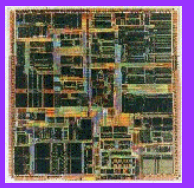
MATHEMATICAL MORPHOLOGY
in
THE PICS PROJECT
Programmable Imaging with a CMOS Sensor
(July 1st 2003 - November 30th 2006)

- **Today's smartcams market**:
  - Very few available products on Smart Cameras (PowerPC based Matrix Vision, Intel Celeron based Matrox Iris P series, Geode based Sony, …)
  - Limited image/video processing capabilities
  - Mostly CCD (thus no ROIs control)
  - None Reconfigurable Smart camera at runtime & HW acceleration as in PICS



- **Forecast market sizes**:
  - Security market: average growth 5% per year
  - Video surveillance: average growth 10% per year
  - Biometrics: average growth 30% per year
  - Automotive market: average growth 120% per year.

Project consortium

Industrial partners:
Grass Valley/Thomson (NL, leader), Philips (NL), DALSA (NL),
e2v (F), ATMEL (F), NXP/Philips (F), THALES/TSS/TED/COM (F), Faurecia (F), BEV (F)
Academic partners:
CMM/ARMINES (F), TIMA (F), CEA/LIST (F)

Project cooperation

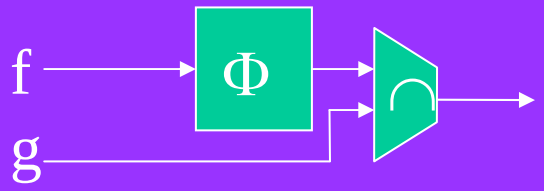
1. Imager design and evaluation
   (Philips NL), DALSA, Grass Valley, e2v, TIMA
2. Algorithm design and evaluation
   CMM, Thales, Faurecia, CEA, BEV
3. Platform design
   Thales, Faurecia, e2v, CMM, CEA, Philips

What is Mathematical Morphology?

- A methodology for image analysis based on Set Theory
- A set of tools usable in many image analysis application domains
- Image analysis software libraries and toolboxes

Neighbourhood operators

Geodesic operators



Iterative operators

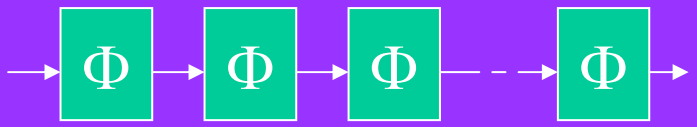
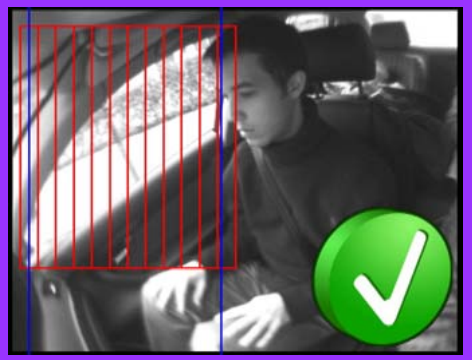


Image analysis applications for an intelligent sensor

Two applications were focused in the scope of the PICS project:

- **License plates detection and reading (car parks access control, automatic speedometers)**

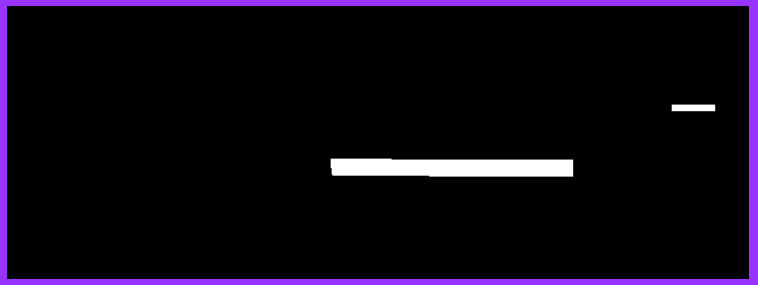
- **Driver and passengers Out Of Position (OOP) monitoring (prevention of accidents dues to airbags release)**



