Project profile

Cluster for Application and Technology Research in Europe on NanoElectronics

CA308 | Image Capture of the Future [ICAF]

PROJECT CONTRIBUTES TO

Communication	✔
Automotive and transport	
Health and aging society	
Safety and security	✔
Energy efficiency	
Digital lifestyle	
Design technology	✔
Sensors and actuators	✔
Process development	
Manufacturing science	✔
More than Moore	
More Moore	
Technology node	90, 180 nm

Partners:

Adimec Advanced Image Systems
Axon Digital Design
Delft University of Technology
EqcoLogic
intoPIX
Ghent University
Grass Valley Cameras
Hasselt University
ON Semiconductor Image Sensor

Project leader:

Jochem Herrmann
Adimec

Key project dates:

Start: October 2011
End: September 2014

Countries involved:

Belgium
The Netherlands

The CATRENE ICAF project aims to research, develop and demonstrate future image capture, processing and transmission technologies for Machine Vision (MV), Security/ Surveillance and Professional Broadcast (PB). Research will cover optics, complementary metal-oxide on silicon (CMOS) imagers, novel two-dimensional (2D) and 3D denoising algorithms, 2D and 3D image processing algorithms, new video transmission integrated circuits (ICs), video compression, Video over Internet Protocol, frame grabbers (MV), compliance recording (PB) and video camera application designs. ICAF's 9 partners include six state-of-the-art manufacturers and three universities with departments specialising in these areas.

The primary objective of the ICAF project is to achieve major advancements in image capture technology and systems to further increase automation in high-added-value production processes, state-of-the-art security systems as well as the traffic and automotive domains. It will also provide enhancements to quality of life by offering creative industries higher resolution image capture technologies - notably 3D video capture and Video over Internet Protocol.

During the course of this project, the consortium will deliver demonstrators of the new technologies developed, which will not only lead to the manufacturing partners producing new revenue-generating products but also intellectual property in the form of patents and innovative new technologies.

Faster and more sensitive

Machine Vision plays an important role in semiconductor (front and back end) and electronics manufacturing equipment. ICAF will provide faster and more sensitive image sensors allowing the next generation of equipment to achieve higher accuracies and speeds.

ICAF will also deliver the silicon needed for the next generation of the CoaXPress interface standard. Three core members of the CoaXPress consortium are participating in ICAF and are recognised worldwide as leaders in their fields.

Because Machine Vision applications increasingly make use of 3D, research will be made on image sensor and processing architectures for applications such as automated optical inspection in electronics manufacturing. This will result in a next generation of technologies for cost effective 3D metrology and inspection systems.

Machine vision cameras are also frequently used for 3D entertainment and have great potential for 3D media production and immersive Internet interaction. ICAF will research 3D algorithms for this application area, aiming at fast on-device pre-processing to support flexible end-processing on computer hardware such as graphics processing units (GPUs).

The ICAF project will provide highly-sensitive image sensors, image improvement and compression algorithms along with transmission technology over coaxial cable.

Although the ICAF project has its main focus on the applications described above, there are many areas with similar technology demands. For instance, the automotive market requires cameras for improved safety (distance monitoring, pedestrian detection, sleep detection and airbag control). A rapidly developing market for automated

surveillance and care of the elderly will also become more important in the future due to demographic trends. In these areas, one of the consortium partners is starting research projects with others involved in those application fields. It is, therefore, expected that a considerable amount of knowledge will be shared.

Better motion portrayal

The Broadcast market has moved from standard definition television to 1080 line interlaced (1080i50) high definition television with a picture performance of 60dB at f/10, and 2000lux. In the near future, the market will move towards 1080 line progressive scan at the existing rate of 50 frames/sec (1080p50). However for better motion portrayal, higher frame rates are needed. The project will develop and demonstrate technology that achieves three times the frame rates of today, with the same picture quality per frame, by using innovative noise-reduction algorithms. The goal is to achieve a signal-to-noise ratio of 60dB at f/10, 2000lux and 1080p150.

For 3D vision, live tests are being performed today with stereoscopy. In the longer term, time-of-flight, plenoptic imaging and other technologies will be developed that allow the use of a single lens. ICAF will set the next step in research on single lens 3D image capture at HD resolutions. In such systems, stereo view interpolation (extrapolation) and depth-map generation technologies will be used without visible loss of image quality.

The ICAF project will also investigate the combination of 3D technologies. The optics in the camera will have to be modified, as well as the CMOS imager that captures the incoming light. New video processing algorithms that can calculate either left/right pictures or depth-maps for the video signals from the CMOS imagers will have to be invented. New algorithms that can take advantage of on-camera pre-processing in combination with IT end-processing will be researched.

The emergence of 3D creates new challenges in order to limit the bandwidth increase that it represents. New compression codecs like Multiview Video Coding (MVC, a new extension of H.264) have been standardised and offer the necessary tools to address the bandwidth issue. The research in ICAF will consist of finding adequate techniques to map these algorithms on field-programmable gate-array (FPGA) devices for real-time operation in a 3D broadcast environment.

The use of commercial off the shelf (COTS) information technology (IT) components (solid state disks, PCI express, Internet Protocol, USB and video compression) in the broadcast domain enables new applications and lowers the cost for existing applications. However, IT equipment suffers from lower reliability, higher power dissipation and requires more physical space than is currently available in the broadcast domain. The image and audio quality requirements of broadcast are also higher, compared to those of IT equipment. This project will take a major step in combining IT and broadcast technologies so that typical IT drawbacks will be avoided while keeping the benefits. 3Gbps video will be compressed to 500Mbps (near lossless compression for broadcast quality over the existing HD infrastructure) or below with a latency $\leq$ 40msec; power consumption of the 1GE transmission part will be less than 10 Watts; physical space will be one tenth of that of IT equipment.

Significant market opportunities

Strategically, it is important for Europe to remain at the forefront of image capture, transmission and processing due to the diversity of applications that support many key industries in Europe, which in turn have export markets beyond Europe. Similarly, the industrial partners in the project all have significant export markets outside Europe with their respective image capture and related technologies.

This project unites small to medium sized companies that are important players in their respective markets and research fields but individually lack the critical size to develop or adapt independently the plurality of technologies needed in professional image capture applications.

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CATRENE (Σ! 4140), the EUREKA **C**luster for **A**pplication and **T**echnology **R**esearch in **E**urope on **N**ano**E**lectronics, will bring about technological leadership for a competitive European information and communications technology industry.

CATRENE focuses on delivering nano-/microelectronic solutions that respond to the needs of society at large, improving the economic prosperity of Europe and reinforcing the ability of its industry to be at the forefront of the global competition.