February 2023

Providing Cues Indicating Device Component Location for Improved User Experience

Ramprasad Sedouram

Dharma Teja

Providing Cues Indicating Device Component Location for Improved User Experience

ABSTRACT

Devices such as smartphones include many input and output components located in different parts of the device. When the device is used for particular purposes, such as capturing images, recording audio, etc., issues such as misalignment between the view on the display and the actual object (due to mismatch of camera location and device location), muffled audio in the recording (due to obstructed microphone), etc. can arise. Such issues can be difficult to detect and fix because users are typically unaware of the locations of these various input and output components. This disclosure describes techniques to automatically detect inadvertent issues with input and/or output and to alert the user via audio and/or visual cues to take mitigating action. The cues can indicate the location of the component and the action to be performed.

KEYWORDS

- Sensor location
- Microphone location
- Camera location
- Camera placement
- Obstructed component
- Device misalignment
- Muffled audio
- Gaze misdirection
- Visual cue
- Audio cue

BACKGROUND

Smartphones and other devices are used to perform a variety of activities, such as capturing videos or photographs, making and receiving calls, paying for purchases, etc. Many of these activities involve the use of various input and output components of the device such as cameras, microphones, Near-Field Communication (NFC) chips, speakers, etc. Performing various actions that involve input sensors and output components typically requires users to interact with the corresponding app via a graphical user interface (GUI) shown on the device display. For example, when photographing an object with the device camera, the GUI shows the framed scene in the center of the device display.

The various input and output components within a device are not physically located at the center of the device display. The position of a component such as a camera in relation to the center of the device display can lead to a confusing or misleading user experience (UX) because the user's attention when performing the task is focused on the app GUI shown on the display. For example, when using the device camera to photograph an object very close to the device, the preview of the captured image of the object is shown centered on the device display even though the object is located right under the camera and not under the center of the device.

While it may be possible to adjust the content shown within the app GUI based on the location of the relevant input and/or output components in relation to the display, current device operating systems (OSes) lack such adjustments or provide only generic universal adjustments for all devices. Such an approach is insufficient and suboptimal because devices vary widely not just in terms of the location of the various components in relation to the display but also regarding the size and resolution of the display itself. As a result, users typically do not receive relevant visual information based on specific locations of various input and output components

on their devices within app GUIs. For example, a user who is unaware of the locations of the microphones on the device can unknowingly block one of the microphones with their finger while recording a video while receiving no information about the problem within the GUI of the recording app. Similarly, a user can inadvertently cover the device speakers when using a device for audio playback, thus receiving audio of suboptimal quality (e.g., muffled due to the device speaker being covered).

DESCRIPTION

This disclosure describes techniques to depict the locations of various relevant input sensors (e.g., camera, microphone, etc.) and/or output transmitters (e.g., speakers, NFC transmitters, etc.) in a device within the app GUI shown on the device display. Such depiction can enable the user to develop positional awareness of device components that generate the inputs and outputs relevant to the task at hand. The positional information can be employed to detect unintended issues (e.g., components that are inadvertently blocked, objects that are misaligned in the GUI in relation to their real-world position, etc.). The user can be alerted of the issues along with suggestions for appropriate corrections, such as unblocking covered sensors, moving the device for proper alignment, etc.

Locations of the various device components in a specific device can be determined based on the make and model of the device. With user permission, any problems with the components relevant for the task a user is performing within the GUI can be detected based on one or more pieces of information, such as the specifics of the task, the user's context, the expected characteristics of the relevant input and output signals based on historical data, the position of the device and surrounding real-world objects, differences between inputs captured by similar components placed at different locations in the device, etc.

For example, consider a scenario in which a user answers an incoming call on their smartwatch while wearing gloves. The sleeve of the user's glove overlaps with the edge of the smartwatch which obstructs one of the microphones. As a result of the obstruction, the user's voice may not be captured with sufficiently high quality. With user permission, degraded audio capture can be detected based on one or more of the following pieces of information: the position(s) of the microphone(s) on the specific model of the smartwatch; differences between input audio levels captured by different microphones (if the device has multiple microphones); the user's likely attire; etc. In addition, unexpected issues with input or output can be detected based on historical information about similar situations. For instance, if a user is blocking a microphone while capturing a video of a parade, the resulting lower audio level can be flagged based on detecting that the video is of a parade and comparing the audio characteristics of typical parades with those of the captured audio.

If any unintended issues are detected, the user can be alerted of the potential problems along with suggested solutions. Such alerts can be provided as audio and/or visual cues, e.g., arrows within the app GUI that point to the positions of relevant input and output components; animations or icons that indicate the location of components that are likely sources of issues; text and/or audio alerts or notifications that suggest actions that can resolve the issue; etc. For instance, for the above example scenarios of an inadvertently blocked microphone, the alerts can show the position of the blocked microphone that is receiving a lower level of audio input than expected and suggest one or more corrective actions such as adjusting clothing, repositioning fingers, speaking louder, moving closer to the scene, moving the device to another position, using an external microphone, wearing earphones, etc. The techniques can additionally depict if

any device components are inactive, e.g., because of being superseded by a connected accessory such as, e.g., earphones, external speakers, external microphones, etc.

