Adjustment of screen brightness in low-power state

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ABSTRACT

Consumer electronic devices generally switch their screens to a low-power or off state when the device is not in active use. During periods of inactivity, the application processor of the device is in a sleep state. For always-on devices, the application processor periodically wakes up to update screen content, e.g., displayed time. However, such wake-up does not include any adjustments of screen brightness, and the screen may be difficult to read during inactive periods despite such periodic updates. This disclosure describes techniques to update screen brightness, and hence maintain screen readability, when the screen is in a low-power state. The techniques leverage periodic wake up of the application processor during inactive periods to enable measurement of ambient light and adjustment of screen brightness.

KEYWORDS

● Screen brightness
● Application processor
● Always-on
● Operating system
● Sleep state

BACKGROUND

While a number of electronic devices are configured to turn the display screen off when the device is not in use, certain types of electronic devices, referred to as always-on devices, have a display screen that is active even during periods of user inactivity. To conserve power, an active screen is often configured in a low-power state during such periods of user inactivity. During inactive periods, the application processor of the device is in a sleep state. The
application processor is configured to wake up periodically to perform certain tasks, e.g., to update screen content such as time, location, weather, etc. depending on the specific device. However, such wake-up does not include any adjustments of screen brightness. Hence, the screen may be difficult to read during inactive periods despite such periodic updates.

In most system-on-chip designs used in these types of devices, an ambient light sensor, if included, is controlled by the application processor, such that ambient-light sensing and environment-based brightness adjustment cannot be carried out without specifically waking the processor. Examples of always-on devices include wearable electronic devices such as smartwatches, fitness trackers, etc.

**DESCRIPTION**

Techniques of this disclosure synchronize ambient-light measurement and screen-brightness adjustment with automatic wake-up of the application processor. In this manner, a screen in a low-powered, always-on state is automatically configured to a brightness level that is appropriate for the ambient light, at instances when the application processor wakes up to update screen content. The updates are carried out by the operating system and eliminate the need to wake up the application processor specifically for the task of screen-brightness adjustment. Thus, the techniques ensure that the screen is readable even during periods of user inactivity, with minimal power consumption.
Fig. 1 illustrates adjustment of screen brightness to match ambient light during times when the screen is in a low-power state. When the application processor wakes (102), e.g., to perform a periodic task such as updating screen content, the ambient light sensor is enabled (104). The ambient light sensor measures ambient light (106), e.g., by taking a number of light samples. The screen brightness is updated (108) based on an accumulative measure of samples taken. The ambient light sensor is disabled (110) once sampling is done.

Enabling / disabling of the ambient light sensor is governed by parameters that are configurable, e.g., via the operating system. Parameters such as allowable instants of light sampling, screen brightness setting, number of light samples taken, etc. can be based on configuration files specified by an original equipment manufacturer/ original design manufacturer (OEM/ODM).
In this manner, techniques of this disclosure enable screen brightness to be updated during low-power state with minimal energy consumption. The techniques are advantageously implemented at the operating system level such that they are generally applicable across all types of devices and eliminate the need to use custom logic. The techniques are implementable at the operating system level and hence available as a framework offering.

CONCLUSION

This disclosure describes techniques to update screen brightness, and hence maintain screen readability, when the screen is in a low-power state. The techniques leverage periodic wake up of the application processor during inactive periods to enable measurement of ambient light and adjustment of screen brightness.