License plate detection and reading

Original enhanced image
(histogram equalisation)

Morphological « Top-Hat » operators

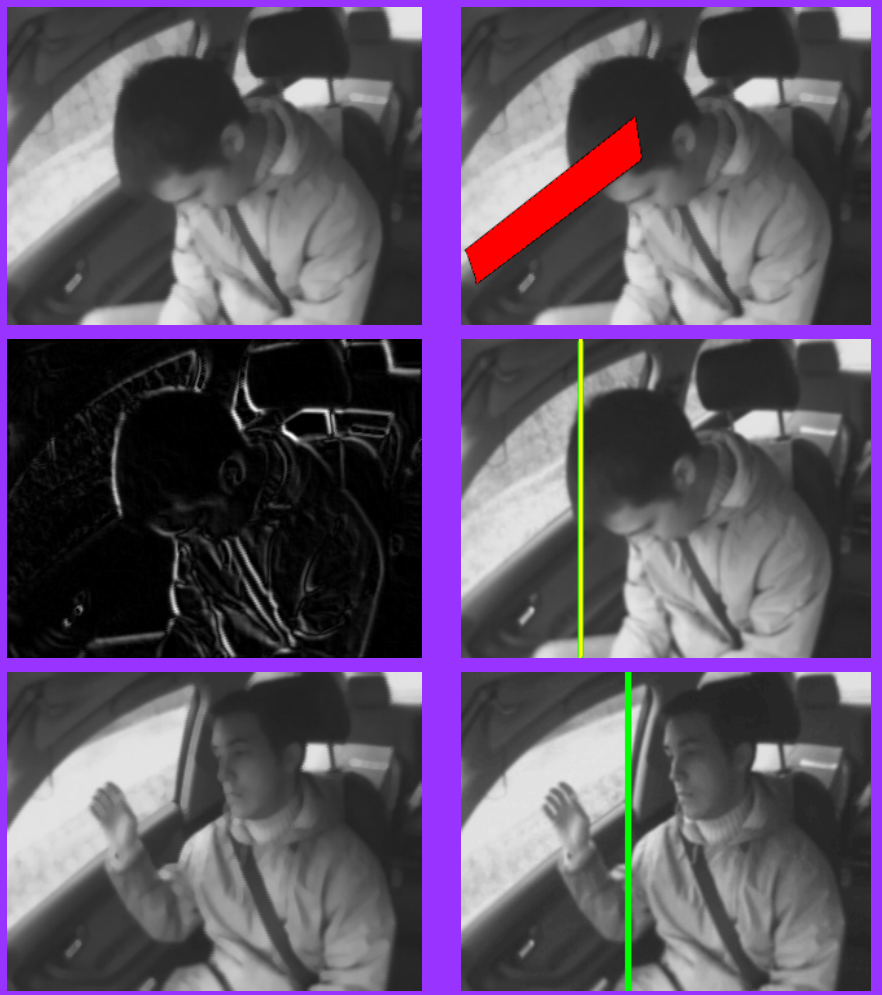


Morphological filtering based on size and shape and ROI detection

OOP application implementation

- Definition of an initial ROI
- Implementation of thick morphological gradients and filterings
- Use of the previous detection to define a dynamic ROI