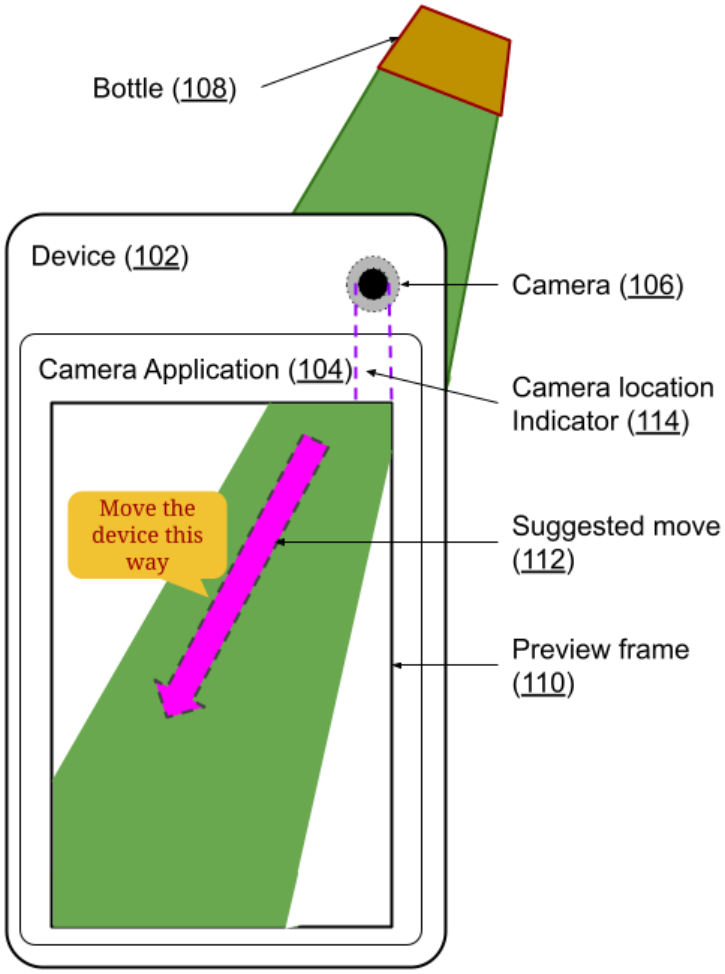

Fig. 1: Depicting camera location and suggesting device move for capturing a close-up

Fig. 1 shows an example of operational implementation of the techniques described in this disclosure for another related example scenario. A user wishes to capture a close-up photo of a bottle (108) with the camera (104) of a device (102). The camera is located in the top-right corner of the device while the scene to be captured is depicted within a preview frame (110) of the camera application (104) centered in the device display. As a result, the close distance between the bottle and the device results in a misalignment between the real-world position of

the bottle in relation to the center of the device and the preview shown in the GUI in the center of the device display.

It is detected that the camera lens is very close to the object, thus causing noticeable misalignment between the viewport and the object. Such detection can be based on camera sensor parameters, from processing the preview image, etc. The location of the device camera is determined based on the device model. A visual indicator (112) is displayed within the GUI suggesting that the user move the device in a particular direction away from the direction of the indicated camera location (114) to properly capture the desired close-up photograph of the object. Similar indications can be displayed when the user is in a video conference but is looking at a portion of the screen that is away from the camera, thus alerting the user that their gaze may be perceived by other participants as not looking at the camera.

The techniques described in this disclosure can be implemented to detect issues with any input and output components in any device, such as smartphones, smartwatches, tablets, laptops, etc. With appropriate user permissions, the implementation can be based on any suitably trained computer vision techniques, machine learning models, or other suitable techniques for analyzing any relevant image and sensor data. Implementation of the techniques can help users avoid problems caused by inadvertent issues with device input and output that may otherwise go undetected. The techniques can be implemented as part of the device operating system or of any application.

Further to the descriptions above, a user may be provided with controls allowing the user to make an election as to both if and when systems, programs or features described herein may enable collection of user information (e.g., information about a user’s device, a user’s context, social network, social actions or activities, profession, a user’s preferences, or a user’s current

location), and if the user is sent content or communications from a server. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is obtained (such as to a city, ZIP code, or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over what information is collected about the user, how that information is used, and what information is provided to the user.

CONCLUSION

Devices such as smartphones include many input and output components located in different parts of the device. When the device is used for particular purposes, such as capturing images, recording audio, etc., issues such as misalignment between the view on the display and the actual object (due to mismatch of camera location and device location), muffled audio in the recording (due to obstructed microphone), etc. can arise. Such issues can be difficult to detect and fix because users are typically unaware of the locations of these various input and output components. This disclosure describes techniques to automatically detect inadvertent issues with input and/or output and to alert the user via audio and/or visual cues to take mitigating action. The cues can indicate the location of the component and the action to be performed.

REFERENCES

1. Rosenthal, Zev. "Devices, Systems and Methods for Improving and Adjusting Communication" US Patent Application Publication No. US20110082698A1, filed October 1, 2010.