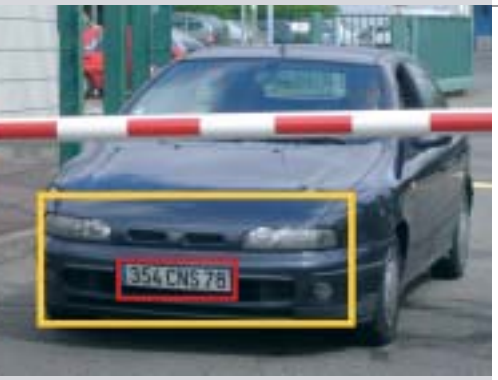
PROJECT RESULT

Automotive electronics

MEDEA+

A406: Programmable imaging with CMOS sensors (PICS)



Smart cameras take an intelligent look at the world

High resolution CMOS-based image sensors fully integrated with versatile image-capture and image-processing systems are set to increase the performance of security systems, improve car safety and upgrade professional television cameras. Digital imaging has long been dominated by Japanese-manufactured charge-coupled devices (CCDs) but, as a result of the MEDEA+ A406 PICS project, European-built CMOS systems are now able to offer a highly versatile and robust alternative that should lead to a migration of most current applications from CCD to more cost-effective CMOS technology within five years.

Demand for digital imaging is growing by leaps and bounds with the explosion in the markets for digital cameras worldwide from professional broadcasting through web cameras, mobile phones and still cameras to automotive safety systems. While charge-coupled device (CCD) sensors dominated digital imaging for more than 20 years, CMOS technology has already replaced CCDs in lower-end devices and is beginning to displace CCDs in medium- to high-end applications.

Having conquered the consumer electronics market, digital cameras are now being used increasingly in security applications such the protection of buildings, shopping streets and transport terminals as well for traffic monitoring and – increasingly – for road charging systems.

Automotive applications are also growing quickly with the average car expected to incorporate up to ten cameras in the near future to help parking, avoid collisions and provide traffic lane departure warnings. Moreover, with the move to high definition television (HDTV), there is a major need for robust high quality imaging systems in new cameras from electronic newsgathering (ENG) and outside broadcast applications to studio use.

Challenging CCD imagers

While CCD imagers can still offer some advantages in terms of high image quality, low noise and mature technology, CMOS technology presents real benefits in terms of low power consumption, on-chip functionality and lower cost. Now rapid improvements in CMOS sensor technology in the past five years, driven by applications in consumer digital cameras, web cameras and camera-equipped mobile phones, are enabling CMOS devices to provide a real challenge to CCD imaging in high-end segments, particularly pro-sumer – high-end consumer – and ENG broadcast applications.

The MEDEA+ A406 PICS project set out to develop programmable CMOS imaging platforms for security, automotive and professional broadcast applications. The aim was to develop high resolution CMOS sensors that could be used in innovative systems incorporating sophisticated image-capture and image-processing features. These make it possible to filter essential information – from a security threat in an airport concourse to warning of a pedestrian in the road.

A key objective was to incorporate all the circuit functions required on a single silicon substrate, providing a fully integrated imaging device that will be more cost effective than CCD-based systems.

PICS involved major European CMOS sensor manufacturers, systems designers and research organisations working together to prove the feasibility of the CMOS approach.

Two different applications were demonstrated to prove the reconfigurability of the approach:

1. **Automated number plate recognition** for the control of car park entrances; such technology could also be used for border controls and road charging – from motorway toll collection to congestion control – as well as identification of stolen vehicles; and
2. **Safer airbag deployment control** involving the detection of the size and position of a car user; this could become a major market as it is already a mandatory requirement in the USA to reduce the risk to child passengers.

Hardware/software split

Major advances were made in CMOS imaging, including:

- Much higher image resolutions – as good if not better than current CCD devices;
- Global rather than rolling shuttering to provide a real snapshot view, achieved by controlling pixel switching;
- Improved frame rates – up to 60 frames/second – for video applications; and
- A versatile programmable platform for on-the-fly image processing.

The definition of an optimum architecture was a major challenge as the processing part has to be able to run many applications with a high level of performance. In particular, it was necessary to define the best division between hardware offering high performance and software that increases flexibility but could reduce performance. For example, previous CMOS imaging applications depended on optimising all elements in a system for a specific purpose – limiting their use. The PICS smart sensor system can be adapted to different applications simply by changing the embedded software.

Other project innovations included the development of a new generation of surveillance solutions that provides much more than simply an image but rather generate alarms to guide the human controller. Most surveillance cameras deliver irrelevant data much of the time. Security only increases if the cameras can become more intelligent and flexible. By integrating sophisticated video processing directly in the imaging system, large amounts of data can be handled and security increased. Similarly, integrating video processing in automotive systems can improve road safety through better driver-assistance systems.

Prize-winning technology

Co-operation in this project enabled European suppliers to obtain a wider view of needs across several markets, particularly security, automotive and professional broadcast, keeping expertise in Europe to compete with other global actors. It also resulted in patent applications from DALSA, Thomson Grass Valley and Philips on imaging and on processing algorithms.

Award of the 2006 Jean-Pierre Noblanc prize for the most innovative and sustainable MEDEA+ project provided additional recognition for the quality of the PICS results. The robust CMOS imaging technology developed in PICS should be available in cost-effective cameras for HDTV within 18 months of the end of the project. And image-processing chipsets studied in the project are already being offered for in-car information and entertainment applications.

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