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Adaptive LED Intensity Control Based on Camera Blocked State Detection

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ABSTRACT

When video recording with flash is activated and the camera is placed on a surface that blocks the camera or in an enclosed space, the camera does not automatically transition to sleep mode. As a result, the LED of the flash continues to operate at full current which may cause overheating and can lead to melting of the LED lens, which is a safety concern. This disclosure describes techniques to automatically detect if a device camera is blocked during video recording or other conditions during which the flash is used. The detection is based on analysis of captured images from the camera as well as from available peripheral sensors to determine if the camera is covered. If the camera is covered, the LED current is set to a low, safe value; else, the LED continues to operate at normal current to provide flash functionality. In various implementations, detecting whether the camera is covered may be based on a voting mechanism where data from each sensor is used to produce a respective likelihood that the camera is covered, and the likelihoods are aggregated to make a determination of whether to adjust the LED current. Detection of whether the camera is blocked may be performed periodically while the LED is on. By automatically dimming the LED, the described techniques reduce power consumption and improve device safety.

KEYWORDS

- LED flash
- LED melt
- Covered camera
- Blocked camera
- Camera obstruction
- Device safety
- Object distance
- Flash illumination

BACKGROUND

In cameras (including smartphones, tablets, and other devices) with video recording capabilities, an issue may arise during the use of the flash function. When video recording with flash is activated and the device is placed on a surface that blocks the camera or in an enclosed space, such as a pocket, the device does not automatically transition to sleep mode since the video recording mode is on. As a result, the LED of the flash continues to operate at full current even though the camera is blocked or covered. Continuous operation of the LED may cause overheating and can lead to melting of the LED lens, which is a safety concern. The risk is exacerbated since the user may be unaware of the ongoing video recording and that the LED flash is active.

DESCRIPTION

This disclosure describes techniques to automatically detect if a device camera is blocked during video recording. The detection is based on captured images from the camera as well as from available peripheral sensors such as a time-of-flight (ToF) sensor, ambient light sensor (ALS), flicker sensor, etc. The captured images and the data from sensors are analyzed to determine if the camera is covered. If the camera is covered, the LED current is set to a low, safe value; else, the LED continues to operate at normal current to provide flash functionality. In various implementations, detecting whether the camera is covered may be based on a voting mechanism where data from each sensor is used to produce a respective likelihood that the camera is covered, and the likelihoods are aggregated to make a determination of whether to adjust the LED current. Detection of whether the camera is blocked may be performed periodically while the LED is on. Upon detection that the camera is no longer covered, the LED current is restored to a normal value. By automatically dimming the LED, the described techniques reduce power consumption and improve device safety.

The techniques in this disclosure describe a method for enhancing safety in smart devices with video recording and flash capabilities. A detection process is implemented to regularly evaluate potential camera obstructions when the flash LED is active during video recording.

