PROJECT PROFILE

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

NETWORKED ICE TERMINALS

Partners:

Adimec
DALSA
EqcoLogic
Grass Valley
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Project leader:

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Key project dates:

Start: January 2006
End: June 2008

Countries involved:

Belgium
France
The Netherlands

The ASIC-CCD project is developing a high-speed platform for professional charge-coupled device applications that allows imagers, cameras and video-processing and transmission systems to operate at ultra-high frequencies of at least 200 MHz and preferably above. Targeted applications include high-speed image capture for slow-motion high definition TV, machine-vision and medical applications. Success in this MEDEA+ project is crucial to strengthen European capabilities in systems-on-silicon for future applications in professional broadcasting, medical screening and digital photography by establishing strategic know-how at all levels – from chipmakers to professional imaging equipment suppliers.

Major advances have been made in the development of CMOS imaging technology for professional and pro-sumer – high-end consumer – applications from digital still cameras to lower level broadcast equipment. But charge-coupled device (CCD) sensors still dominate the high-end broadcast TV market, particularly with the move to high definition TV (HDTV). It is therefore essential that European industry develops a systems-on-silicon platform for high-speed CCD imaging to meet tough Japanese competition and to ensure that European broadcasters, the medical industry and profession audiovisual equipment suppliers have early access to world-beating technology.

CCD sensors have dominated imager applications since the early 1980s. However, CMOS imager technology has improved rapidly in the past five years, driven by applications in consumer digital cameras, web cameras and camera-equipped mobile phones. While CMOS provides benefits in terms of low power consumption, on-chip functionality and lower cost, CCD offers advantages in terms of very high image quality, low noise and mature technology.

Professional CCD applications

It is expected therefore that CCD imagers will continue to be used for some time in top end professional applications where image quality is of prime concern. However CMOS imagers will no doubt eventually take over from CCD even in such high end segments. The market expectation is that there will be a gradual migration from CCD to CMOS sensors in the higher segments in the coming five years, with the top segments such as high-end broadcast migrating last.

Current effort in the CMOS domain is focusing increasingly on pro-sumer and electronic newsgathering (ENG) broadcast applications. Support for this has been provided by work such as in the MEDEA+ A406 PICS project. However, even in this mid-market segment, CMOS imagers still need to prove themselves, so it is still too early to abandon further CCD imager technology development. Moreover, there is great pressure in the short term to move to HDTV resolutions with higher frame rates.

The MEDEA+ 2A206 ASIC-CCD project intends to develop a high-speed platform for such professional CCD imaging applications.

This will cover sensor technology, supporting chips, camera technology, video-processing and transmission technology. Test vehicles will include a CCD image sensor, a broadcast TV camera and a machine-vision imager.

Project partners cover the complete chain: capturing images, processing the data and transmitting the information. They include one of the world's leading broadcast television camera producers and a major manufacturer of digital imaging and machine-vision products for applications such as industrial inspection.

Market in transition

The global broadcast market is in transition from standard television to HDTV. The number of HDTV products sold has already overtaken that of standard TV products in Australia, Japan and the USA. And even in China and Europe, which have moved more slowly, major events such as the Olympic Games, football matches and concerts are already produced in HDTV and down-converted to standard TV for transmission.

To maintain the market share gained in the broadcast market, European suppliers must introduce true high-definition 1080p standard products that can generate the current HDTV standards with higher frame rates to enable slow motion applications such as triple speed or 1080i150. It is also necessary to continue to improve video-processing functionality. And it is essential to be able to reduce the cost price of cameras to meet expected price erosion once the broadcast market has nearly finished the switchover to HDTV.

Gaining access to lower market segments such as ENG and even pro-sumer applications would provide additional growth. This could be achieved by increasing integration of video-processing capabilities inside the camera to reduce price, size and power consumption.

So, to stay at the forefront of the broadcast market and to be able to enter the lower pro-sumer market segment requires a new CCD imager that can handle higher frame rates – the current state of the art is limited to a pixel-rate of about 40 million pixels a second.

It also demands new video-processing capabilities and speeds that meet the video-processing requirements in all the different market segments. In the early 1990s, professional broadcast cameras moved from analogue to digital video-processing. All manufacturers now use dedicated application-specific integrated circuits (ASICs) for the video-processing chain in their cameras. Data rates will have to be increased by a factor of three – requiring processors able to run at 225 million samples a second. This will require a complete redefinition of today's rigid architecture to obtain a flexible structure using a central router.

Work packages will cover the CCD imager, peripheral chips, image processing, networking and demonstrators. A special vehicle will be used for development and evaluation of high-speed concepts for pixel, register and amplifiers for the CCD image. New modules will be developed to enhance overall pixel quality, improve tungsten strapping for higher speeds and ensure better quantum efficiency. And the frame rate of an existing HDTV image sensor will be increased by a factor of four, requiring increases in both horizontal and vertical clock speeds.

A prototype video-processing system will also be designed based on proof in a field programmable gate array (FPGA) and preparation of a suitable ASIC – delivery of the ASIC is outside the timeframe of the project.

Crucial for Europe

It is crucial that Europe remains an important player in the global imaging industry as this market moves rapidly to higher resolutions and higher frame rates with a demand for high-quality, high-resolution video ever increasing. The international reputations and customer bases of the ASIC-CCD manufacturing partners will allow them to develop and implement a coherent technology strategy and to market the downstream results subsequently. It will also help build knowledge and generate intellectual property in Europe as well as creating production value here.

The synergy between the partners in this MEDEA+ project, each active in relatively small markets, will ensure the results of ASIC-CCD will have a major impact on the overall competitive position of the European industry, especially in CCD imagers for professional applications, broadcast and pro-AV camera, machine-vision, medical-equipment and semiconductor industries. Potential new applications include: broadcast slow motion with high resolution; medical sensors with high frame rates; high-speed inspection cameras with high line and/or frame rates; and higher frame rates for digital still photography, allowing options for real-time video.

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