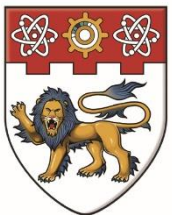

NANYANG TECHNOLOGICAL UNIVERSITY

A Multi-mode Sensor: Merge an Ambient Light Sensor into a CMOS Image Sensor

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Abstract

Ambient light sensors (ALSs) are quite often used in the portable electronic devices. In a smartphone, the ALS enables automatic control of display backlight brightness over a wide range of illumination conditions from a dark environment to direct sunlight. The control reduces the power consumption and improves visibility under varying lighting conditions.

The conventional ALS consists of two parts: photodetectors and conversion circuits. A typical conversion circuit can be current-mode analog-to-digital convertor (ADC); pulse-width modulation (PWM) module; or pulse-frequency modulation (PFM) module. In this thesis, a new conversion circuit is proposed. The proposed ADC employs a two-step architecture combined with the time-domain measurement technique. A current-mode ADC is adopted as the coarse ADC. The residue current left by the coarse A/D conversion is finely quantized by a PWM module. The proposed architecture can improve the accuracy of detection, since PWM module can correct the possible coarse conversion errors. Meanwhile, it can shorten the conversion time, since the input current of the PWM module is compressed by the coarse ADC into a small range.

A multi-mode sensor can be developed by merging the proposed ALS into a CMOS image sensor (CIS). Since power consumption plays an important role in CIS, a low-power application can be achieved by separating the power supply and switching them in different modes. In other words, during ambient light sensing, the circuits for picture/video readout are in standby mode and do not consume power; and vice versa.

The thesis presents the design of the proposed multi-mode sensor. The chip with 64×64 pixel array is implemented in AMS 0.35 μm 2P4M CMOS technology. In the following sections of the thesis, it will show the whole design flow of the proposed sensor chip.