→ Reduce false detection



OOP monitoring, an example

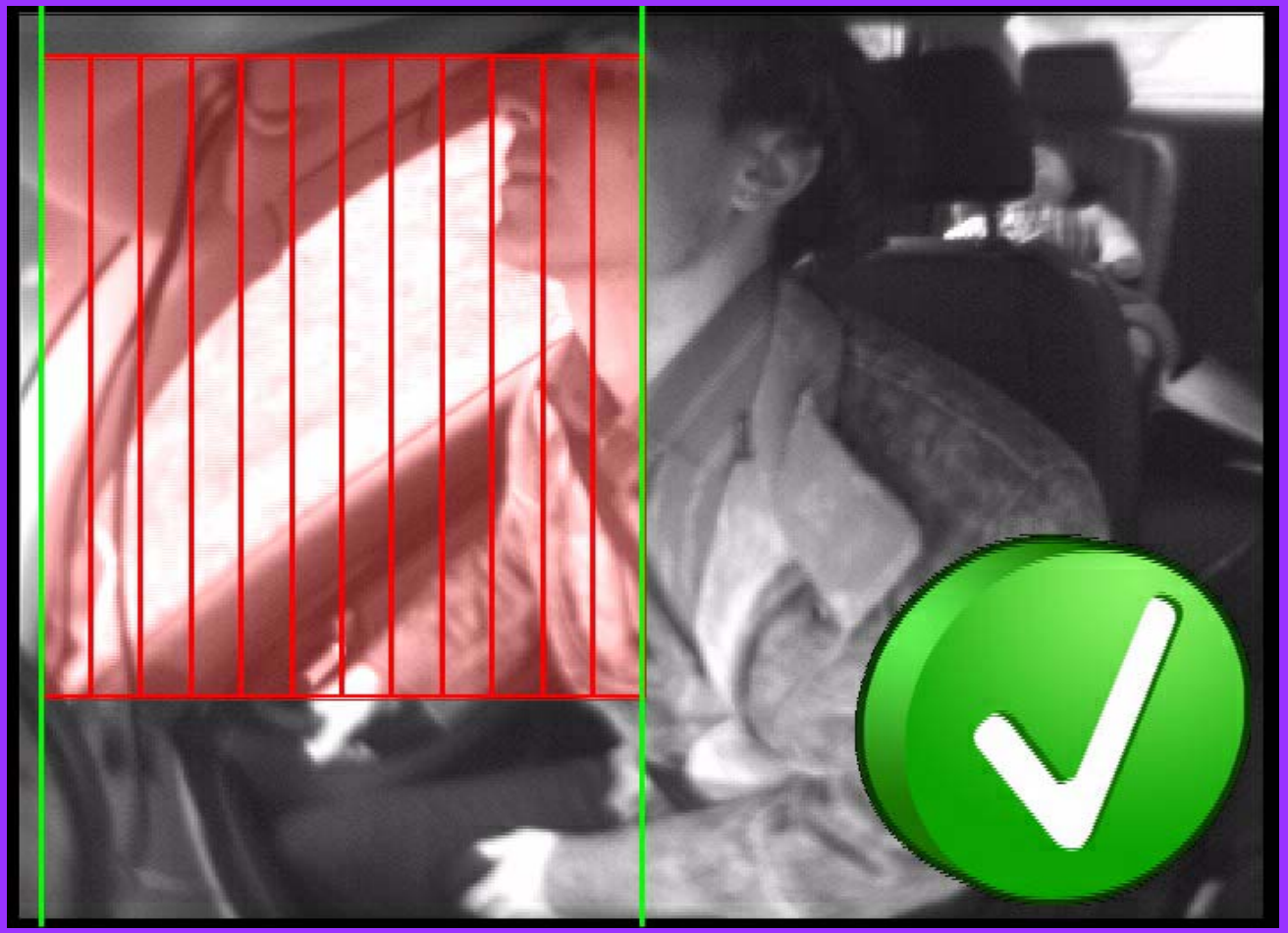
