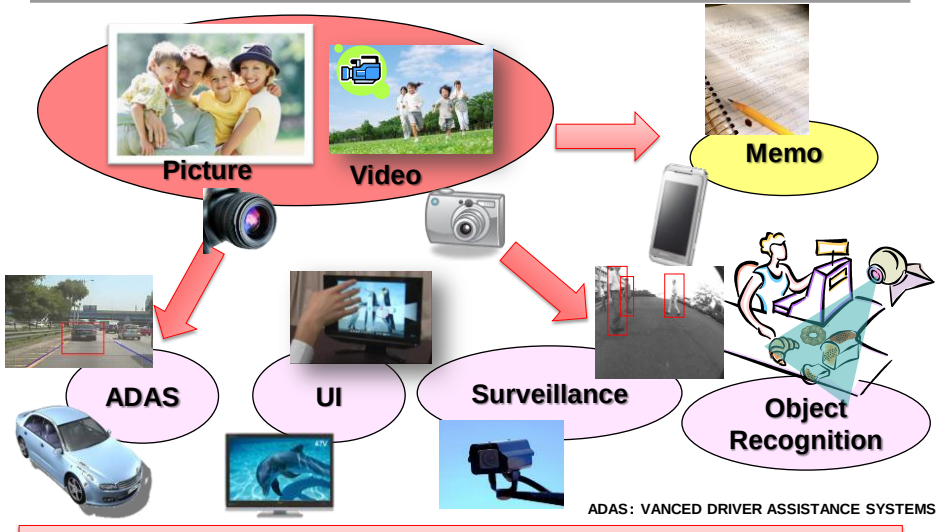
TOSHIBA
Leading Innovation

Image Sensing and Processing — A New Challenge of MPSoCs

Takashi Miyamori

Toshiba Corporation

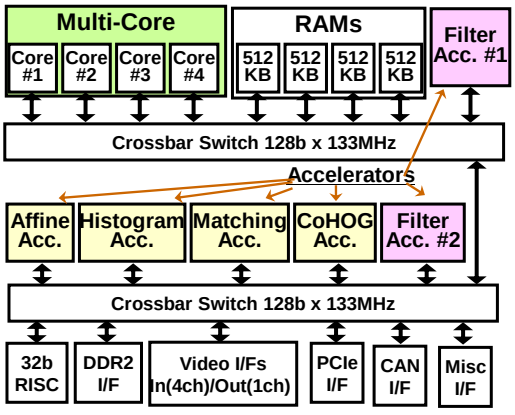
Applications of Camera Systems

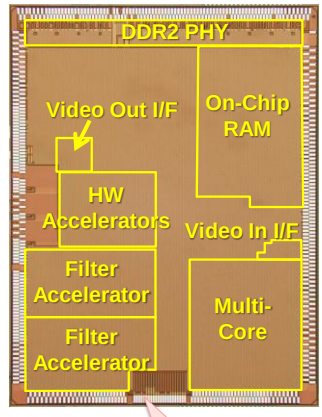


ADAS: VANCED DRIVER ASSISTANCE SYSTEMS

- **Usages of cameras have been expanding. These special purpose cameras are based on computer vision technologies.**

Image Recognition SoC: Visconti™2 [ISSCC 2012]





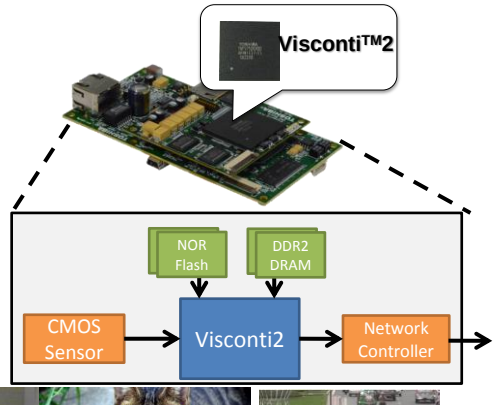
40nm CMOS
44.55mm²

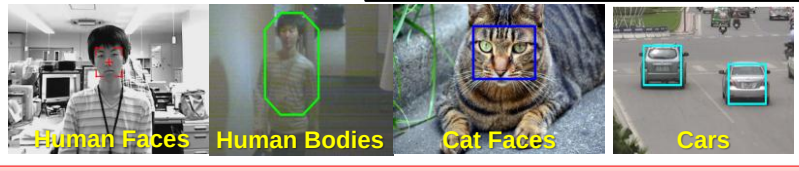
- **Heterogeneous Multi-core SoC for image recognition**
  - **Multi-core and "Highly parallelized" accelerators**
    - **Peak performance: 464GOPS**
    - **Total chip power consumption was less than 3W**
  - **Good recognition performance**
    - **CoHOG based image recognition was implemented**