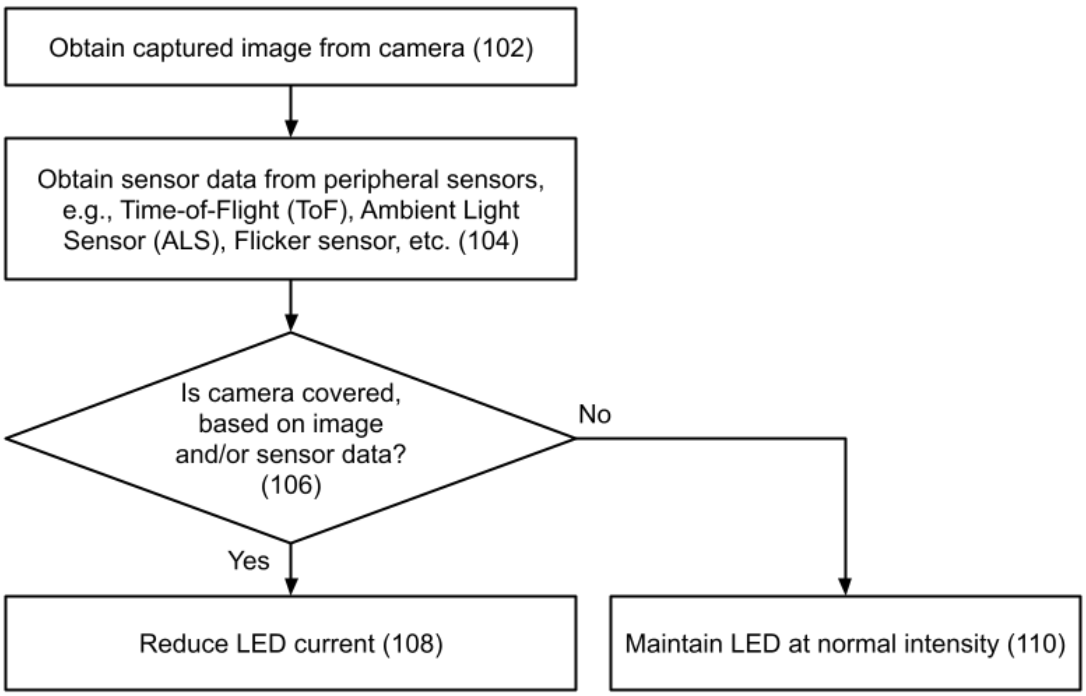

Fig. 1: Process for automatic LED current adjustment

Fig. 1 illustrates a process for managing LED intensity in devices capable of recording video and/or still photography. An image captured by the camera is obtained (102) in order to determine if the camera lens is covered or obstructed in any way. In addition, sensor data is also obtained from peripheral sensors (104). For example, sensor data may be gathered from Time of Flight (ToF) sensors, ambient light sensors (ALS), flicker sensors, etc. as may be available on the device.

The captured images and the data from sensors are analyzed to determine if the camera is covered. If the camera is covered, the LED current is set to a low, safe value; else, the LED continues to operate at normal current to provide flash functionality. In various implementations, detecting whether the camera is covered may be based on a voting mechanism where data from each sensor (ALS, TOF, image analysis, histogram analysis, etc.) is used to produce a respective likelihood that the camera is covered, and the likelihoods are aggregated to make a determination of whether to adjust the LED current. If a determination is made that the lens is covered, the LED intensity is reduced to a predetermined safe level (108) and is subsequently restored to regular intensity if it is detected that the lens is no longer covered (e.g., the obstruction is removed). If, on the other hand, a determination is made that the lens is not covered, the LED intensity is maintained at normal levels (110).

While the foregoing description refers to video recording, the techniques can be utilized in any flash use condition such as the use of a camera in photography mode, panorama mode, high frame rate video mode, etc. If the LED flash is used and the camera is detected to be covered/blocked, a lower LED current setting is utilized to prevent overheating and waste of power.

The detection process can be performed in any camera that uses an LED flash, and where there is a possibility that the camera is on while the lens is blocked. For example, the detection process can be implemented in a smartphone or other device.

Additionally, or alternatively to adjusting LED current based on detection of the lens being covered, operation of the LED flash can be controlled based on a distance between the object (within camera view) and the device. In this case, the LED flash is operated with a current that is determined based on the distance. For example, the LED current is maintained at a low value if the object is too close (e.g., indicating that the camera is blocked) or too far (indicating that the use of the LED flash does not help improve image quality). For intermediate object distances, the

LED current is set to an appropriate value based on the distance, such that flash illumination is made available to improve the quality of the captured image or video.

CONCLUSION

This disclosure describes techniques to automatically detect if a device camera is blocked during video recording or other conditions during which the flash is used. The detection is based on analysis of captured images from the camera as well as from available peripheral sensors to determine if the camera is covered. If the camera is covered, the LED current is set to a low, safe value; else, the LED continues to operate at normal current to provide flash functionality. In various implementations, detecting whether the camera is covered may be based on a voting mechanism where data from each sensor is used to produce a respective likelihood that the camera is covered, and the likelihoods are aggregated to make a determination of whether to adjust the LED current. Detection of whether the camera is blocked may be performed periodically while the LED is on. By automatically dimming the LED, the described techniques reduce power consumption and improve device safety.