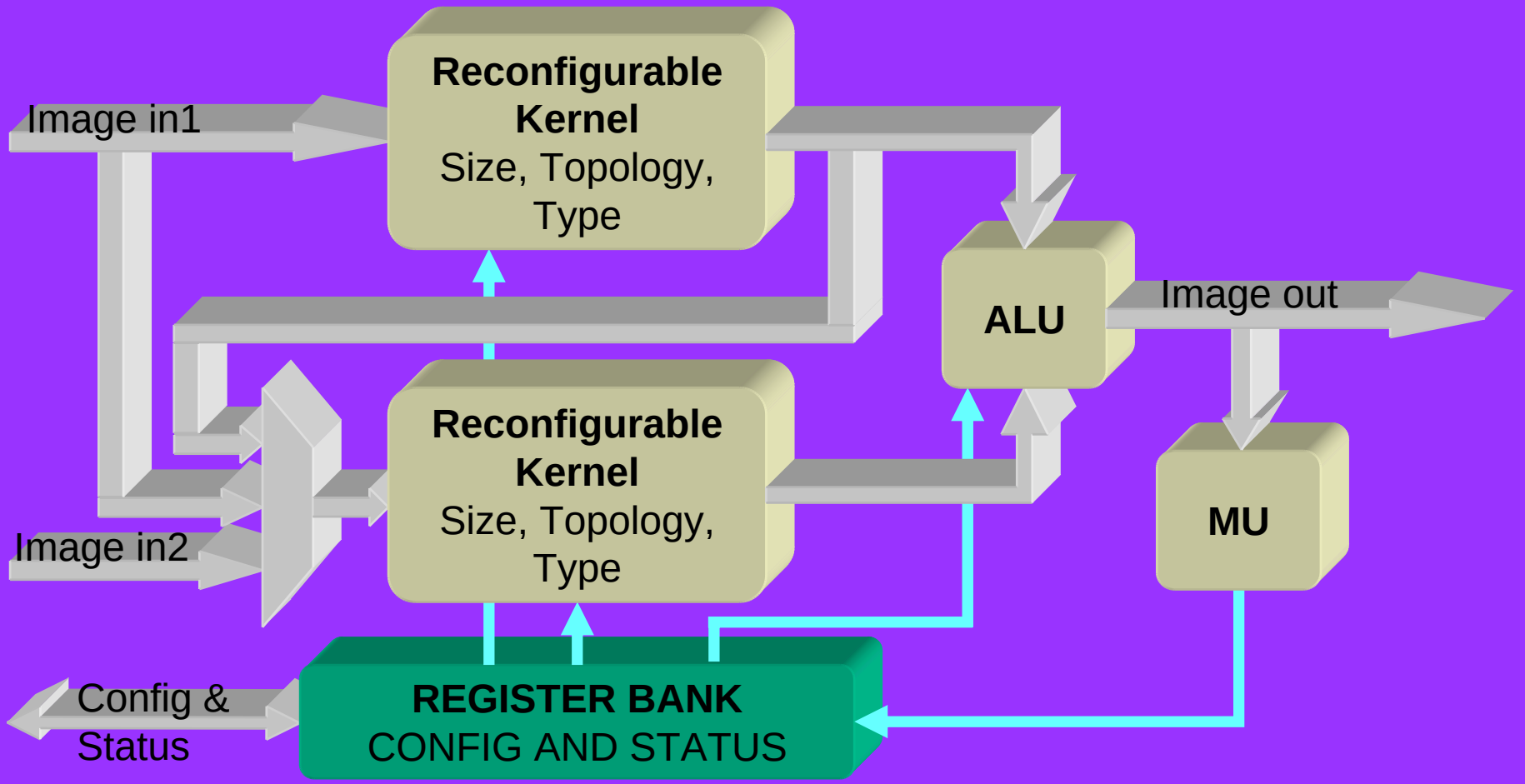
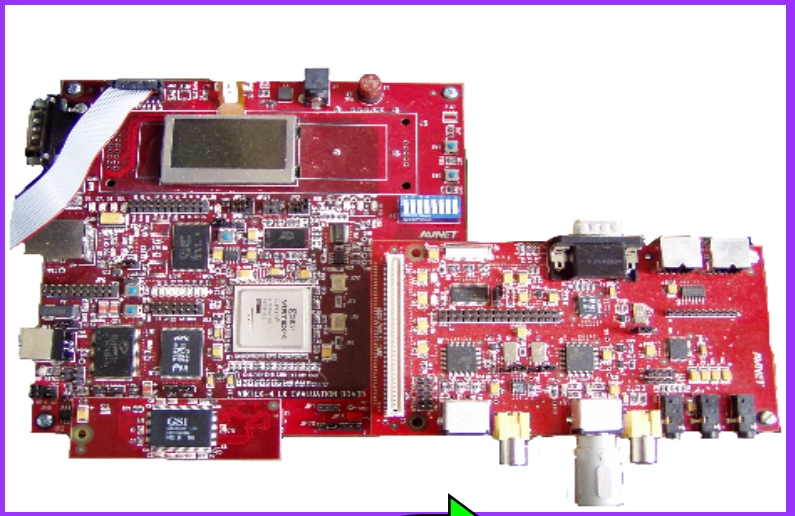


