PROJECT RESULT

Networked
ICE terminals

MEDEA+

2A206: High-end CCD imagers and video processing for applications (ASIC-CCD)

Slow-motion in high definition

A limitation with the introduction of high-definition (HD) broadcast TV and other HD imaging systems has been poor quality slow-motion replay. The reasons for this were attributed to the constraints of the charge-coupled device (CCDs) imagers and supporting circuitry in the cameras. The ASIC-CCD project developed new image-capture sub-systems to address these issues. The first products were demonstrated during the UEFA soccer championship in June 2008. This continuing development work has now put European manufacturers of HD image-capture sub-systems in a leading position on the world stage.

Despite tremendous advances in CMOS-based imagers, charge-coupled device (CCD) sensors still dominate the high-end broadcast TV market, particularly with the adoption of high-definition television (HDTV) by most of the leading broadcasters. It was therefore essential that European industry should develop a system-on-silicon platform for high-speed CCD imaging to meet aggressive Japanese competition and to ensure that European broadcasters, the medical industry and professional audio-visual equipment suppliers have early access to world-beating technology.

The primary goal of the MEDEA+ 2A206 ASIC-CCD project was to develop a high-speed platform that would allow a CCD imaging unit, camera, image-processing and transmission media to be operated at ultra-high frequencies of an at-least 200 MHz pixel rate – 200 frames per second – and even higher, for playback at 50 frames per second.

Targeted applications included the high-speed image-capturing requirements of slow-motion HDTV, machine vision and medical applications. The partners in the MEDEA+ project were all involved in the different aspects of the complete chain of image-capture equipment, processing the data and transmitting the information.

Meeting quality demands

CCD sensors have dominated imaging applications since the early 1980s. However, CMOS imaging technology has improved rapidly over the last few years, driven by applications in consumer digital cameras, web cameras and camera-equipped mobile phones. Although CMOS offers benefits in terms of low power consumption, on-chip functionality and lower cost, CCD technology provides the benefits of very high image quality, low noise and stability. For this reason, CCD image-capture devices will continue to dominate in professional applications for the next five years, until superseded there by CMOS as well.

The initiator of this MEDEA+ project was Grass Valley, one of Europe's leading manufacturers of broadcast cameras. The aim was to increase the company's product portfolio in the field of HDTV image capture. The remaining partners were brought together in the aegis of this project to have coverage of every aspect of the value chain.

ASIC-CCD involved four main areas: high-speed imagers, peripheral CMOS integrated circuits (ICs) for high-speed CCD systems, a video-processing library and data-transmission networks. Results of the work were shown in a series of demonstrators.

A threefold approach was adopted to imaging with:

- Evaluation of technology for high speed CCD operation with new devices;
- Adaption of an existing HDTV image sensor to triple the frame rate; and
- Development of improved CCD semiconductor technology combining an increased signal-to-noise ratio with higher speeds.

Peripheral ICs were developed for sub-systems capable of driving and reading the CCD at significantly higher speeds to create a clean raw video output signal running at the higher frame rates. Again a threefold approach was taken with a new timing generator, a new companion chip and integrated clamp-and-sample circuitry as an alternative method to reduce reset noise.

A video-processing library was developed for professional camera applications with clock speeds up to 225 MHz. A complete video-processing chain was demonstrated running at triple speed in the latest field-programmable gate-array (FPGA) technology. Grass Valley was able to deliver prototype triple-speed camera systems for the European Soccer Championship and Olympic Games in 2008. The cameras performed exceptionally well.

A networking system was developed comprising a point-to-point link at high data rate supporting HDTV data transmission with increased data rate over legacy cables. This involved development of line drivers and equalizers. The most immediate demand is for high performance industrial and commercial camera networking.

Complete chain optimised

As a result of the work carried out during ASIC-CCD, the complete image-capturing chain has been optimised to operate a CCD sensor housed within a camera, video processing and transmission channels at three times the basic video frequency. In this way, super slow motion (SUPER-SLOMO) is possible with the added benefit of HDTV quality.

For the general public, the benefits are most notably the exceptional quality of the images that can now be viewed in slow motion on the HDTV screen. As a spin-off, high-speed image capture can also be achieved in other application fields. Furthermore, the advances made in this MEDEA+ project also facilitates higher processing and transmission rates, opening up other potential applications in TV broadcasting.

The successful outcome of ASIC-CCD therefore opens up new market opportunities for the project partners. Virtually any field that relies on image capture with replay in slow motion will be a target area and that includes both amateur and professional cinematography, TV broadcasting, digital cinema, medical imaging and machine-vision applications.

Currently, all consumer-level image capture technology comes from the Far East and it is only the rather more limited professional market that is addressed by a small number of European manufacturers. This MEDEA+ project has made a considerable contribution to the opportunity for European manufacturers to build on its developments. Moreover, the potential for spin-offs into other application areas presents considerable opportunities that are already being seized by partners in the project.

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Grass Valley
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KEY PROJECT DATES:

Start: January 2006
End: June 2008

COUNTRIES INVOLVED:

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