Automotive Imaging ICs Keep An "Eye" On The Road

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In the quest to make driving more enjoyable and safer, designers are relying on the most advanced video sensors and processors for greater driver assistance and comfort (see “Semi ICs Drive Auto Safety And Control Innovation,” Electronic Design, Oct. 9, 2008, p. 28). Intelligent video systems have proven essential, spurring on the need for the design and manufacture of cost-effective vision-system ICs.

As part of this trend, STMicroelectronics’ and Mobileye N.V.'s joint introduction of the second-generation EyeQ2 system- on-a-chip (SoC) 120-MHz processor marked an important milestone. The chip takes active automotive vision safety to new levels by increasing the processing power of the firstgeneration device sixfold. It features a theoretical equivalent computational power of an Intel Pentium IV processor with a 4-GHz clock rate (Fig. 1).

Now in production, the first-generation EyeQ1 boasts lane departure warning, traffic-sign recognition, collision avoidance through radar/camera sensor fusion, and forward collision warning. It’s manufactured on a 0.18-µm CMOS process. The second-generation EyeQ2 adds pedestrian detection.

THE NEXT GENERATION

The Mobileye EyeQ2’s architecture consists of two 32-bit RISC ARM946 CPUs, four parallel-processing vision computing engines, an eight-channel direct-memory-access (DMA) controller, and several peripherals. A control ARM CPU manages the vision computing engines, ARM processor logic, DMA functions, and the peripherals. The engines and CPU logic perform all of the intensive vision computations required by applications such as tracking and pattern classification.

The vision computing engines communicate over a highbandwidth multilayer matrix block via a common master port. A high-speed, 84-bit wide, 288-kbyte, on-chip SRAM is located on the matrix for fast image memory storage and retrieval. There’s also a separate 32-bit low-bandwidth peripheral bus that connects all of the various peripherals, including the controller-area- network (CAN) controllers.

A ONE-TWO PUNCH

The EyeQ processors were co-developed as components for advanced driver-assistance system programs. They’re now supplemented with the VL5510 CMOS image sensor from STMicroelectronics, which is tailored specifically for the advanced driver-assistance systems segment (Fig. 2). Together with the EyeQ processors, STMicroelectronics delivers a “one-two” punch in pushing the performance envelope of automotive vision-based driver-assistance systems.

The VL550 sensor, manufactured on a 0.13-µm four-metallayer process, features an overall dynamic range of 140 dB (120 dB in-scene dynamic range) and a 1024- by 512-pixel monochrome format. This suits it for wide-angle products, which are common in the automotive field. The high dynamic response is fully programmable with 10 knee points available to tune pixel response. Pixels are a mere 5.6 by 5.6 µm. Maximum analog gain is +24 dB.

Performance features include very high sensitivity of 7.14 V/lux and very low dark current of 33 atoamps/pixel at 25°C. The sensor offers high quantum efficiency in the near-infrared light region. Operating temperature range is –40°C to 125°C.
The complete camera module readily connects to camera-enabled baseband processors. Video data is sent out over a 12-bit parallel interface and a high-speed serial compact camera port (CCP) serial link. The sensor features an I2C interface, a universal serial asynchronous transmitter (UART) interface, and serial-parallel interface (SPI) control and master interfaces.

Also, it operates from 3.3 V ±10%, or 2.5 V ±10%, using low-voltage differential signaling (LVDS). Power dissipation is quite low at 150 mW while operating at the maximum frame rate of 34 frames/s and at the highest resolution, and a mere 15 µW in the standby mode. Functions include a 12-bit analog-to-digital converter (ADC), phase-locked loop (PLL), vertical-fixed pattern noise (VFPN) correction, defect detection capability, and a microcontroller for system-level flexibility. Also on-chip is anti dark-sun correction circuitry.

The VL5510 comes in bare die or an organic land-grid array (OLGA) package. Currently sampling, it will be mass-produced early next year. Pricing is expected to be in the range of $20 each for bare-die quantities of 10,000 pieces.

1. This second-generation EyeQ2 SoC vision processor, co-developed and manufactured by STMicroelectronics and Mobileye N.V., adds powerful computational capability for automotive vision-based driver-assistance systems.

2. STMicroelectronics’ VL5510 CMOS image sensor features a high dynamic range and high resolution—performance that’s needed in automotive driver-assistance systems.