Image Processor Module structure

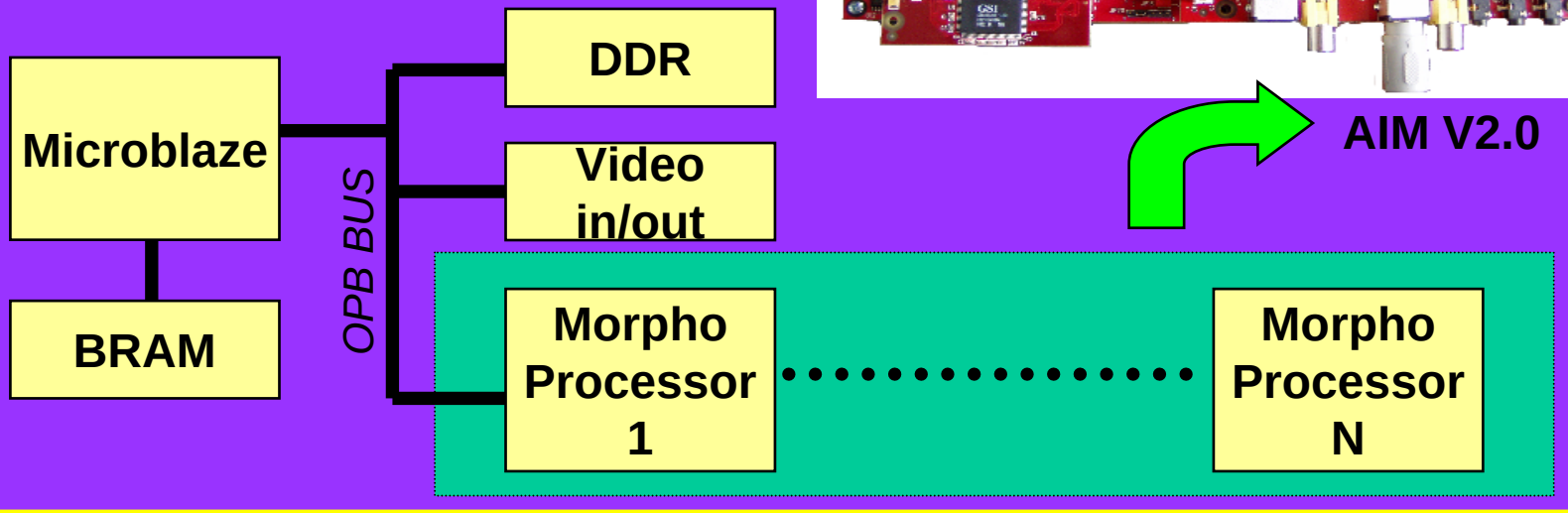


PICS morphological processor implementation

Xilinx microblaze integration with a 10 stage pipeline (which represents 20 Morphological processors)



AIM V2.0



PICS (A406) MEDEA+

The PICS project received the **JEAN-PIERRE NOBLANC AWARD FOR EXCELLENCE** in 2006 from the MEDEA+ Comittee
It was the second award received by CMM (first one for the POCKET MULTIMEDIA project in 2005)