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Display flicker detection using on-device optical sensor

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ABSTRACT

Display flicker is an important electro-optical measure of the display quality of a thin-film-transistor liquid-crystal display (TFT LCD). Currently, displays are tuned at the factory using flicker detection equipment that is relatively expensive and bulky. This disclosure describes techniques that leverage the internal optical sensor of the display-under-test to measure display flicker. The techniques reduce factory test-fixture costs and sizes, and also simplify test procedures.

KEYWORDS

- Display flicker
- Optical sensor
- TFT
- LCD
- Ambient light sensor (ALS)

BACKGROUND

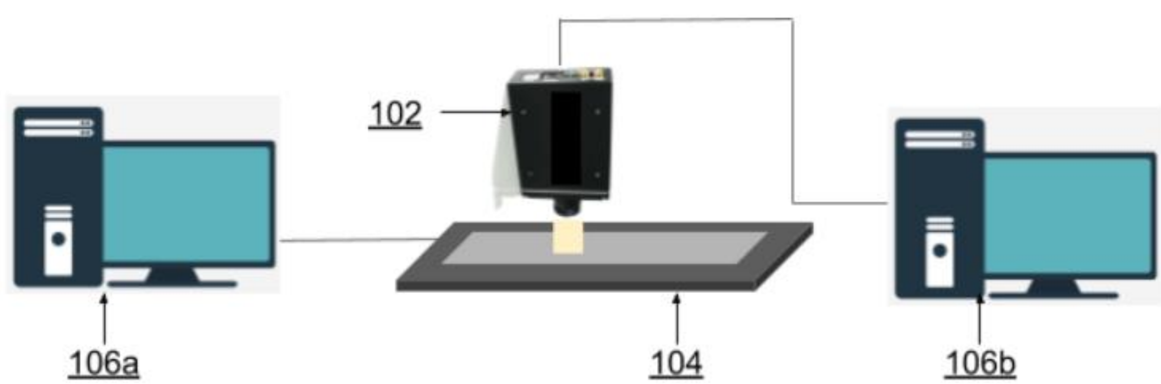

Fig. 1

Display flicker is an important electro-optical measure of the display quality of a TFT LCD. Displays are typically tuned at the factory using flicker detection equipment comprising high speed photodetectors and amplifiers, e.g., as shown in Fig. 1. The flicker-detector (102) currently used in factories is relatively expensive and bulky. Besides, not only does the display-under-test (104) have a computer (106a) to control it, so too does the flicker-detector (106b).

DESCRIPTION

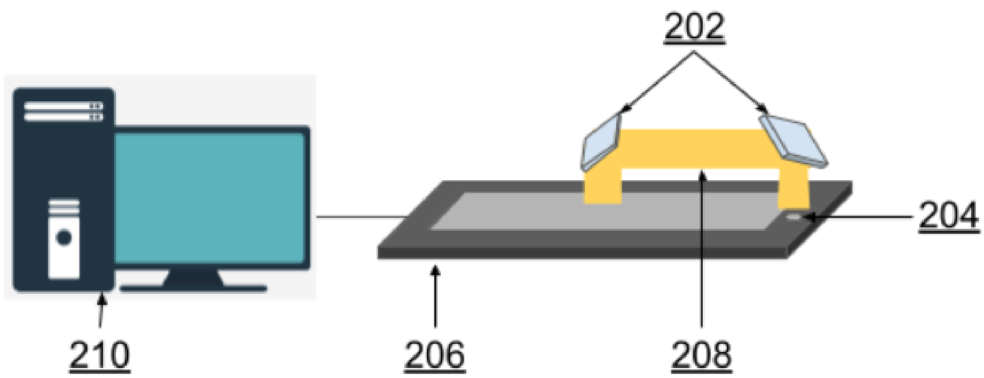

Fig. 2: Flicker detection using on-device optical sensor

Fig. 2 illustrates flicker detection using an on-device optical sensor, per techniques of this disclosure. Two forty-five degree angled mirrors (202) are arranged such that light (208) emanating from a display-under-test (206) is directed to an on-device ambient light sensor (204) with AC flicker-detection capability. The device-under-test, including its on-board ambient light sensor (ALS), is controlled by a single computer (210).

The on-board ALS is typically 2mm by 2mm by 1mm, and is installed on top of the display behind its glass. The mirror on the left can be moved to any location on the display to enable examination of different areas of the display. The two mirrors are disposed such that their relative orientations can be optimized for data collection.

In this manner, the display can be tuned for flicker optimization using the optical sensor that is on board the display itself. External flicker detection equipment is no longer required. The computer used to control the external flicker detector is also obviated. Per the techniques, a single computer both tunes the display-under-test and collects and analyzes data from the on-board ALS. The costs of, and the lab-space occupied by, the external flicker detector and its associated computer is thereby saved.

