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Screen brightness adjustment using machine learning

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ABSTRACT

Mobile devices, e.g., smartphones, tablets, etc., often include a light sensor that senses ambient light. Data from this sensor is used to set the screen brightness. During ordinary usage of such devices, the light sensor sometimes gets covered, e.g., by the user's fingers, which leads to a quick decrease in screen brightness. This makes for a poor user experience. This disclosure describes machine learning techniques that determine whether a detected change in ambient light is due to a true decrease in ambient light conditions or due to an occlusion of the light sensor. Screen brightness adjustments can be made on such determination.

KEYWORDS

- display brightness
- screen brightness
- light sensor
- ambient light
- environmental light
- occlusion detection
- inadvertent occlusion

BACKGROUND

Mobile devices, e.g., smartphones, tablets, etc., often include a light sensor that senses ambient light. Data from this sensor is used to set the screen brightness. The light sensor can be, e.g., a dedicated photodiode, a camera, a brightness sensor, a vicinity sensor, etc. During ordinary usage of such devices, e.g., when using the phone with both hands, the light sensor sometimes gets covered, e.g., by the user's fingers, which leads to a quick decrease in screen brightness. This makes for a poor user experience.

DESCRIPTION

This disclosure describes machine learning techniques that determine whether a detected change in ambient light conditions is due to a true decrease in ambient light or due to an occlusion of the light sensor. If the detected change in ambient light is determined as being due to inadvertent occlusion of the light sensor, follow-up action is taken, such as:

- informing the user that the light sensor is occluded, possibly by their finger;
- decoupling screen brightness from the level of detected ambient light temporarily, e.g., for the current session;
- reducing the speed with which screen brightness changes with a change in detected ambient light;
- providing the user with an option to disable automatic brightness adjustment for at least the current session; etc.

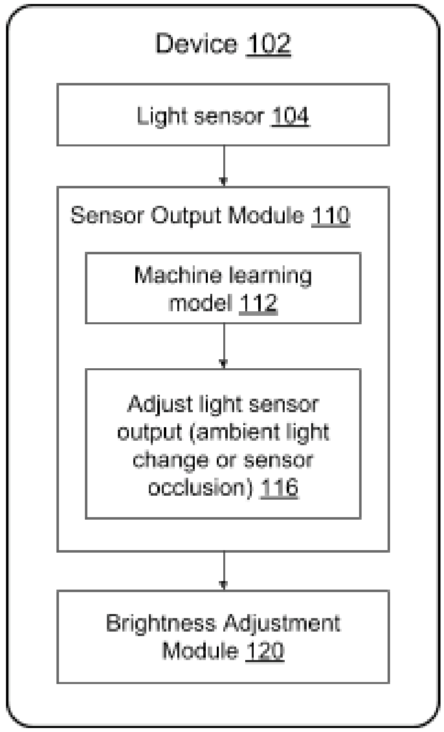

Fig. 1: Brightness adjustment

Fig. 1 illustrates an example device (102) that utilizes machine learning to determine the cause of change in light sensor output and make appropriate adjustments, per techniques of this disclosure. A sensor output module (110) includes a trained machine learning model (112) and adjusts light sensor output (116) based on output from a light sensor (104). For example, the ML model (112) is trained to determine if a detected change in the light sensor output is valid, e.g., triggered by actual change in ambient light, or invalid, e.g., triggered by an occlusion of the light sensor by the user's hand or other object. Training of the model can be performed, e.g., in a supervised manner by having users purposefully cover the light sensor fully or partially with their fingers and recording the resulting change in light sensor output. The adjusted light sensor output is provided to a brightness adjustment module (120) that can adjust display brightness accordingly. Modules 110 and 120 can be implemented as software (e.g., as part of the device operating system), hardware, or as a combination.

In situations where the user is likely to inadvertently cover the light sensor, e.g., when using the device with both hands, the light sensor measures large changes in brightness in the time leading to the occlusion of the light sensor. These changes in brightness are due to, e.g., the movement of hands in the vicinity of the light sensor. The machine learning model recognizes such patterns of rapid change in light sensor output preceding an occlusion as not indicative of a genuine change in ambient light.

A change in light sensor output is classified by the machine learning model as valid, e.g., due to a genuine change in ambient light. In this case, the output of the light sensor is passed as-is, and the screen brightness is adjusted accordingly. If the change in light sensor output is classified as invalid with high certainty, then the change in light sensor output is ignored, e.g., no change in the light sensor output is indicated, which prevents adjustment of screen brightness. Further, if the change in light sensor output is classified as invalid with low certainty, the device can be configured to slow down the adjustments to the screen brightness or not perform adjustments at all.

If the output of the ML model indicates uncertainty about the cause of change in light sensor output, the device can be configured to display a UI, e.g., unobtrusive dialog box, that requests the user to indicate a preference regarding temporarily disabling automatic screen brightness, e.g., for the current session. With user permission, responses provided via such UI can be utilized as additional training samples for the machine learning model. For example, if the user elects to disable automatic brightness, then the change in light sensor output is determined as invalid; if the user elects to leave automatic brightness enabled, then the change in light sensor output is determined as valid.

In this manner, the techniques of this disclosure enhance user experience by assessing the causes of changes in light sensor output. When a user permits use of user feedback for training, the machine learning model that determines the cause of change in light can be further trained based on such feedback. The user retains full control over screen brightness.

CONCLUSION

This disclosure describes machine learning techniques that determine whether a detected change in ambient light is due to a true decrease in ambient light conditions or due to an occlusion of the light sensor. Screen brightness adjustments can be made on such determination.