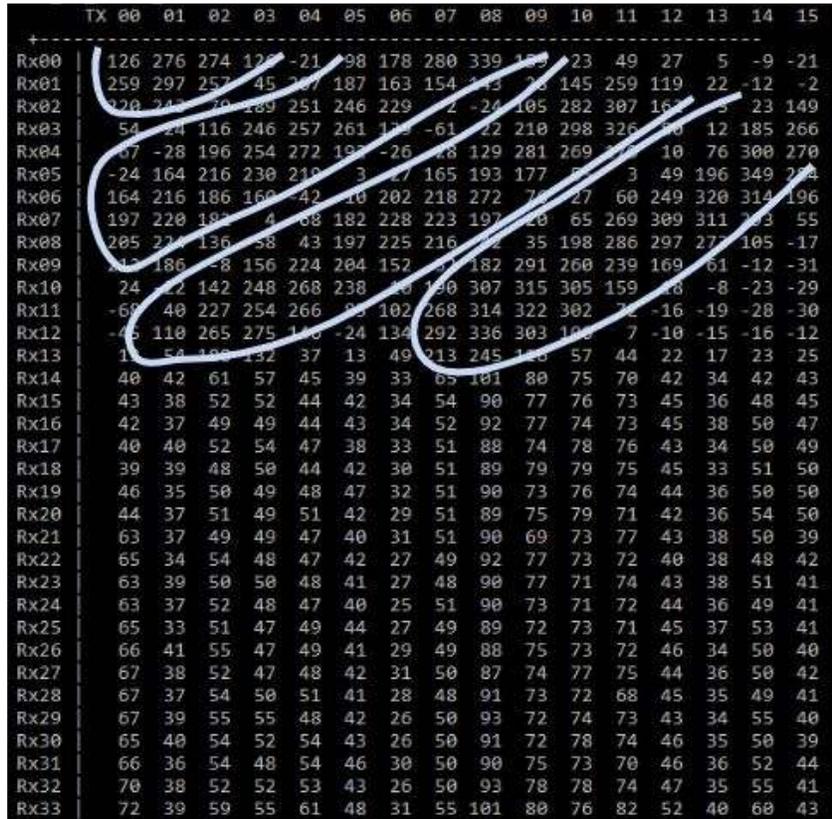


Figure 3: Example touch signature.

A machine-learned model may be utilized to create the audio signature and/or the touch signature for use in determining if an audio signal or a touch signal corresponds to a user covering a lower portion of the device. Audio/touch data samples can be collected and categorized with corresponding correct audio/touch signature classifications to train the machine-learning model. After sufficient training, the machine-learning model can be deployed to the CRM as a machine-learned model. Model training can be performed on a remote computing system. Instead, or in addition, some or all of the model training can be performed on the mobile device. For example, prior to performing the techniques, the device may enter a calibration or learning mode that uses

machine-learning techniques to determine the audio/touch signature that is specific to the user. Visual or other prompts may be used to help the user complete the training of the machine-learned model.

Responsive to detecting a matching touch signal (*e.g.*, that matches the touch signature), the microphone input to the application is muted. The muting may be performed by sending an instruction to the application corresponding to the call (*e.g.*, send an instruction to execute a microphone muting command), or directly by an operating system of the device (*e.g.*, not powering the microphone, disconnecting the microphone, or not allowing the application to access the microphone).

A notification may be presented to the user that the microphone input to the application has been muted. The notification may be in conjunction with a muting function of the application (*e.g.*, a mute button press) or a separate notification. The notification may be visual, audible, or haptic and may use the touchscreen, speaker, or haptic mechanism of the device.

Responsive to no longer detecting the matching touch signal, the microphone input to the application is unmuted. When the microphone input is unmuted, a different notification may be presented to the user (*e.g.*, visual, audio, haptic). The touch sensor may also be powered down until another audio signal that matches the audio signature is detected.

Once the microphone input is unmuted and as long as the application is still using the microphone, the device goes back to monitoring the output from the microphone for an audio signal that matches the audio signature.

By using a two-step technique for intelligent microphone muting (*e.g.*, audio and touch signatures), false positives may be mitigated, and device power may be saved by not leaving the touch sensor powered.

**References:**

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