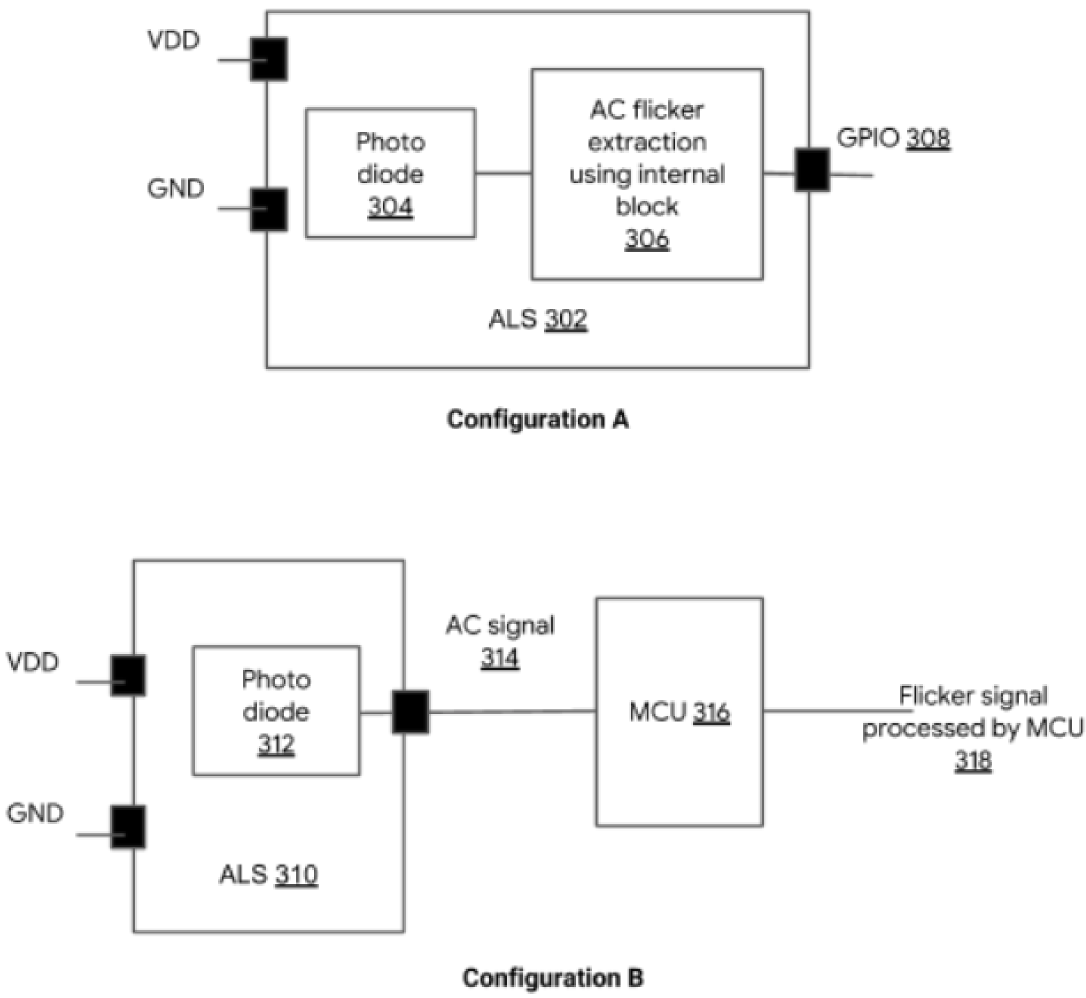

Fig. 3: Configurations for flicker detection using on-device optical sensor

Ambient light sensors (ALS) come in different configurations. As illustrated in Fig. 3, in one example configuration (configuration A), the ALS package (302) comprises a photodiode

(304) and an internal block (306) that performs AC flicker extraction. The internal AC flicker extraction block comprises bandpass filters, amplifiers, analog-to-digital converters, etc. In such a configuration, the digitized light-intensity changes can be directly captured from the ALS, e.g., via a general-purpose input-output bus (308). The light-intensity changes can be statistically analyzed, e.g., by computing variance, to derive flicker.

In another example configuration (configuration B), the ALS package (310) comprises a photodiode (312), such that an analog (AC) signal (314) is produced as output. In such a configuration, the AC signal is digitized and conditioned by a microcontroller unit (316) to produce an MCU-processed digital flicker signal (318). The MCU performs the task of digitizing, filtering, and amplification of the AC signal. In configuration B, the MCU can optimize the common electrode voltage and peak voltage of the display controller to optimize flicker.

CONCLUSION

This disclosure describes techniques that leverage the internal optical sensor of a display under test to measure display flicker. The techniques reduce factory test-fixture costs and sizes, and also simplify test procedures.