PROJECT PROFILE

A406: Programmable imaging with CMOS sensors (PICS)

AUTOMOTIVE ELECTRONICS

Partners:

Atmel
Blue Eye Video
CEA-LIST
DALSA
Ecole des Mines de Paris
Faurecia
Philips
Thales
Thomson
TIMA/INPG

Project leader:

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Thomson

Key project dates:

Start: July 2003
End: November 2006

Countries involved:

France
The Netherlands

CMOS imagers are fast gaining ground on charge-coupled devices, driven by continuous improvements in CMOS technology and lithography. CMOS is already found in modestly specified products such as webcams, still cameras and mobile phones. Now, the production processes have evolved to a point that warrants research into devices for professional and more demanding consumer applications. However, a number of technical hurdles remain. In the MEDEA+ A406 PICS project, a consortium of industrial and academic partners from France and the Netherlands is seeking to resolve these problems, and to develop CMOS imagers suitable for adoption in security, automotive, broadcasting and other sectors.

Advances in affordable digital imaging technology fuelled a mass migration from film-based photography and movie-making, and permitted the introduction of low cost webcams, still cameras and photo-capable mobile phones. Since the 1970s, the dominant technology for consumer applications, as well as for professional imaging, has been charge-coupled devices (CCDs). However, European industry failed to make a significant impact, progressively losing market share — mainly to Japan — because of a lack of presence in high volume camcorder production. Now, the major players are turning their attention to CMOS technology, in which Europe's established position presents a real opportunity to regain the initiative.

Cameras will increasingly become standard equipment in cars, where up to five image sensors are likely to be incorporated as part of active and passive safety systems by the end of the decade. In the security sector, more intelligent systems for access control, intrusion detection and personal identification will become the norm. And any improvements in image-capture techniques will naturally be seized upon by the broadcasting and visual arts community, for whom picture quality is an ultimate objective.

Advantages of CMOS

The inherent advantages CMOS can offer over CCD in all these areas include:

- Fabrication using standard processes, reducing costs and allowing on-chip integration of image processing and imager control;
- Lower power consumption, for extended battery life in mobile equipment;
- Random access to selected pixel regions for flexible implementation of electronic functions such as pan, tilt, zoom, motion detection and image analysis;
- Higher picture quality, due to the absence of streaking or blooming caused by pixel overflow;
- Fast read-out, permitting high video frame rates; and
- Programmable digital signal processing structures linked closely to the imager — creating more intelligent cameras with additional functionality, and facilitating management of multi-camera systems.

Fully integrated CMOS camera-on-chip solutions with modest performance capabilities

are already incorporated in a variety of low-end consumer products, but they have not yet achieved the picture quality standards needed for more sophisticated appliances and professional applications. Moreover, most have so far been in the form of dedicated single-purpose designs. Today, while no imminent revolution is expected in CCD, CMOS imagers are steadily gaining ground as a result of continuing improvements in the technology itself and in lithographic processes for chip manufacture. There is now a real prospect of achieving the necessary improvements in performance, while creating a more versatile hardware platform with programmable functionality and standardised interconnections that will allow widespread use and thereby reduce risks.

European strengths

Key to meeting these challenges is a fundamental understanding of CMOS, where Europe is a major player. Optimising the image quality obtainable from CMOS imagers for mobile phones will generate volume business and permit production at competitive prices, thus avoiding a repetition of the CCD scenario. At the same time, combining the acquired expertise with knowledge in professional applications where Europe is also particularly strong holds out the prospect of further synergy through technology transfer.

Security, the automotive industry and professional broadcasting all meet these criteria, and all are well represented in the MEDEA+ A406 PICS consortium, led by Thomson Broadcast and Media Solutions. Given the broad experience of the participants, other applications such as medical and professional still cameras could also emerge.

Versatile solutions

Control of high quality CMOS imagers is a complex process involving both digital and analogue functions that, with current technology, can give rise to interference problems if integrated on a single chip. The solution is to separate the imager itself from one or more support devices. The aims of PICS are to define a general architecture allowing a modular design approach, to develop prototype imager and on-the-fly reconfigurable video-processing chips, and to build a library of intellectual property (IP) that the partners can incorporate into advanced products addressing a multitude of applications.

Three of Europe's largest CMOS imaging specialists are working together to generate the silicon, while prominent equipment manufacturers have designed the applications and are evaluating the resulting products. Three research institutes are providing further support in circuit design, reconfigurability and testability.

The primary targeted outcomes are four chips: a black-and-white high definition TV (HDTV) stand-alone imager, a companion chip for CMOS imagers, and a standard resolution colour imager with adjoining processing on a separate chip.

Innovative design is producing imagers that should be competitive with the best CCDs appearing on the market by the end of the project period, while the overall architecture is enabling image characteristics to be optimised for different applications. It is also providing intelligent functions, such as automatic alarms, that greatly simplify management of multi-camera systems and permit authentication for legal purposes.

The associated software allows on-the-fly application reconfiguration of the blocks. This permits remote program updating via networks that also give controlled access to images via any data transmission medium, including Internet.

Three applications

Three specific applications have been chosen as the test-beds for these concepts. The first is licence-plate recognition, suitable for parking area control, stolen vehicle detection and speed limit enforcement. CMOS technology will provide the ability to analyse scenes at camera level and to transmit only relevant data or alarms to the operator, minimising the amount of data requiring human interpretation.

Secondly, the use of an in-car camera as the means to modify airbag deployment in response to the observed size and position of a seat occupant. Europe manufactures the world's most advanced cars. Reinforcing its links with this sector will help the semiconductor industry to consolidate leadership in the expanding field of in-car electronics, which already account for 30% of total vehicle costs.

Finally, a new prototype camera head will be designed for professional broadcasting. This has a simple and versatile interface to the rest of the camera system, allowing it to be employed in different configurations – in the studio, as a cabled camera for field productions, as a camcorder, and for 'split cam' filming, where the front module is operated in a limited space environment at a distance from the support module.

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