Intelligent Camera with Image Recognition SoC Visconti™2

- **Intelligent Camera**

12cm x 7 cm x 3 cm



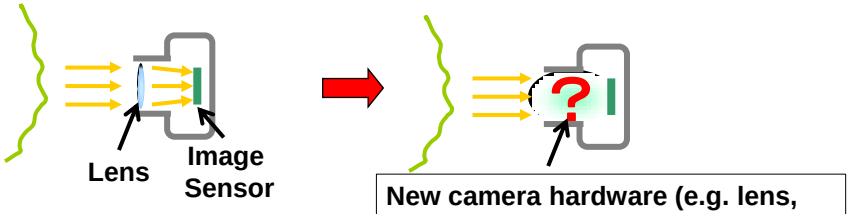


It can detect four types of objects simultaneously.

Computational Camera

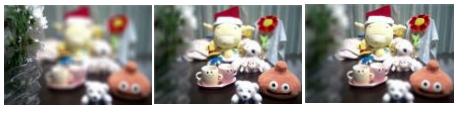
***Goals*: Realize breakthroughs beyond conventional cameras**

<Conventional Camera> **<Computational Camera>**



New camera hardware (e.g. lens, diaphragm, sensors, etc.) and digital signal processing

- **Coded Exposure for Deblur**
- **Refocus**

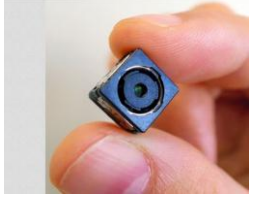


- **Depth Map**

Recognition/AR

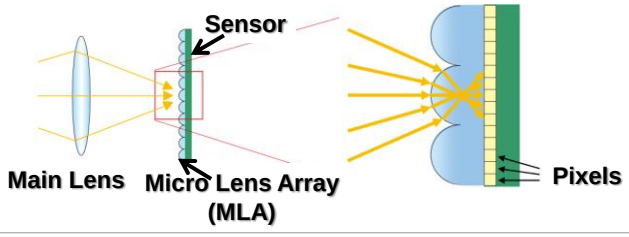
Toshiba Compound Eye Camera

Toshiba putting focus on taking misfocusing out of photos



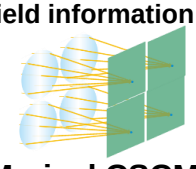
- **500,000 lenses, each 0.03mm in diameter**
- **Refocus**
- **Depth calculation**

The Asahi Shimbun, December 27, 2012
http://ajw.asahi.com/article/economy/business/AJ201212270054



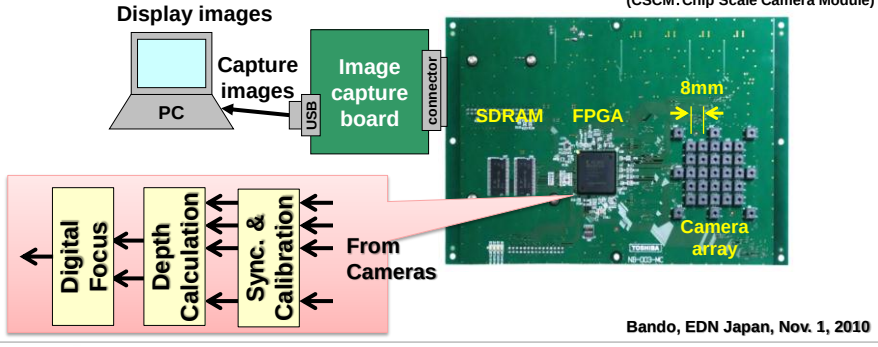
Toshiba Multi-View Camera Demonstration Board

