PROJECT RESULTS

CAT120

Significant improvements in performance and image quality of advanced image-capturing systems [CISTERN]

Better CMOS image sensors, integral design of optics, image-sensor corrections and image processing, as well as high flexibility in multispectral configurations and production volumes, will all lead to improvements in performance and image quality of advanced image-capturing systems. These systems include high-resolution/highly-sensitive security cameras, as well as hyper-spectral, broadcast and time-of-flight ones.

The broadcast market is moving towards the next video standard, UHDTV (ultra-high definition television), for which two generations have been defined (level 1 for 4K horizontal resolution; level 2 for 8K horizontal resolution). In addition, high-end security HDTV is available today and the UHDTV version is expected in the coming years. However, as depth-imaging applications evolve, there are also growing needs to meet higher specifications in features and performance.

Addressing next-generation imaging-application requirements

CISTERN's research & development work covered such technologies as CMOS image sensors, time-of-flight (ToF) sensors, zoom optics, multispectral imaging and real-time image-processing algorithms, all of which are needed in the next generation of the following application domains:

- Digital lifestyle: broadcast image systems for first-generation UHD-TV and 3D entertainment systems;
- High-end security: UHD surveillance systems;
- Multispectral imaging for specific applications, like sorting in the food industry.

CISTERN met all its key project objectives, in particular to:

- Start in-house CMOS image-sensor development. at Grass Valley;
- Develop next-generation CMOS image-sensors with improved pixels;
- Develop high-speed real-time image processing techniques for bigger and faster sensors and improved image quality;
- Develop capability to produce multispectral imagers through hybridisation of multispectral filter arrays on top of CMOS sensors;
- Demonstrate improved performance of CMOS imagers, combined with related processing in a number of demonstrators;
- Demonstrate the readout performance of the CMOS ToF sensor;
- Develop and demonstrate a camera lens assembly with digital chromatic-lens aberration corrections to improve image quality for security applications;
- Deliver demonstrators of the new technologies developed, which will not only lead to manufacturing partners producing new revenue generating products; but also intellectual property in the form of patents and innovative new technologies.

Importantly, the project consortium comprised three state-of-the-art manufacturers in application domains relevant to the project, and two universities with departments specialising in the relevant research areas.

From improved performance to high flexibility

CISTERN delivered the following key benefits:

- An advanced ToF-sensor design with improved performance (better and more CMOS pixels) that makes sorting and mapping functions – increasingly required to improve production quality and productivity in the food industry and modern agriculture – low-cost and also execute faster and more reliably;
- Smaller, high-performance pixels integrated with high-quality optics and image processing;
- In-pixel attenuation functionality and in-pixel area temperature sensing;
- Combined optimisation of a low-cost lens, high-resolution CMOS sensor and high-speed image improvement algorithms inside the camera for best-in-class performance, while lowering the overall cost of the system;
- A high-performance 320k ToF imager, providing four times more lateral resolution and increased depth resolution;
- A new technology offering multispectral sensors through the hybridisation of a CMOS sensor and multispectral filter at pixel scale. This technology offers high flexibility in multispectral configurations and production volumes.

PROJECT CONTRIBUTES TO

- Communication
- Health and aging society
- Safety and security
- Energy efficiency
- Digital lifestyle
- Design technology
- Sensors and actuators
- Process development

PARTNERS

Grass Valley
Adimec
SoftKinetic Sensors NV
Delft University of Technology
University of Burgundy

COUNTRIES INVOLVED

- Netherlands
- Belgium
- France

PROJECT LEADER

Klaas Jan Damstra
Grass Valley

www.cistern.nl

KEY PROJECT DATES

1 April 2015 - 30 June 2018

Markets to match demand

CISTERN's deliverables fit nicely with key trends and developments of several important markets and application areas. For example, broadcast, security & surveillance, ToF technology, entertainment and the food sorting markets all underscore the importance of CMOS, ToF and multi/hyper-spectral sensor technologies across multiple segments. The penetration of CMOS image-sensors is in almost every technology-related market. The mobile market is key to the CMOS image-sensor (CIS) industry. This sector has maintained a 10.5% CAGR between 2016 and 2022 due to the introduction of dual and 3D cameras. General trends in 3D (stacking) technologies are focused on quality, size, weight, cost and robustness.

However, the primary influence on the CISTERN project is the accelerated adoption-rate of UHDTV in broadcast and security; ToF technology in entertainment applications; and multi/hyper-spectral technology in the agriculture domain. In the broadcast market, all camera manufactures launched 4K UHD broadcast cameras and some important ones also took the next step with 8K UHD versions. These cameras are ready for HDR (high dynamic range) productions and make use of the wide colour gamut BT2020. The Olympic Games in Tokyo in 2020 will be the first big event where 8K UHD will be deployed.

In the high-end security domain, we see high-end security cameras, supporting 4K UHD, and thus becoming more accepted in this market. Currently, 4K UHD cameras are, being used in long-range security & detection systems in vehicles for autonomous-driving. Sensors supporting 8K resolutions are now coming to market, but the move to 8K UHD will be slower in this application domain than in the broadcast one. The largest sensor manufacturer in this application space sees significant growth in the mid- to long-term in the image-sensor business. And given this growing market, this manufacturer views surveillance cameras as a new image-sensor application for which it has high expectations.

In addition, according to the latest market analysis, Variant Market Research reports that the forecast for the global gesture-recognition market for consumer electronics is expected to reach $43.6 billion by 2024, with a compound annual growth rate (CAGR) of 16.2% from 2016 to 2024. And sales in the drone market are expected to increase by 25%, as in previous years.

Finally, the hyperspectral-imaging (HSI) sector is also flourishing, thanks to an increasing global acceptance of HSI technologies in mining & mineralogy, machine vision and life science & diagnostics. The global market has been segmented on the basis of application and region. Based on application, the HSI market is categorized into food & agriculture, military surveillance, environment monitoring and life sciences & medical diagnostics, together with calorimetry, meteorology, mining & mineralogy, machine vision, and process control. The military surveillance (defence) segment contributed the maximum share with 18.6% in 2014 to the overall market; followed by environment testing and mining & mineralogy. Military surveillance is expected to reach $13.87 million by 2020, at a CAGR of 9.7%. However, the fastest-growing application segment is life science & medical diagnostics, which is expected to grow at a CAGR of 13.7 % from 2014 to 2019.

CATRENE Office
44 rue Cambronne
F-75015 Paris - France
Tel. +33 1 40 64 45 60
Fax +33 1 40 64 45 89
Email catrene@catrene.org
www.catrene.org

CATRENE (E! 4140), the EUREKA Cluster for Application and Technology Research in Europe on NanoElectronics, 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.