- **Camera Array**
  - **Captures different light field information from multiple cameras**



- **FPGA board with 33 2M-pixel CSCMs**

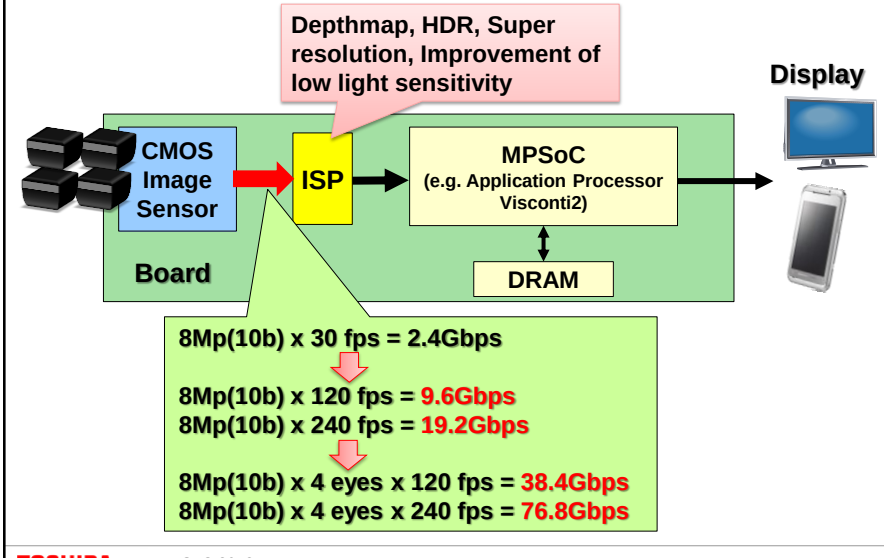
(CSCM: Chip Scale Camera Module)



Bando, EDN Japan, Nov. 1, 2010

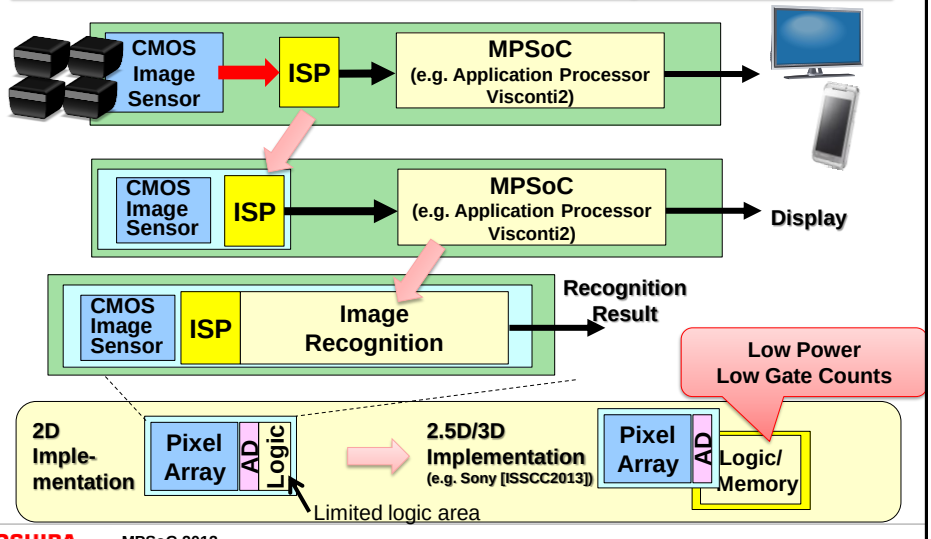
Bandwidth Issue

Tremendous Bandwidth between sensors and ISP chip



Challenge of MPSoCs

ISP and Image recognition will be included in sensor module to reduce bandwidth between sensor and logics



Summary

- **Usages of cameras have been expanding**
  - e.g. ADAS, User Interface, Life logging, Surveillance, Image recognition, Augment Reality, etc.
- **Computational Camera which consist of novel camera hardware and digital signal processing will realize new applications**
  - Lots of computational power for image processing
  - Large data bandwidth
  - Limited power and area budget

- Efficient MPSoC Architecture for Image Processing and Recognition
  - 3D Implementation of Image Sensor, Logics, and Memory